Southeastern Beach Mouse
(*Peromyscus polionotus niveiventris*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Jacksonville Ecological Services Field Office
Southeast Region
Jacksonville, Florida

5-YEAR REVIEW
Species reviewed: Southeastern Beach Mouse
(*Peromyscus polionotus niveiventris*)

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I. GENERAL INFORMATION

A. Methodology used to complete the review:

In conducting this 5-year review, we relied on available information pertaining to historic and current distributions, life history, and habitat of the southeastern beach mouse (SEBM). The Service lead recovery biologist for this subspecies conducted the review. Our sources include the final listing rule for this subspecies under the Endangered Species Act (Act); the recovery plan; peer reviewed scientific publications; unpublished field observations by the Service, State, and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists. No part of the review was contracted to an outside party. The draft status review was sent out for peer review to seven academic professionals with expertise on the SEBM and its habitat. Peer reviewers were provided guidance to follow during the review process. Comments and suggestions received from peer reviewers were incorporated into the status review document (see Appendix). The public notice for this review was published on April 26, 2007, with a 60-day public comment period. Comments were received from state and Federal agencies and were incorporated as appropriate into the 5-year review.

B. Reviewers

Lead Region -- Southeast Region: Kelly Bibb, 404-679-7132

Lead Field Office -- Jacksonville, FL, Ecological Services: Annie Dziergowski, 904-232-2580

Cooperating Field Office(s) -- Vero Beach, FL, Ecological Services: Cindy Schultz, 772-562-3909

C. Background

1. **FR Notice citation announcing initiation of this review:** 72 FR 20866, April 26, 2007.

2. **Species status:** Stable (2007 Recovery Data Call). The Service's most recent data call (2007) on the status of the SEBM indicated the population is stable. The quantity and quality of habitat remains unchanged. In order to examine genetic variability throughout the subspecies' range, surveys are being conducted at Smyrna Dunes Park (SDP), Canaveral National Seashore (CANA), Merritt Island National Wildlife Refuge

Name of plan: Multi-species Recovery Plan for South Florida
Date issued: May 18, 1999 (MSRP not the final recovery plan but does provide information and recovery actions for SEBM in South Florida).

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

1. **Is the species under review a vertebrate?** Yes.

2. **Is the species under review listed as a DPS?** No.

3. **Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?** No.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes.

2. **Adequacy of recovery criteria.**

   a. **Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?** Yes. Since the recovery plan was written, much of the information on the biology of the SEBM has not changed. However, based on the extent of habitat loss and other factors addressed in this review, it may be difficult to meet the recovery criteria. The recovery criteria should be updated to reflect new factors and information when the recovery plan is revised.

   b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?** Factor A (present or threatened destruction, modification or curtailment of its habitat or range) was identified as the primary factor affecting the subspecies at the time of the SEBM listing, and is only partially addressed in the recovery criteria. Factor C (disease and predation) is discussed in the recovery plan as a serious threat, but is not addressed in the recovery criteria. Factor E (other natural or manmade factors affecting its continued existence) is also a threat, but is not addressed in the

(MINWR)/Kennedy Space Center (KSC), Cape Canaveral Air Force Station (CCAFS), and Pelican Island National Wildlife Refuge (PINWR). During these surveys, the habitat conditions of unoccupied sites within the historic range of the SEBM are also being evaluated to determine their potential as future reintroduction sites. These surveys will continue until spring 2008.

3. **Recovery achieved:** 2 (25-50% recovery objectives achieved)
Information collected at the time of this review indicated that the recovery achieved should have been changed during the 2007 Recovery Data Call from 1 to 2 to reflect recovery actions that have been implemented in the past few years. The SEBM has been monitored continuously, and reintroduction of this subspecies into a site(s) where it has been extirpated is planned for spring 2008.

4. **Listing history:**
Original Listing
FR notice: 54 FR 20598
Date listed: May 12, 1989
Entity listed: Subspecies
Classification: Threatened

5. **Associated rulemakings:** None

6. **Review History:** A previous 5-year review for this subspecies was noticed on November 6, 1991 (56 FR 56384). In that review, the status of many species were simultaneously evaluated with no in-depth assessment of the five factors as they pertained to the individual species. The notice summarily listed the species and stated that no changes in the designation of any of the species were warranted at that time. In particular, no changes were proposed for the status of the SEBM in that review.

Final Recovery Plan – 1993

Recovery Data Call – 2007, 2006, 2005, 2004, 2003, 2002, 2001, 2000, 1999, and 1998.

7. **Species' Recovery Priority Number at start of review (48 FR 43098):**
9C (Degree of threat is moderate with a high recovery potential with conflict).

8. **Recovery Plan:**
Name of plan: Recovery Plan for the Anastasia Island Beach Mouse (*Peromyscus polionotus phasma*) and Southeastern Beach Mouse (*Peromyscus polionotus niveiventris*)
Date issued: September 23, 1993

recovery criteria. Factors B and D are not relevant to this subspecies.

3. **List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.**

"The Southeastern beach mouse can be considered for delisting if 10 viable, self-sustaining populations can be established throughout a significant portion of its historic range. More specifically, delisting can be considered if the following conditions are met:

1. *Viable populations are maintained on the 5 public land areas where the subspecies currently occurs. Each population should not fluctuate below an effective breeding size of 500 individuals.*
2. *Five additional viable populations are established throughout the historic range of the subspecies.*
3. *These populations should be monitored for at least 5 years."* [Please note that as section B.2.a above indicates, these criteria need to be revised. The criteria are presented here because they do provide a framework to evaluate status in terms of the best available information below on the species. We have also tried to relate the new information to these 1993 criteria.]

The recovery criteria to delist (USFWS 1993) have not been met. Historically, the SEBM was found along approximately 360 kilometers (km) of coastline from Volusia County south to Broward County, Florida (Humphrey et al. 1987). By the time the subspecies was listed in 1989, SEBM were only known to occur in the beach dunes of Volusia County south to Indian River County. The range is now restricted to about 80.5 km of coastline. The SEBM has been extirpated from most of the southern portion of its historic range (USFWS 1993).

The SEBM has not reached recovery since it is only found at six sites and has been extirpated throughout the remainder of this subspecies historic range. The population size at these sites varies greatly, from one mouse to thousands and most are not self-sustaining populations. Several of the five sites listed in the 1993 Recovery Plan and referred to in the recovery criteria are still occupied by SEBM; however, several sites have become extirpated. The extirpated sites include Seaview Subdivision, Treasure Shores Park, and Turtle Trail Public Beach Access area in Indian River County and Pepper Park and Fort Pierce State Park (FPSP) in St. Lucie County. SEBM are known to be present at 1) SDP, Volusia County; 2) CANA, Volusia and Brevard Counties; 3) MINWR/KSC, Brevard County; 4) CCAFS, Brevard County 5) Sebastian Inlet State Park (SISP, south of the inlet), Indian River County; and 6) PINWR, Indian River County. SDP, MINWR/KSC, and CCAFS have viable populations with an effective breeding size of at least 500 individuals as evidenced by

continued trapping efforts at these sites. These sites are all located towards the northern range of the SEBM. The SEBM was believed to be extirpated south of SISP but was discovered along Jungle Trail at PINWR in 2006 (Weidlich 2002, J. Stout, University of Central Florida, personal communication, 2006). The Service is planning to reintroduce SEBM into the southern portion of the historic range at Archie Carr National Wildlife Refuge (ACNWR) and SISP (north of the inlet) in Brevard County to help establish additional populations on conservation lands.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends, demographic features, or demographic trends: Because of their close ancestry and analogous life histories, research on one beach mouse subspecies is often inferred to the other subspecies, although some aspects are unique to the subspecies. Based on research on old-field mice (*Peromyscus polionotus*) and other beach mouse subspecies, beach mice are considered monogamous (Smith 1966, Foltz 1981, Lynn 2000). While a majority of individuals appear to pair for life, paired males may sire extra litters with unpaired females. Beach mice are considered sexually mature at 55 days of age; however, some are capable of breeding earlier (Weston 2007). Gestation averages 28 to 30 days (Weston 2007) and the average litter size is four pups (Fleming and Holler 1990). Littering intervals may be as short as 26 days (Bowen 1968). Peak breeding season for some beach mice subspecies has been observed in fall and winter, declining in spring, and falling to low levels in summer (Blair 1951). Stout (1979), Oddy *et al.* (1999), and Oddy (2000) observed peaks in fall, summer, and winter. However, pregnant and lactating beach mice have been observed in all seasons (Stout 1979, Moyers *et al.* 1999, Oddy *et al.* 1999, Oddy 2000, Oddy unpublished data, Suazo 2006).

Long-term trapping data have shown that beach mouse densities are markedly variable and can fluctuate by magnitudes on a seasonal and annual basis (Terman 1968). These fluctuations can result from changes in reproduction rates, food availability, habitat quality and quantity, catastrophic events, disease, and predation (Blair 1951, Smith 1966, Bowen 1968, Stout 1979, Hill 1989, Rave and Holler 1992, Swilling *et al.* 1998, Oddy 2000, Swilling 2000, Sneckenberger 2001, Weidlich 2002). Without suitable habitat sufficient in size and quality to support the cyclical nature of beach mouse population dynamics, beach mouse subspecies may be at risk from local extirpation and extinction and may not

attain the densities necessary to withstand storm events and seasonal fluctuations of resources.

Unlike many species that have annually-based life cycles and can be sampled annually to determine population parameters, beach mice breed year-round, producing up to 13 generations within one year (overlapping and asynchronous among individuals). To calculate demographic and population growth rates for beach mouse populations, trapping would need to occur on a monthly or bi-monthly basis. Furthermore, because of their annual and seasonal population fluctuations and differences between sites, abundance data alone have little meaning. Population estimates for SEBM on each of the sites have not been determined, although some estimates do occur (i.e., CCAFS (Oddy 2000) and Treasure Shores Park (Humphrey and Frank 1992)). Given that the data we currently collect and have access to are limited, population trends of SEBM are difficult to determine.

Surveys and monitoring at all sites have been conducted by live trapping, marking, and recapturing. For example, at SDP in 2004, Suazo (2004) found 27 beach mice over 720 trap nights. In 2006 and 2007, researchers found the SDP population to be stable and secure based on their trapping data (J. Van Zant, University of Central Florida, personal communication, 2007). Prior to 2004, no small mammal surveys had been conducted at SDP.

CANA was last surveyed for SEBM in 2003-2004 with less than 20 captures and recaptures over 1,000 trap nights (M. Gaines, University of Miami, personal communication, 2004). The SEBM population appears to have remained the same since the 1991-1992 surveys conducted by CANA staff, which had 36 captures and recaptures over 1,632 trap nights (Stiner 1991, 1992). Loss of habitat due to erosion of the coastal dunes back into the coastal strand/scrub is most likely the primary reason for the decline.

The first trapping of SEBM on MINWR/KSC was in 1975 in front of Launch Complex 41 (Stout 1979). This site was trapped again in 1976 and from 1977 until September 1979 (Stout 1979, Extine and Stout 1987). These trapping efforts along the dunes at MINWR/KSC resulted in 771 captures/recaptures in 2,256 trap nights (Stout 1979, Extine 1980). In 1990-1991, a baseline survey (29 transects) of SEBM at MINWR/KSC was conducted along the entire dune system, which resulted in 539 beach mouse captures/ recaptures over 3,937 trap nights (Provancha and Oddy 1992). From 1995 to 1997, surveys were conducted to monitor launch impacts from Titan, Atlas, and Delta launches. One of the three

coastal grids was located at MINWR/KSC and yielded 92 captures/recaptures in 1,138 trap nights (Oddy *et al.* 1999).

In 2001, the dune grid set up by Stout (1979) on MNWR/KSC was reset and trapped through 2002 and from 2004-present (Oddy unpublished data, Oddy and Barfus 2006, Oddy 2007, Oddy in preparation). A total of 164 SEBM were captured/recaptured over 932 trap nights in 2001-2002, while 348 were captured/recaptured over 970 trap nights in 2004-2005 (Oddy unpublished data). In 2006, Oddy and Barfus set an additional grid in the location of several of the 1990-1991 transects. A total of 506 SEBM were captured/recaptured over 1,044 trap nights in 2006 and 660 over 1,235 trap nights in 2007 (Oddy 2007, Oddy *et al.* in preparation) at the two grids.

Provancha *et al.* (2005) performed surveys on MINWR/KSC in 2003-2005 and found a recapture rate similar to the 1990-1991 and 1995-1997 surveys. The 2003-2005 surveys also found two SEBM along transects located within the coastal scrub 4 km from the beach. The 2003-2005 and 2006 surveys found an increase in the number of SEBM at MINWR/KSC, while 2007 surveys showed a decrease in the number of mice in the months of September-November before increasing again in December (Oddy *et al.* in preparation). The decrease is believed to be a natural fluctuation in the population possibly resulting from an abundance of food on the ground and not the result of a new threat (D. Oddy, Dynamac Corporation, personal communication, 2007). Overall, surveys indicate that the number of SEBM have remained stable since 1990-1991.

At CCAFS in the late 1970s, trapping effort found 257 SEBM over 1,520 trap nights in the coastal scrub (Keim 1979, Stout 1979). Humphrey *et al.* (1987) had 18 captures in 217 trap nights at CCAFS, which had excellent habitat. Mercadante (1989) recorded 313 captures over 1,016 trap nights on the dunes by Launch Complex 40. Surveys conducted from 1995-1997 on four grids (1,708 captures over 9,913 trap nights) documented a significant drop in the population in 1995 (8 captures over 1,195 trap nights) due to hurricanes and tropical storms, which impacted dune habitat (Oddy and Stolen 1995, Oddy *et al.* 1999, Oddy 2000). However, by 1997, the population had recovered and the number of mice peaked (372 captures over 956 trap nights). Surveys conducted in the fall of 1998-2000 at the same locations showed another decrease in the population with 80 captures over 3,245 trap nights (Oddy *et al.* 1998; Oddy and Rebmann 1999, 2000). In addition, surveys in 1995-1997 were conducted to monitor launch impacts

from Titan, Atlas, and Delta launches. A total of 117 captures over 3,725 trap nights were documented along four transects located along the dunes behind the Atlas Launch Complexes (Oddy *et al.* 1999).

More recent surveys (2003-2005) of both the primary dunes and coastal scrub at CCAFS showed that this population decreased significantly, mostly along the primary dunes from hurricane-related impacts (Stout *et al.* 2006). Although the coastal scrub habitat was not damaged in the storms, some inland areas showed signs of a decrease in beach mice while other inland areas showed an increase in beach mice (Stout *et al.* 2006, 2007). On the primary dunes, recovery of the population was slow and did not occur until mid-2005 (Stout *et al.* 2006). By mid-2005, the populations of SEBM were once again stable with 60 captures in 562 trap nights in front of Launch Complex 41 (just north of the CCAFS/KSC boundary) (Oddy and Barfus 2006). The population continued to exhibit normal fluctuations in the coastal dune systems as well as in the coastal scrub of CCAFS into 2006 (Stout *et al.* 2007).

The population in the Brevard County sections of ACNWR and SISP were believed to have been extirpated in 1972, presumably by feral cats (USFWS 1999, 2007). Feral cats have since been removed from these areas. Reintroduction of SEBM into ACNWR and SISP in Brevard County is planned to take place in spring 2008.

The SEBM population at SISP in Indian River County (south of Sebastian Inlet) has been reported in relatively low numbers and has continued to decrease significantly over the past 10 years. Trapping at SISP by Humphrey *et al.* (1987) resulted in two captures over 69 trap nights in 1986 and 3 captures over 113 trap nights in 1986 at the Turtle Trail Public Access Area. Robson (1989) had 4 captures over 176 trap nights in 1988 at SISP. Weight (1995) had 5 captures over 321 trap nights in 1995 at Orchid Island Golf and Beach Club. Bard (1997) reported 11 captures at SISP in 1,296 trap nights from May 1995 to April 1997. In 1997, a small but persistent population was trapped at SISP (Florida Department of Environmental Protection (FDEP) 2001). In the spring of 2006, one adult female SEBM was trapped out of a total of 1,680 trap nights at SISP (south of the inlet) (J. DePue, FDEP, personal communication, 2006). No SEBM have been found during trapping events since 2006.

In the early 1990s, an area just north of Treasure Shores Park in Indian River County adjacent to the Seaview Subdivision in Indian River County was trapped and yielded 46 captures over 22 trap nights (Land Planning Group 1991, Weidlich 2002). Humphrey and Frank (1992) reported 228 captures in 859 trap nights in December 1991 and determined a population estimate for the area of 303 individuals. Trapping efforts from the mid- to late-1990s at Treasure Shores Park documented a decline in SEBM (45 captures in 640 trap nights in April 1995, 10 individuals over 412 trap nights, and 8 individuals in 544 trap nights in April 1996 (Tritaik 1997)) from an estimated 303 individuals (Humphrey and Frank 1992) down to fewer than 10 individuals (USFWS 1999). Weidlich (2002) documented a continued decline of the population with only 28 individuals captured in a total of 5,505 trap nights between November 1996 and January 1999.

At PINWR SEBM were historically found along Jungle Trail, but by 2002 were thought to be extirpated south of SISP (Weidlich 2002). However, in the spring of 2006, 19 SEBM were found at PINWR in an old field that had formerly been a citrus grove (J. Stout, University of Central Florida, personal communication, 2006). In April 2007, researchers trapped 17 mice that had moved into additional areas that had once been citrus groves (J. Van Zant, personal communication, 2007).

Trapping efforts conducted in 1988 at Ft. Pierce State Park (FPSP) in St. Lucie County resulted in the capture of only one SEBM (Robson 1989). By 1997, trapping efforts did not result in the capture of any beach mice at FPSP (Jennings and Miller 1997). No recent trapping efforts have been conducted for SEBM south of PINWR and it now believed that this subspecies has been extirpated throughout its southern historic portion of its range. The extirpation of SEBM is likely due to fragmentation of the habitat preventing SEBM from migrating back into these areas. The SEBM no longer occurs at Jupiter Island in Martin County, Palm Beach and Lake Worth in Palm Beach County, and Hillsboro Inlet or Hollywood Beach in Broward County. Much of the habitat within these counties has been lost to coastal development. However, FPSP in St. Lucie County and Hobe Sound National Wildlife Refuge (HSNWR) in Martin County are both within the historic range of this subspecies and habitat in these areas could support SEBM. Therefore, these sites should be considered as potential reintroduction sites if it is determined that threats have been removed and there is a substantial food source.

Currently there are six sites where SEBM populations are found varying in size, from one mouse to thousands and most are not self-sustaining populations. Only three of these sites (SDP, MINWR/KSC, and CCAFS) would be considered stable with a population size of over 500 individuals. Monitoring these sites should continue to determine how SEBM are responding to habitat alterations due to storms. Reintroduction is being considered within the historic range of the SEBM to establish additional populations. Overall, the status of the SEBM is considered stable.

b. **Genetics, genetic variation, or trends in genetic variation:** Selander *et al.* (1971) conducted an electrophoretic study on 30 populations of *P. polionotus* and estimated that the level of allozyme variation found in beach mouse populations was at least 40 percent lower than the level of variation in nearby inland populations. This study indicates that beach mouse populations already have lower genetic variability before inbreeding, bottleneck events, or founder effects that may occur in a reintroduced population.

Genetic samples were collected at SDP, MINWR/KSC, CCAFS, SISP, and PINWR by researchers at the University of Central Florida to look for genetic differences between SEBM at these sites. They found that the population of SEBM appears to consist of a single mitochondrial DNA (mtDNA) lineage which implies they are all genetically similar (J. Van Zant, personal communication, 2007; Degner *et al.* 2007). Sequencing analysis did show an individual with a different haplotype; however, because it was a single individual the nucleotide differences could be an artifact of the sequencing process.

c. **Taxonomic classification or changes in nomenclature:** Since the listing of the SEBM, further research on the taxonomic validity of the subspecific classification of beach mice has been initiated and/or conducted. Preliminary results of these studies support the separation of beach mice from inland forms, and support the currently accepted taxonomy (Bowen 1968) that each beach mouse group represents a unique and isolated subspecies (Stout *et al.* 2006, Degner *et al.* 2007).

d. **Spatial distribution, trends in spatial distribution, or historic range:** Bangs (1898) found SEBM abundant from Palm Beach in Palm Beach County to Ponce Inlet in Volusia County. The historic distribution of the SEBM was from Ponce (Mosquito) Inlet, Volusia County, southward to Hollywood, Broward County, and possibly as far south as Miami Beach in Dade County, Florida

(Stout 1992). Currently SEBM populations are found in Volusia, Brevard, and Indian River Counties (SDP, CANA, MINWR/KSC, CCAFS, SISP, and PINWR). No SEBM have been located south of Indian River County in St. Lucie, Martin, Palm Beach, and Broward Counties in recent years. SEBM once occupied over 360 km of Florida's southeastern coast; it now occupies about 80.5 km of coastline (USFWS 1993).

Habitat fragmentation due to habitat destruction (residential and commercial development) has created disjunct, isolated populations of SEBM along the east coast of Florida. Only three of the SEBM populations in Volusia and Brevard Counties (SDP, MINWR/KSC, and CCAFS) are large and healthy and are protected on public lands; however, they are geographically, and thus genetically, isolated from populations in Indian River County due to the presence of Sebastian Inlet (USFWS 1999). No natural dispersal can occur from Brevard County populations to enhance the populations to the south. Five inlets between Indian River and Broward counties create unnatural barriers to dispersal along this length of coast.

The Bureau of Land Management (BLM) leases 101 hectares to Volusia County for use as a park, Smyrna Dunes Park (B. Daws, BLM, personal communication, 2007). SEBM are known to occupy a portion of this area. The population of SEBM at SDP was not documented until 2004 when trapping was conducted (Suazo 2004). There has been no known movement of SEBM from SDP to populations 20-30 km south (Suazo 2004), but genetic evidence suggests recent gene flow (Degner *et al.* 2007).

At CANA, the population of SEBM is found mainly at the southern end of the park near MINWR/KSC where habitat conditions are most suitable (Stiner 1991, 1992). A few mice have also been documented at the northern end of the park further inland and beyond the dunes. Long-term monitoring is needed to determine the distribution and population fluctuations of beach mice at CANA. Surveys should also be conducted to determine if the necessary food resources are available (Keserauskis 2007) and all restoration efforts should include plantings and enhancement of these food resources.

A 70-km barrier island complex is formed by CANA, MINWR/KSC, and CCAFS. This barrier island is one of the longest stretches of undeveloped coastal dune/strand on the east coast (Oddy 2000, Oddy and Barfus 2006). MINWR/KSC comprises 10 km of this barrier island. The population of SEBM

at MINWR/KSC is found on 132 hectares of dune and coastal strand habitat south of the CANA boundary to north of the CCAFS boundary (USFWS 2006a). SEBM have also been documented within scrub habitat as far as 4 km from the beach. The populations on MINWR/KSC as a whole have remained stable since the 1990s, although several of the areas surveyed have experienced habitat loss due to continued overwash from storm events.

CCAFS makes up 21.7 km of the 70-km barrier island mentioned above (Oddy 2000). This area contains 640 hectares of coastal dunes and strand where SEBM are found (Johnson Controls World Services, Inc. 1991). Trapping at CCAFS includes both the primary dunes as well as inland areas in the coastal scrub. SEBM also have been documented inhabiting structures (i.e., office buildings) several km inland (Oddy 2000).

The SEBM was historically found along the coastline of the ACNWR's 33-km boundary within Brevard and Indian River Counties. This population was extirpated in the 1970s, presumably due to predation by feral cats (USFWS 1999, 2007). Weidlich (2002) reported habitat loss resulting from the destruction of the primary dunes due to coastal erosion from tropical storms and hurricanes and construction of inlets and jetties as the primary threat to the SEBM in the Indian River County portion of ACNWR.

SEBM were extirpated in 1972 from SISP (north of the inlet) in Brevard County. SEBM have been documented as occupying SISP (south of the inlet) in Indian River County as recently as 2006, although none have been found since then.

SEBM have been documented within the old fields off Jungle Trail Road in PINWR. PINWR is composed of 147 hectares of upland and wetland habitat (USFWS 2006b). The SEBM occupy a small part of the upland areas made up of old fields that were converted from citrus groves. The area used by SEBM is west of A1A and the beach dunes in Indian River County. It is unknown where this population originated, possibly from the now extirpated Treasure Shores Park located along the coastline east of PINWR.

Beach mouse populations naturally persist through local extirpations due to storm events or the harsh, stochastic nature of coastal ecosystems. Historically, these areas would be recolonized as population densities increased and dispersal occurred from adjacent populated areas. From a genetic perspective, beach mice

recover well from population size reductions (Wooten 1994), given sufficient habitat is available for population expansion after the bottleneck occurs. As residential and commercial development has fragmented the coastal dune landscape, beach mice can no longer recolonize along these areas as they did in the past (Holliman 1983). As a continuous presence of beach mice or suitable habitat along the coastline does not currently exist and hurricanes could impact the entire range of the subspecies, the probability of beach mice persisting would be enhanced by the restoration of contiguous tracts of suitable habitat occupied by multiple independent populations (Shaffer and Stein 2000, Danielson 2005).

e. **Habitat or ecosystem conditions:** Beach mice occupy both frontal (primary and secondary) and scrub dunes on a permanent basis and studies have found no detectable differences in beach mouse body mass, home range size, dispersal, reproduction, survival, food quality, and burrow site availability between scrub and frontal dunes in Alabama (Swilling *et al.* 1998, Swilling 2000, Sneckenberger 2001); however, this is not the case in the MINWR/KSC and CCAFS where oak scrub is more extensive between coastal dunes and inland oak scrub (Stout *et al.* 2007).

Beach mice have long been thought to be food specialists (Ehrhart 1978a), although recent data show SEBM are actually food generalists (Keserauskis 2007). Sea oats, seeds, and various beach grasses were thought to be the primary food resources for this species (Blair 1951) with both invertebrates, (Smith 1966, Ehrhart 1971) and vertebrates (Gentry and Smith 1968) also consumed. Recent data have shown the diet of SEBM varies among habitats and within habitats, and non-grass materials and arthropods that feed on non-grass materials comprise the majority of their diet (Keserauskis 2007). The scrub dunes appear to serve as refugia for beach mice during and after a tropical storm event (Holliman 1983, Swilling *et al.* 1998, Oddy 2000), from which recolonization of the frontal dunes takes place (Swilling *et al.* 1998, Sneckenberger 2001). This suggests that access to primary, secondary, and scrub dune habitat is essential to beach mice at the individual level.

Typical vegetation that SEBM would occupy in the foredunes is generally sparse, consisting of salt-tolerant species adapted to harsh conditions. The most important species are sea oats (*Uniola paniculata*), railroad vine (*Ipomoea pes-caprae*), beach morning glory (*I. imperati*), beach cordgrass (*Spartina patens*), and beach elder (*Iva imbricata*), which facilitate dune formation by trapping windblown sand and stabilizing the dune (Frank and Humphrey

1992). Most of the range of SEBM has been altered by erosion and overwash that resulted in the loss of vegetation over the past several years.

SDP contains 101 hectares of coastal dune and upland habitat at the northern tip of the New Smyrna Beach peninsula in Volusia County, Florida. The park is limited to the north by Ponce de Leon Inlet. About one-third of the park consists of dune fields that are occupied by SEBM. Beyond the primary dune, woody plants such as wax myrtle (*Myrica cerifera*) mark the beginning of the coastal strand (Suazo 2004). Disturbance to the dunes by visitors is avoided by the presence of elevated crossovers designed to protect the beach mouse habitat. The Volusia County Natural Resources Department has received funding to manage this habitat by prescribed burning and mechanical clearing to reduce the woody vegetation and create more sandy openings that will benefit the SEBM. A prescribed burn is planned for 2008 or when weather conditions are suitable for burning. The use of a snow fence to establish secondary and tertiary dune fields would greatly expand the inland habitat to safe-guard some of the SEBM in case of severe storm events.

The habitat at CANA is described as a narrow dune habitat where the vegetation has become overgrown and no longer provides open areas for beach mice. Dense sea grape (*Coccoloba uvifera*) and saw palmetto (*Serenoa repens*) now encroach along the narrow primary dunes. CANA dunes have been severely eroded in recent years due to storm events (i.e., hurricanes and northeasters). Dune restoration and management of the coastal strand/scrub using prescribed burning and mechanical clearing could allow the establishment of ground cover with sea oaks and other grasses and herbs. However, care must be exercised in placing such openings, which could result in blow outs and unwanted erosion.

Toombs (2001) conducted surveys at MINWR/KSC in 2001 and captured SEBM in the primary dunes. They were not found in areas of dense saw palmetto where it may be more difficult to burrow. Oddy *et al.* (1999) also conducted trapping at MINWR/KSC in a grid located in a previously disturbed, overgrown coastal scrub and had 92 captures over 1,138 trap nights from 1995-1997 and 0 captures over 87 trap nights in July 1998. The vegetation likely became too overgrown to be suitable for beach mice to occupy. Provancha *et al.* (2005) trapped two beach mice 4 km from the dunes within scrub habitat that contained saw palmetto and scrub oaks (*Quercus spp.*), which is more typical habitat for the old field mouse. This area has been regularly managed for several years using prescribed burning and

mechanical clearing to create openings and reduce the vegetation to make it more suitable for the federally listed Florida scrub-jay (*Aphelocoma coerulescens*). Most of the coastal scrub on MINWR/KSC and CCAFS will not provide suitable habitat for SEBM without prescribed fires and mechanical clearing.

In August and September 2004, four hurricanes impacted the primary dune habitat located at MINWR/KSC. In some areas, the storms caused significant erosion along with sand accretion beyond the dunes eliminating several beach mouse trapping areas (Provancha *et al.* 2005). Erosion caused complete overwash in several areas eliminating vegetation from the dunes. Restoration efforts in these overwashed areas were conducted prior to May 2005 and resulted in the reconstruction of non-vegetated sand dunes (Provancha *et al.* 2005). A dune revegetation project was conducted later in 2005. As of November 2007, about 50% of the restored dune remains and all of the grasses planted on the backside of the current dunes survived (J. Provancha, Dynamac Corporation, personal communication, 2007). However, the beaches continue to experience severe erosion events. Revegetation of the dunes should include a diversity of coastal plants like beach sunflower (*Helianthus debilis),* ground cherry (*Polygala walteri)*, and sea oats, identified by Keserauskis (2007) to provide not only food resources for the SEBM but to help stabilize the dunes.

Kurz (1942) and Johnson and Barbour (1990) composed a vegetation profile of CCAFS that describes several habitat types that SEBM inhabit. The dunes at CCAFS are broad but low and gently sloping and, therefore, are susceptible to salt water intrusion and alterations from even small storms (Oddy 2000, Stout *et al.* 2007). The foredune and primary dune are composed of typical vegetation such as sea oats, railroad vine, dune panic grass (*Panicum amarum*) and beach morning glory. Between the dunes and scrub habitat is coastal grassland that contains purple muhly grass (*Muhlenbergia capillaries)*, a sedge (*Fimbristylis castanea*), beardgrass (*Andropogon* spp.), Virginia dropseed (*Sporobolus virginicus*), saltgrass (*Distichlis spicata*), and *Schizachyrium* spp. (Oddy *et al.* 1999, Oddy 2000, Keserauskis 2007). The coastal grassland is best developed south of the tip of CCAFS where sand accumulation continues and is considered part of the transitional zone (Johnson and Barbour 1990). The dune and grassland areas are important for the SEBM at CCAFS as habitat and as the most continuous cover for dispersal along the coast line.

SEBM have also been trapped in the inland habitats, coastal strand and oak scrub, at CCAFS. The coastal strand is composed of saw

palmetto, sea grape, tough buckthorn (*Sideroxylon tenax*), and wax myrtle. This area is also considered part of the transitional zone (Johnson and Barbour 1990). The shrub cover may be dense with sandy openings. Further inland is the coastal scrub, a shrub community where oaks, such as the coastal form of live oak (*Quercus virginiana*), are dominant (Kurz 1942).

The Brevard County portion of ACNWR with suitable habitat for SEBM is adjacent to SISP (north of the inlet). The habitat here is similar but needs a prescribed burn, which may be problematic due to the close proximity of coastal development interspersed within and north of the refuge. Mechanical clearing and exotic plant and animal control are being implemented at the refuge to reduce threats to SEBM. Vegetation surveys should be conducted to determine if the necessary food resources are available (Keserauskis 2007).

SISP has 23 acres of beach dune habitat and 36 acres of coastal strand habitat that is suitable for SEBM (FDEP 2001). The beach dune habitat has typical vegetation found along the eastern coastline such as sea oats, railroad vine, beach morning glory, and bitter panic grass. This habitat is found north and south of the inlet at SISP. Throughout SISP, the beach dune transitions into coastal strand, which is composed of sea grapes, saw palmetto, and wax myrtle. South of the inlet, the habitat is highly fragmented; beach facilities, a pedestrian crossover, footpaths, a staff residence, a museum, and State Road A1A are located in the coastal strand. In 1997, a prescribed burning program was initiated at SISP (south of the inlet) to reduce the amount of hardwood encroachment and increase the coverage of grasses for SEBM. A prescribed burn was conducted in summer 2007 at SISP (north of the inlet) which created sandy openings and reduced the hardwoods.

SEBM occupy the old-field habitat off Jungle Trail at PINWR. The old-field habitat was converted from citrus groves. This area is characterized by sandy soils, herbaceous cover, and early successional vegetation (USFWS 2006b). Currently, PINWR has restored 100 acres of the old citrus groves. In some areas, these openings have created habitat that the SEBM now occupy. During current and future restoration, the areas currently occupied by SEBM will be avoided.

Much of the habitat in St. Lucie and Martin Counties has been lost to coastal development. If enough suitable habitat is present and threats are removed on public lands in these counties, FPSP and HSNWR should be considered for future reintroduction of SEBM.

The habitat at most sites occupied by SEBM remains intact and suitable. Coastal construction has already affected most of the habitat along the east coast of Florida. Coastal scrub in most of the areas needs to be managed to provide openings for beach mice.

2. Five-Factor Analysis

a. Present or threatened destruction, modification, or curtailment of its habitat or range: The SEBM used to occupy 360 km of the Atlantic coastline from Volusia to Broward Counties (Humphrey *et al.* 1987). Due to habitat loss and fragmentation, SEBM now occupy 80.5 km of the coastline from Volusia to Indian River Counties. The primary threat to the survival and recovery of the SEBM is the continued loss, fragmentation, and alteration of beach dune, coastal strand, and scrub habitat. Large-scale commercial and residential development on the Atlantic coast has eliminated beach mouse habitat in Palm Beach and Broward Counties (USFWS 1999). This increased urbanization has also increased the recreational use of dunes and impacted the vegetation essential for dune maintenance and stabilization. Loss of dune vegetation results in widespread wind and water erosion and reduces the effectiveness of the dune to protect beach mouse habitat (USFWS 1999). Coastal development and construction of inlets has fragmented the habitat and limited the movement of SEBM to recolonize adjacent sites.

In addition to increased urbanization, coastal erosion is responsible for the loss of the dune environment along the Atlantic coast, particularly during winter storms, tropical storms, and hurricanes. At SISP, several vehicular access roads for beach renourishment projects have been constructed through the coastal strand and have not been revegetated. These areas are more susceptible to blowouts and erosion due to the lack of vegetative cover (FDEP 2001). 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 SISP (just south of Sebastian inlet). This rate is six times the average erosion rate for the county (USFWS 1999). 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 (FDEP 1996).

All known areas that currently have SEBM are in county, state, or

Federal ownership. Although there is no longer loss of habitat from development sites within the SEBM range, these areas do border the existing protected areas and could affect the management at these sites. SISP has an active management plan that addresses habitat needs of SEBM. The Refuges (MINWR, ACNWR, and PINWR) all have draft or final comprehensive conservation plans that, if implemented, will help in managing for SEBM. KSC and CCAFS are restricted areas that are not accessible by the public, which has reduced the human related impacts to these areas. Management actions, such as prescribed burning and mechanical clearing, need to be implemented regularly at all of these sites (Suazo 2006). In 2007, SDP received funding from the Service's Coastal Program to manage (i.e., prescribe burn) the beach dune and coastal strand areas of the park to benefit the SEBM.

SDP has created a 3.22 km elevated crossover throughout the coastal strand and primary dune habitat, which has greatly reduced human impacts to this area. CANA receives a large number of visitors and has established designated crossovers to access the beach. At SISP, pedestrians continue to use unvegetated openings created from past beach renourishment projects in the primary and secondary dune to access the beach (FDEP 2001). This has resulted in the loss of stabilizing vegetation and exposure of the sediments to erosion by wind.

Due to habitat loss and fragmentation, SEBM now occupies only 22% of its former range. Efforts have been made at a number of sites to reduce human impacts, but the primary threat to the survival and recovery of the SEBM continues to be fragmentation and alteration of beach dune, coastal strand, and scrub habitat.

b. **Overutilization for commercial, recreational, scientific, or educational purposes:** Not known as a threat at the time of listing or at present. Although scientific research does involve trapping and taking genetic samples (i.e., tail snips), there has not been a significant loss of SEBM to scientific purposes.

c. **Disease or predation:** Beach mice have a number of natural predators including the coachwhip (*Masticophis flagellum*), corn snake (*Elaphe guttata guttata*), pygmy rattlesnake (*Sistrurus miliarius*), eastern diamondback rattlesnake (*Crotalus adamanteus*), short-eared owl (*Asio flammeus*), great-horned owl (*Bubo virginianus*), great blue heron (*Ardea herodias*), northern harrier (*Circus cyaneus*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), eastern spotted skunk (*Spilogale*

putorius), weasel (*Mustela frenata*), bobcat (*Lynx rufus*), house cat (*Felis catus*), and raccoon (*Procyon lotor*) (Blair 1951, Bowen 1968, Holler 1992, Novak 1997, Moyers *et al.* 1999, Oddy 2000, Van Zant and Wooten 2003). Predation by natural predators in beach mouse populations that have sufficient recruitment and habitat availability is natural and not a concern. Precautions (i.e., excluder traps like those developed by Layne (1987)) in trapping areas should be considered if natural predators are targeting these areas.

On the other hand, increased predation pressure on isolated beach mouse populations from natural and non-native predators can have a substantial impact. Free-roaming and feral cats are believed to have a devastating effect on beach mouse persistence (Bowen 1968, Linzey 1978, Frank 1996) and are considered the primary cause of the extirpation of isolated populations of beach mice and a contributing factor to the extinction of the Pallid beach mouse (*P. polionotus decoloratus*) (Bowen 1968, Ehrhart 1978b, Holliman 1983, Humphrey 1992). Predation of beach mice by feral cats has been documented (Van Zant and Wooten 2003) and is considered one of the most serious threats to beach mouse populations (Gore *in litt.* 1994, Frank 1996). Cat tracks have been observed in areas of low trapping success for beach mice (Moyers *et al.* 1999).

Feral cats can affect SEBM population dynamics and depress densities. The encroachment of residential housing on the Atlantic Coast increases the likelihood of predation by domestic cats. A healthy population of SEBM at SISP (north of the inlet) in Brevard County was completely extirpated by 1972, presumably by feral cats (USFWS 1999). This also included the area north of Sebastian Inlet that is now part of the ACNWR. Since that time, both ACNWR and SISP have removed cats from these sites.

No specific diseases are known to occur in SEBM (that they would transfer to one another) but because of their restricted geographic range an outbreak or epidemic of some epizootic nature could decimate the population.

d. **Inadequacy of existing regulatory mechanisms:** The SEBM is state listed by the Florida Fish and Wildlife Conservation Commission, which allows the state to protect beach mice under Florida Administrative Code (F.A.C.) 68A-27 along with the FDEP. The Service has addressed the impacts to SEBM using several existing regulatory mechanisms (e.g., sections 7 and 10 of the Endangered Species Act, as amended) that are working to benefit this subspecies. Several county, state, and Federal

properties (SDP, CANA, MINWR/KSC, CCAFS, ACNWR, SISP, and PINWR) have protection measures for SEBM included in their management plans. In 2005, Volusia County approved a beach management plan that discusses SEBM at SDP. CANA is currently working on a draft general management plan that will be released in fall 2008. PINWR has a final comprehensive conservation plan; MINWR and ACNWR comprehensive conservation plans are still in draft but include management such as mechanical clearing and prescribed burning for SEBM. Recommendations for this review did not rely on the actions discussed in the draft plans but will be included in the next 5-year review for SEBM. CCAFS has an Integrated Natural Resources Management Plan that discusses their plans for SEBM on their property.

SISP was established as a recreation area in 1966. FDEP manages SISP for the conservation and protection of natural, historical, and cultural resources and for resource-based public outdoor recreation compatible with the conservation and protection of the property (FDEP 2001). The F.A.C. 253.03 and 259.03, Chapter 18-2, requires a State Land Management Plan for all state parks such as SISP. An approved management plan that addresses the protection and monitoring of SEBM was approved in 2001. State protections have adequately protected beach mice on their lands.

Overall, existing regulatory mechanisms have been adequate to protect SEBM in the areas they currently exist on County, State, and Federal lands.

e. **Other natural or manmade factors affecting its continued existence:** One of the greatest threats to SEBM populations in coastal areas is the potential for a catastrophic loss of the entire population because of a severe hurricane. While a large hurricane could cause waves to overwash the dunes and eliminate occupied habitat, frequent but less severe hurricanes are actually more of a threat since they occur more often and still result in impacts to occupied habitat (Frank 1996). The establishment of additional populations within the historic range could reduce the possibility of extinction.

In March 2007, the Service held a Captive Management Feasibility Workshop to explore the feasibility of and options for developing a captive management program for beach mouse subspecies. Workshop participants developed the following list of potential roles that captive populations might play in beach mouse conservation: 1) provide an insurance policy against subspecies

extinction; 2) provide a source population for reintroduction into new habitat or habitat from which beach mouse populations have been extirpated; 3) provide a source for demographic supplementation of small populations; 4) provide a source for genetic supplementation of small (inbred) populations; 5) preserve a genetic reservoir to guard against sudden population bottlenecks; 6) preserve unique genetic lines to guard against loss of local genetically distinct populations; 7) serve as ambassadors through education outreach to reduce threats associated with human activities; and 8) provide research opportunities to gain knowledge of the species and to improve the effectiveness of management actions. The final report describes both the pros and cons of short and long-term captive programs. The report also provides valuable information for determining what needs to be done to protect the remaining populations of SEBM in case of a catastrophic event such as a hurricane (Traylor-Holzer and Lacy 2007).

Of the five listing factors, habitat loss and degradation (Factor A) and predators (Factor C) are considered major threats to SEBM and are addressed in the recovery plan. Other natural factors such as hurricanes (Factor E) could be a major threat and need to be addressed in the SEBM recovery plan. Factors B and D are not considered threats at this time.

D. Synthesis

The SEBM has been extirpated from its southern range in St. Lucie, Martin, Palm Beach, and Broward Counties. SEBM are now found only on county, state, and Federal lands that include SDP, CANA, MINWR/KSC, CCAFS, SISP (south of the inlet), and PINWR. Regular surveys of these sites have shown that the populations have remained stable at SDP, MINWR/KSC, and CCAFS. CANA's population has been decreasing due to the loss of habitat from erosion, which has created a narrow strip of habitat. SEBM were extirpated from SISP (north of the inlet) in 1972. The SEBM population at SISP (south of the inlet) has been decreasing and only one female was located in 2006. A small population of SEBM at PINWR was discovered in 2006 in recently created old field habitat that was formerly citrus groves. The long-term persistence of any of these populations may depend on the ability of mice from adjacent parts of the range to recolonize beaches. Fragmentation by coastal construction, inlets, and hurricanes has resulted in isolated populations of SEBM throughout the subspecies' range. To avoid the risk of extinction from demographic, catastrophic, epizootic, or genetic events, an attempt should be made to establish viable populations of SEBM in remaining areas of suitable habitat throughout the subspecies' historic range. ACNWR, SISP, FPSP, and HSNWR could be potential reintroduction sites. Reintroduction and translocation plans need to include surveys and, if needed, plantings of necessary food resources for SEBM. Currently there are

plans to reintroduce SEBM from CCAFS to ACNWR and SISP (north of the inlet) in spring 2008.

There are still several threats affecting the SEBM throughout its range. Habitat loss was considered the major threat when this subspecies was listed. Habitat loss continues to occur throughout the range mainly due to erosion caused by northeasters and tropical storms, although habitat loss due to succession and invasion by exotics due to lack of management is also a concern. Coastal development has already caused the extirpation of SEBM from St. Lucie, Martin, Palm Beach, and Broward Counties. Habitat loss has resulted from beach renourishment projects that have eliminated coastal vegetation. Most of the public lands now have crossovers that allow visitors to access the beach, and this has alleviated some of the impacts to the dunes. SDP and SISP are working on restoring the habitat by implementing prescribed burning in the primary dunes and coastal strand areas. At MINWR/KSC and CCAFS, where SEBM occupy the coastal scrub some prescribed burning to reduce hardwoods and create open sandy areas has occurred, although much more is needed.

Predation by feral and free-ranging cats is a serious threat to SEBM. Before the SEBM was listed, feral cats had extirpated the populations of SEBM in 1972 at SISP (north of the inlet). However, SISP and ACNWR (area of refuge just north of SISP) have conducted an extensive feral cat removal program and are now considered to be suitable reintroduction sites. It is unknown if any other sites with SEBM have a feral cat issue, but if feral cats are already present or move into these areas they could have serious effects on any population of SEBM. Therefore, monitoring for cats and other predators and predator control should be an ongoing aspect of beach mouse management throughout the subspecies' range.

Hurricanes are the most catastrophic threat to the entire SEBM population. If any areas with large populations of SEBM (MINWR/KSC and CCAFS) are impacted by a storm, the entire beach dune habitat could be lost. This is why it is critical to establish additional populations within the historic range and to manage adjacent coastal strand and scrub areas as population overflows and refugia from storm events.

We are recommending that the status of SEBM remain the same for several reasons. First, the above-mentioned threats could result in a major impact to SEBM populations. In addition, the recovery criteria for SEBM have not been met. The recovery criteria state that SEBM can be considered for delisting from threatened status if 10 viable, self-sustaining populations can be established throughout a significant portion of its historic range. This requirement has not been met since SEBM are currently found at only six with only SDP, MINWR/KSC, and CCAFS having viable populations, and a significant portion of the historic range of the SEBM has been altered or destroyed.

III. RESULTS

A. Recommended Classification: No change is needed.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

The following suggested recommendations are in order of priority. Please note that these actions are not necessarily specific to SEBM. To that end, many actions listed are appropriate for all beach mouse subspecies, and in most cases research conducted or plans developed for one subspecies would serve all subspecies.

1. Revise the current recovery plan to include updated objective and measurable recovery criteria. Currently, the recovery plan includes both the Anastasia Island beach mouse and the SEBM. Individual plans should be developed for these two subspecies to address the specific recovery actions relating to each subspecies.

2. Provide funding and technical support for further research on:

    a. The effects of prescribed burning and other management tools within the dune habitat at all sites that currently have SEBM populations. Continue working with public land managers to increase management on their sites.

    b. Improve the management of coastal strand/scrub habitat at MINWR/KSC, CCAFS, ACNWR, SISP, and PINWR to expand the available habitat for SEBM. It should be supported by research to appropriately address the ecological requirements of SEBM to achieve habitat restoration needs (e.g., prescribed fire and mechanical treatment of the vegetative component in the coastal strand/scrub and surveys or planting as needed of necessary food resources). Funding should be provided to support habitat restoration projects.

    c. Continue genetic sampling of different populations. Goals for genetic sampling should be defined and a protocol established to achieve these goals. Such sampling can tell us if inbreeding depression is occurring. This information can also help the Service determine what constitutes a stable population for SEBM recovery.

    d. Perform a population viability analysis to estimate the probability of survival of SEBM populations of differing effective breeding size.

3. Develop an emergency response plan to outline actions taken in case of severe threats to the persistence of SEBM (i.e., forecasted category 5 hurricane, feral cat population increase, population crash) (Traylor-Holzer and Lacy 2007).

4. Develop and implement a long-term monitoring program for SEBM throughout its current and historic range. This plan should include goals and objectives such as

habitat mapping; obtaining demographic, landscape, or dispersal data; estimating future population trends or the likelihood of extinction; assessing management options; and evaluating future research priorities. A monitoring program is necessary for several other recommendations listed, particularly the Emergency Response Plan, land acquisition, translocation, and habitat management projects.

5. Develop a translocation plan to identify key sites, set criteria for when translocations are needed, consider genetic as well as demographic characteristics of the donor and recipient populations, and include an assessment of the suitability of the recipient habitat (i.e., habitat quality, food resources present, minimization or removal of feral cats and other threats). Public-private partnerships and easements should also be explored. Future translocation of SEBM should be considered at ACNWR, SISP, FPSP, and HSNWR if it can be shown that there is suitable habitat (e.g., the coastal strand/scrub habitat) to support additional mice and potential threats have been removed.

6. Continue to educate the public at the public parks about the importance of dune habitat. In addition, an outreach/education program should be developed and focused on the threats feral and house cats pose to wildlife.

7. Enforce the use of crossovers in areas with suitable beach mouse habitat to reduce impacts to the dunes. Restore habitats with native plant species that are also food sources for SEBM.

8. Continue feral cat removal and control from areas of suitable SEBM habitat.

V. REFERENCES

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 at Sebastian Inlet State Recreation Area, Indian River County. On file at the U.S. Fish and Wildlife Service, Jacksonville Field Office, Jacksonville, Florida.

Blair, W.F. 1951. Population structure, social behavior, and environmental relations in a natural population of the beach mouse (*Peromyscus polionotus leucocephalus*). Contributions from the Laboratories of Vertebrate Biology 48:1-47.

Bowen, W.W. 1968. Variation and evolution of Gulf Coast populations of beach mice, *Peromyscus polionotus*. Bulletin of Florida State Museum of Natural History 12:1-91.

Danielson, B.J. 2005. Importance of multiple independent populations of Alabama beach mice. Issue paper and presentation to Alabama Beach Mouse Recovery Team. May 16, 2005.

Degner, J.F., I.J. Stout, J.D. Roth, and C.L. Parkinson. 2007. Population genetics and conservation of the threatened southeastern beach mouse (*Peromyscus polionotus niveiventris*): subspecies and evolutionary units. Conservation Genetics 8:1441-1452.

Ehrhart, L.M. 1971. Behavioral studies of three subspecies of the old-field mouse, *Peromyscus polionotus*. Unpublished Ph.D. Dissertation, Cornell University. 237 pp.

Ehrhart, L.M. 1978a. Choctawhatchee beach mouse. Pages 18-19. *In*: J.N. Layne, (editor) Rare and endangered biota of Florida. Vol. 1, Mammals. University Presses of Florida, Gainesville.

Ehrhart, L.M. 1978b. Pallid beach mouse. Pages 8-10. *In:* J.N. Layne (editor). Rare and Endangered Biota of Florida. Volume . 1, Mammals. University Presses of Florida, Gainesville.

Extine, D.D. 1980. Population biology of the beach mouse, *Peromyscus polionotus niveiventris*. Unpublished Master's Thesis University of Central Florida, Orlando. 82 pp.

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.

Fleming, K.L. and N.R. Holler. 1990. Reproduction in captive Santa Rosa beach mice (*Peromyscus polionotus leucocephalus*) and Choctawhatchee beach mice (*P.p. allophrys*). Journal of the Alabama Academy of Science 61:143.

Florida Department of Environmental Protection (FDEP). 1996. Unpublished data summaries of shoreline erosion measured in terms of change in mean high water level, from Ocean Hideaway to Treasure Shores. On file at the U.S. Fish and Wildlife Service, Jacksonville Field Office, Jacksonville, Florida.

Florida Department of Environmental Protection (FDEP). 2001. Sebastian Inlet State Park Unit Management Plan. Florida Division of Recreation and Parks, Tallahassee, Florida.

Foltz, D.W. 1981. Genetic evidence for the long-term monogamy in a small rodent, *Peromyscus polionotus*. American Naturalist 117:665-675.

Frank, P.A. 1996. Ecology and conservation of the Anastasia Island beach mouse (*Peromyscus polionotus phasma*). Unpublished Ph.D. Dissertation, University of Florida, Gainesville. 111 pp.

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 the exotic house mice (*Mus musculus*). Final Rep. No. NG88-0066 to Florida Game and Fresh Water Fish Commission. 70 pp.

Gentry, J.B. and M.H. Smith. 1968. Food habits and burrow associates of *Peromyscus polionotus*. Journal of Mammalogy 49(3):562-565.

Gore, J. (Florida Game and Fresh Water Fish Commission). 1994. Letter to John Milio. 5 pp.

Hill, E.A. 1989. Population dynamics, habitat, and distribution of the Alabama beach mouse. Unpublished Master's Thesis, Auburn University, Auburn, Alabama.

Holler, N.R. 1992. Choctawhatchee beach mouse. Pages 102-109. *In:* S.R. Humphrey (editor). Rare and Endangered Biota of Florida, Volume 1. Mammals. University Presses of Florida, Gainesville.

Holliman, D.C. 1983. Status and habitat of Alabama gulf coast beach mice *Peromyscus polionotus ammobates* and *P. p. allophrys*. Northeast Gulf Science 6:121-129.

Humphrey, S.R. 1992. Pallid beach mouse. Pages 19-23. *In:* S.R. Humphrey (editor). Rare and Endangered Biota of Florida. Volume I. Mammals. University Presses of Florida, Gainesville, Florida.

Humphrey, S.R. and P.A. Frank. 1992. Survey for the southeastern beach mouse at Treasure Shores Park. Final Report to the Indian River County Board of County Commissioners

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 #25. Gainesville, Florida. 39 pp.

Jennings, D.P. and J.B. Miller. 1997. Data summaries for southeastern beach mouse trapping efforts in St. Lucie County. On file at the U.S. Fish and Wildlife Service, Jacksonville Field Office, Jacksonville, Florida.

Johnson, A.F. and M.G. Barbour. 1990. Dunes and maritime forests. Pages 429-480. *In:* R.L. Myers and J.J. Ewel (editors). Ecosystems of Florida. University of Central Florida Press, Orlando, Florida.

Johnson Controls World Services, Inc. 1991. Fish and Wildlife Management Plan for Cape Canaveral Air Force Station. Patrick Air Force Base, Florida.

Keim, M.H. 1979. Small mammal population dynamics and community structure in three East Central Florida communities. Unpublished Master's Thesis, University of Central Florida, Orlando, Florida. 212 pp.

Keserauskis, M.M. 2007. Trophic states of a small mammal assemblage on Cape Canaveral Air Force Station with an emphasis on *Peromyscus polionotus niveiventris* (southeastern beach mouse). Unpublished Master's Thesis, University of Central Florida, Orlando, Florida. 46 pp.

Kurz, H. 1942. Florida dunes and scrub vegetation and geology. Florida Geology Survey Bulletin 23:15-154.

Land Planning Group, Inc. 1991. Southeastern beach mouse survey of Seaview Subdivision, Indian River County. Final Report to Financial Services Group, Inc., Stuart, Florida. On file at the U.S. Fish and Wildlife Service, Jacksonville Field Office, Jacksonville, Florida.

Layne, J.N. 1987. An enclosure for protecting small mammal traps from disturbance. Journal of Mammalogy 68(3):666-668.

Linzey, D.W. 1978. Perdido Bay beach mouse. Pages 19-20. *In:* J.N. Layne (editor). Rare and Endangered Biota of Florida, Volume 1. Mammals. University Presses of Florida, Gainesville.

Lynn, W.J. 2000. Social organization and burrow-site selection of the Alabama beach mouse (*Peromyscus polionotus ammobates*). Unpublished Master's Thesis, Auburn University, Auburn, Alabama.

Mercadante, M. 1989. Population density estimates of the southeastern beach mouse at Launch Complex 40, CCAFS. Unpublished Report to the USAF. 7 pp.

Moyers, J.E., N.R. Holler, and M.C. Wooten. 1999. Species status report, current distribution and status of the Perdido Key, Choctawhatchee and St. Andrew Beach Mouse. U.S. Fish and Wildlife Service Grant Agreement No. 1448-0004-94-9174.

Novak, J.A. 1997. Home range and habitat use of Choctawhatchee beach mice. Unpublished Master's Thesis, Auburn University, Auburn, Alabama. 113 pp.

Oddy, D.M. 2000. Population estimate and demography of the southeastern beach mouse (*Peromyscus polionotus niveiventris)* on Cape Canaveral Air Force Station, Florida. Unpublished Master's Thesis, University of Central Florida, Orlando, Florida. 94 pp.

Oddy, D.M. 2007. Demography of southeastern beach mouse (*Peromyscus polionotus niveiventris)* on the John F. Kennedy Space Center. Annual Report to U.S. Fish and Wildlife Service, Jacksonville, Florida. 14 pp.

Oddy, D.M. In preparation. Demography of southeastern beach mouse (*Peromyscus polionotus niveiventris)* on the John F. Kennedy Space Center. Annual Report to U.S. Fish and Wildlife Service, Jacksonville, Florida.

Oddy, D.M. and J.R. Barfus. 2006. Demography of southeastern beach mouse (*Peromyscus polionotus niveiventris)* on the John F. Kennedy Space Center. Annual Report to U.S. Fish and Wildlife Service, Jacksonville, Florida. 14 pp.

Oddy, D.M., J.M. Rebmann, and J.R. Reich. 1998. Southeastern beach mouse survey at Cape Canaveral Air Station. Report to Canaveral Port Authority. 9 pp.

Oddy, D.M. and J.M. Rebmann. 1999. Southeastern beach mouse survey at Cape Canaveral Air Station. Report to Canaveral Port Authority. 24 pp.

Oddy, D.M. and J.M. Rebmann. 2000. Southeastern beach mouse survey at Cape Canaveral Air Station. Report to Canaveral Port Authority. 12 pp.

Oddy, D.M. and E.D. Stolen. 1995. Southeastern beach mouse survey at Cape Canaveral Air Station. Report to Canaveral Port Authority. 13 pp.

Oddy, D.M., E.D. Stolen, P.A. Schmalzer, V.L. Larson, M.A. Hensley, P. Hall, and S.R. Turek. 1999. Environmental conditions and threatened and endangered species populations near the Delta, Atlas, and Titan Launch Complexes, Cape Canaveral Air Station. NASA Technical Memorandum # 208553. 126 pp.

Provancha, J.A. and D.M. Oddy. 1992. A mark and release study of the southeastern beach mouse (*Peromyscus polionotus niveiventris)* on the Kennedy Space Center, Florida. Florida Scientist 55:28.

Provancha, J.A., R.B. Smith, and B.A. Homa. 2005. Abundance and distribution of southeastern beach mouse on Kennedy Space Center and Merritt Island National Wildlife Refuge, Florida. Final Report to U.S. Fish and Wildlife Service, Jacksonville, Florida.

Rave, E.H. and N.R. Holler. 1992. Population dynamics of beach mice (*Peromyscus polionotus ammobates*) in southern Alabama. Journal of Mammalogy 73:347-355.

Robson, M.S. 1989. Southeastern beach mouse survey. Nongame Wildlife Section Report, Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Selander, R.K., M.H. Smith, S.Y. Yang, W.E. Johnson, and J.B. Gentry. 1971. Biochemical polymorphism and systematics in the genus *Peromyscus*. I. Variation in the old-field mouse (*Peromyscus polionotus*). University of Texas Studies in Genetics 6:49-90.

Shaffer, M. and B.A. Stein. 2000. Safeguarding our Precious Heritage. Chapter 11 in Stein, B.A., L.S. Kutner, and J.S. Adams (editors). Precious Heritage: The Status of Biodiversity in the United States. Oxford University Press, New York. 399 pp.

Smith, M.H. 1966. The evolutionary significance of certain behavioral, physiological, and morphological adaptations of the old-field mouse, *Peromyscus polionotus*. Unpublished Ph.D. Dissertation, University of Florida, Gainesville. 187 pp.

Sneckenberger, S.I. 2001. Factors influencing habitat use by the Alabama beach mouse (*Peromyscus polionotus ammobates*). Unpublished Master's Thesis, Auburn University, Auburn, Alabama.

Stiner, J.C. 1991. Survey of the threatened southeastern beach mouse (*Peromyscus polionotus niveiventris*) at Canaveral National Seashore, Florida. Unpublished Report to the National Park Service. 18 pp.

Stiner, J.C. 1992. Supplemental survey of the threatened southeastern beach mouse (*Peromyscus polionotus niveiventris*) at Canaveral National Seashore, Florida. Unpublished Report to the National Park Service. 16 pp.

Stout, I.J. 1979. Terrestrial community analysis. Vol. 1 of IV: a continuation of baseline studies for environmentally monitoring space transportation systems (STS) at John F. Kennedy Space Center. NASA Contract Report #10-8986. 628 pp.

Stout, I.J. 1992. Southeastern beach mouse. Pages 242-249. *In:* S.R. Humphrey (editor). Rare and Endangered Biota of Florida. Volume I. Mammals. University Presses of Florida, Gainesville.

Stout, I.J., J.D. Roth, and C.L. Parkinson. 2006. The distribution and abundance of southeastern beach mouse (*Peromyscus polionotus niveiventris)* on the Cape Canaveral Air Force Station. Draft Annual Report to Cape Canaveral Air Force Station. Grant No.: 11-20-6012. 51 pp.

Stout, I.J., J.D. Roth, and C.L. Parkinson. 2007. The distribution and abundance of southeastern beach mouse (*Peromyscus polionotus niveiventris*) on the Cape Canaveral Air Force Station. Draft Final Report to Cape Canaveral Air Force Station. Grant No.: 24036012. 166 pp.

Suazo, A.A. 2004. A new record of southeastern beach mouse (*Peromyscus polionotus niveiventris)* from New Smyrna Beach, Florida, U.S.A. Unpublished data on file at U.S. Fish and Wildlife Service, Jacksonville Field Office, Jacksonville, Florida.

Suazo, A.A. 2006. Responses of small rodents to restoration and management techniques of Florida scrub at Cape Canaveral Air Force Station, Florida. Unpublished Master's Thesis, University of Central Florida, Orlando, Florida. 50 pp.

Swilling, W.R. 2000. Ecological dynamics of the endangered Alabama beach mouse (*Peromyscus polionotus ammobates*). Unpublished Master's Thesis, Auburn University, Auburn, Alabama.

Swilling, W.R. Jr., M.C. Wooten, N.R. Holler, and W.J. Lynn. 1998. Population dynamics of Alabama beach mice (*Peromyscus polionotus ammobates*) following Hurricane Opal. American Midland Naturalist 140:287-298.

Terman, C.R. 1968. Population dynamics. Pages 412-450. *In*: J.A. King (editor). Biology of *Peromyscus*. Special Publication No. 2, American Society of Mammalogists. 593 pp.

Toombs, A.K. 2001. Summary report of live trapping survey of the southeastern beach mouse (*Peromyscus polionotus niveiventris)*, along Canaveral National Seashore, Merritt Island National Wildlife Refuge, Cape Canaveral Air Force Station, Florida. On file at the U.S. Fish and Wildlife Service, Jacksonville Field Office, Jacksonville, Florida.

Traylor-Holzer, K. and R. Lacy (editors). 2007. Beach mouse captive population feasibility workshop final report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, Minnesota.

Tritaik, P. 1997. Data summaries for southeastern beach mouse trapping efforts at Treasures Shores Park. On file at the U.S. Fish and Wildlife Service, Jacksonville Field Office, Jacksonville, Florida.

U.S. Fish and Wildlife Service (USFWS). 1993. Recovery Plan for the Anastasia Island and Southeastern Beach Mouse. Atlanta, Georgia. 30 pp.

U.S. Fish and Wildlife Service (USFWS). 1999. Multi-Species Recovery Plan for South Florida (Southeastern Beach Mouse). Atlanta, Georgia. 20 pp.

U.S. Fish and Wildlife Service (USFWS). 2006a. Merritt Island National Wildlife Refuge Draft Comprehensive Conservation Plan. Atlanta, Georgia. 311 pp.

U.S. Fish and Wildlife Service (USFWS). 2006b. Pelican Island National Wildlife Refuge Comprehensive Conservation Plan. Atlanta, Georgia. 158 pp.

U.S. Fish and Wildlife Service. 2007. Archie Carr National Wildlife Refuge Draft Wildlife and Habitat Management Review. Vero Beach, Florida. 54 pp.

Van Zant, J.L. and M.C. Wooten. 2003. Translocation of Choctawhatchee beach mice (*Peromyscus polionotus allophrys*): hard lessons learned. Biological Conservation 112(3):405-413

Weidlich, J.S. 2002. A survey of the mammals of the Archie Carr and Pelican Island National Wildlife Refuge. Unpublished Master's Thesis, University of Central Florida, Orlando. 188 pp.

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, Jacksonville Field Office, Jacksonville, Florida.

Weston, J. 2007. Captive breeding of beach mice. Peromyscus Genetic Stock Center, University of South Carolina, Columbia.

Wooten, M.C. 1994. Estimation of genetic variation and systematic status of populations of the beach mouse, *Peromyscus polionotus*. Final Report, Florida Game and Freshwater Fish Commission, Tallahassee, Florida.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Southeastern Beach Mouse (*Peromyscus polionotus niveiventris*)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review: No change is needed

Review Conducted By: Annie Dziergowski

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 4/3/08
David L. Hankla

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 4/7/08
ACTING Assistant Regional Director
Ecological Services

APPENDIX

Summary of peer review for the 5-year review of Southeastern beach mouse (*Peromyscus polionotus niveiventris*)

A. Peer Review Method: See B. below.

B. Peer Review Charge: On November 21, 2007, the following letter and Guidance for Peer Reviewers of Five-Year Status Reviews were sent via e-mail to potential reviewers requesting comments on the 5-year review. Requests were sent to Jason DePue (Department of Environmental Protection, Division of Recreation and Parks), John Stiner (Canaveral National Seashore), Jack Stout (University of Central Florida), Jeff Gore (Florida Fish and Wildlife Conservation Commission), Donna Oddy (Dynamac Corporation), Jane Provancha (Dynamac Corporation), and David Webster (University of North Carolina at Wilmington).

We request your assistance in serving as a peer reviewer of the U.S. Fish and Wildlife Service (Service) 5-year status review of the endangered southeastern beach mouse (Peromyscus polionotus niveiventris). The 5-year review is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.). A 5-year review is a periodic process conducted to ensure the listing classification of a species as threatened or endangered on the Federal List of Endangered and Threatened Wildlife and Plants is accurate. The initiation of the 5-year review for the southeastern beach mouse was announced in the Federal Register on April 26, 2007, and the public comment period closed on June 26, 2007. Public comments have been incorporated into the status review.

The enclosed draft of the status review has been prepared by the Service pursuant to the Act. In keeping with Service directives for maintaining a high level of scientific integrity in the official documents our agency produces, we are seeking your assistance as a peer reviewer for this draft. Guidance for peer reviewers is enclosed with this letter. If you are able to assist us, we request your comments be received in this office on or before December 14, 2007. Please send your comments to Annie Dziergowski at the address on this letter. You may fax your comments to Annie Dziergowski at (904)232-2404 or send comments by e-mail to Annie_Dziergowski@fws.gov.

We appreciate your assistance in helping to ensure our decisions continue to be based on the best available science. If you have any questions or need additional information, please contact Annie Dziergowski at (904)232-2580 extension 116. Thank you for your assistance.

Sincerely yours,

David L. Hankla
Field Supervisor

Enclosures

Guidance for Peer Reviewers of Five-Year Status Reviews

U.S. Fish and Wildlife Service, North Florida Ecological Services Office

July 5, 2007

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with Service policy.

Peer reviewers should:

1. *Review all materials provided by the Service.*

2. *Identify, review, and provide other relevant data apparently not used by the Service.*

3. *Not provide recommendations on the Endangered Species Act (ESA) classification (e.g., endangered, threatened) of the species.*

4. *Provide written comments on:*
   - *Validity of any models, data, or analyses used or relied on in the review.*
   - *Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.*
   - *Oversights, omissions, and inconsistencies.*
   - *Reasonableness of judgments made from the scientific evidence.*
   - *Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.*
   - *Strengths and limitation of the overall product.*

5. *Keep in mind the requirement that we must use the best available scientific data in determining the species' status. This does not mean we must have statistically significant data on population trends or data from all known populations.*

All peer reviews and comments will be public documents, and portions may be incorporated verbatim into our final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Annie Dziergowski, U.S. Fish and Wildlife Service, at 904-232-2580 extension 116, email: annie_dziergowski@fws.gov.

C. Summary of Peer Review Comments/Report

A summary of peer review comments from the five respondents is provided below. The complete set of comments is available at the Jacksonville Ecological Services Field Office, U.S. Fish and Wildlife Service, 6620 Southpoint Drive South, Suite 310, Jacksonville, Florida, 32216. The Services accepted all minor edits from peer reviewers. Overall reviewers felt the draft document adequately characterizes the known information on the status and threats of the listed

populations. The following discussion is limited to where there was disagreement or additional information was provided.

Jason DePue, Florida Department of Environmental Protection, Office of Recreation and Parks, Orlando, Florida: Mr. DePue provided clarification of the information on trapping events at SISP. He also expressed some concern about the status of SEBM at certain sites. He believes that certain populations may be more vulnerable to hurricanes or tropical storms, which could result in extinction. Overall, the total population of SEBM might be stable, but indicated that certain populations have been declining in recent years. Some minor edits were suggested.

Donna Oddy, Dynamac Corporation, Kennedy Space Center, Florida: Ms. Oddy provided additional citations as well as information not available when the review was first drafted. The information she provided included site specific trapping data under Section C(1)(a). Also under this section, she provided some past data to show population trends at certain sites. Ms. Oddy also provided additional information studies conducted on food preferences and other small mammal studies done at KSC/CCAFS. Numerous minor edits were suggested.

Jane Provancha, Dynamac Corporation, Cape Canaveral, Florida: Ms. Provancha commented on the recovery criteria and the need for "10 viable, self-sustaining populations." She also questioned the definition of the word "population" used in the review. Ms. Provancha also provided clarification on the level of management that has actually occurred or should occur at several sites. She also referenced several other citations that should be included in the review. Some minor edits were suggested.

Dr. Jack Stout, University of Central Florida, Orlando,Florida: Dr. Stout provided additional citations for some of the information used in this review. He provided clarification on population trends in section C(1)(a). He also provided past trapping data. Numerous minor edits were suggested.

Dr. David Webster, University of North Carolina at Wilmington, Wilmington, North Carolina: Dr. Webster evaluated the entire document and found that even with the limited data available the review was sufficient. He identified some areas where additional information is needed (e.g., the effects of predation (including parasites), competition (*Mus musculus* and *Sigmodon hispidus*), direct loss of habitat, and a decline in habitat quality on the demography of local populations). He commented that the review did a good job identifying what was not known and not drawing conclusions that went beyond what the data allowed. Overall, he found the review did an excellent job in bringing together the information available and inserted information, where appropriate, about future plans.

D. Response to Peer Review:

Jason DePue, Florida Department of Environmental Protection, Office of Recreation and Parks, Orlando, Florida: All suggested edits and new information were incorporated.

Donna Oddy, Dynamac Corporation, Kennedy Space Center, Florida: All suggested edits and new information were incorporated.

Jane Provancha, Dynamac Corporation, Cape Canaveral, Florida: All suggested edits and new information were incorporated. Ms. Provancha had several questions that were not addressed in this review but will need to be considered during the revision to the recovery plan for this subspecies.

Dr. Jack Stout, University of Central Florida, Orlando,Florida: All suggested edits and new information were incorporated.

Dr. David Webster, University of North Carolina at Wilmington, Wilmington, North Carolina: All comments were incorporated into the review.