ST. ANDREW BEACH MOUSE RECOVERY PLAN

(*Peromyscus polionotus peninsularis*)

DRAFT

U.S. FISH AND WILDLIFE SERVICE
SOUTHEAST REGION

Technical/Agency Draft Recovery Plan

for the

ST. ANDREW BEACH MOUSE
(*Peromyscus polionotus peninsularis*)

Prepared by

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for

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Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans published by the U.S. Fish and Wildlife Service (Service) are sometimes prepared with the assistance of recovery teams, contractors, State agencies, and other affected and interested parties. Objectives of the plan will be obtained and any necessary funds made available subject to budgetary and other constraints affecting parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific tasks and may not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in developing the plan, other than the Service. Recovery plans represent the official position of the Service **only** after they have been signed by the Regional Director as approved. Approved recovery plans are subject to modification as dictated by new information, changes in species status, and the completion of recovery actions.

By approving this recovery plan, the Regional Director certifies that the data used in its development represent the best scientific and commercial information available at the time it was written. Copies of all documents reviewed in the development of the plan are available in the administrative record at the Panama City Field Office, in Panama City, Florida.

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EXECUTIVE SUMMARY

Current Status: The St. Andrew beach mouse is federally listed as endangered. Currently, there are two populations of the St. Andrew beach mouse: East Crooked Island, Bay County, and St. Joseph Peninsula, Gulf County, Florida.

Habitat Requirements and Limiting Factors: The St. Andrew beach mouse inhabits the primary, secondary, and scrub dunes within the coastal ecosystem. Beach mice require well developed dune systems in which to live out their life cycle. They dig their burrows into the face of the dunes near vegetative cover. Their diet is comprised primarily of the seeds and fruits of plants within their dune habitat with insects providing seasonal supplements.

Threats to the St. Andrew beach mouse consist of habitat loss/alteration from land development and associated human use, hurricanes and other tropical storm events, non-native predators, and recreational activity associated with development and tourism, that weaken and encroach on the dune ecosystem. Other potential threats are shoreline erosion, feral hogs, competition from house mice, intra-specific crossbreeding with Choctawhatchee beach mice, and artificial lighting. Availability of suitable habitat may be a limiting factor during periods of population expansion or following catastrophic weather events.

Recovery Strategy: The St. Andrew beach mouse is faced with numerous threats to its populations and to its habitat. Due to its limited range and fragmentation of habitat, these threats combined continue to present a threat to its existence. Through population reestablishment, habitat protection, minimization or removal of known threats, and public education and stewardship, this subspecies could be downlisted from endangered to threatened and eventually removed from the Federal List of Endangered and Threatened Wildlife.

Recovery Goals: The long-term recovery goal for the St. Andrew beach mouse is to perpetuate the long-term viability of the subspecies in the wild. This goal is represented by the delisting and removal from the Federal List of Endangered and Threatened Wildlife. The interim recovery goal is to downlist from endangered to threatened status.

Recovery Objectives:

1. Reestablish additional populations
2. Threat minimization or removal.
3. Habitat protection and/or restoration.
4. Outreach/Education to the public.

Recovery Criteria:

Reclassification from Endangered to Threatened Status (Downlisting)

1. A stable or increasing population trend is maintained at St. Joseph Peninsula State Park and East Crooked Island on Tyndall Air Force Base over a 10 year period based on data obtained from accepted, standardized, monitoring methods.

2. An additional viable or self-sustaining population is reestablished at St. Joe Beach that shows a stable or increasing trend, after the initial repopulation of unoccupied habitat, over a 10 year period based on data obtained from accepted, standardized, monitoring methods.
3. At least 87% of designated St. Andrew beach mice critical habitat is protected and under a management plan that addresses conservation of beach mice. The plans, at a minimum, address the following:
   a) Impact of commercial/residential development and recreational use including pedestrians and motorized vehicles to beach mice habitat..
   b) Impact of shoreline erosion to beach mice habitat.
   c) Impact of artificial lighting on beach mice habitat.
   d) Control of feral cats and hogs in beach mice habitat.
4. Non-native predators, including free roaming cats and cat colonies, are controlled in areas with known populations of beach mice (Tyndall Air Force Base's property at East Crooked Island, St. Joseph Peninsula State Park, and their respective adjacent private lands) at levels in which they do not pose a threat to beach mice.
5. County or local government, within the range of the St. Andrew beach mouse, have regulations or other protection mechanisms that:
   a) Minimize impacts to dunes in beach mice habitat due to recreational use.
   b) Prohibit free-roaming cats and cat colonies.
   c) Minimize impacts of commercial and residential developments in primary, secondary, and scrub dunes. Measures include minimizing footprints; preserving connectivity between primary, secondary and scrub dunes; using native landscaping; and constructing boardwalks over dunes for beach access.
   d) Minimize impacts of artificial lighting in beach mice habitat by requiring sea turtle lighting, in areas visible from the beach and wildlife lighting, in areas not visible from the beach.
6. Emergency response plan is prepared to prevent extirpation of any population of St. Andrew beach mice from tropical storms/hurricanes and other disasters.
7. If determined to be necessary, an Action Plan is prepared to address the potential threat of cross-breeding with Choctawhatchee beach mice from W. Crooked Island.
8. Capture of house mice in beach mouse habitat shows a declining trend over a period of 10 years and no new infestations are found within the range of the St. Andrew beach mouse.

Removal from the List of Endangered and Threatened Species (Delisting)

1. A stable or increasing population trend is maintained at St. Joseph Peninsula State Park, East Crooked Island on Tyndall Air Force Base, and St. Joe Beach over a 20-year period based on data obtained from accepted, standardized, monitoring methods.

2. An additional viable population is reestablished at Cape San Blas, Eglin Air Force Base, and has a stable or increasing population trend over a 10 year period based on data obtained from standardized monitoring methods.
3. At least 87% of designated St. Andrew beach mice critical habitat is protected and under a management plan that addresses conservation of beach mice, priority is given to those lands that provide connectivity. The plans, at a minimum, manage for the following:
    a) Impact of commercial/residential development and recreational use including pedestrians and motorized vehicles to beach mice habitat..
    b) Impact of shoreline erosion to beach mice habitat.
    c) Impact of artificial lighting on beach mice habitat.
    d) Control of feral cats and hogs, including free ranging cats in beach mice habitat
4. Non-native predators, including free roaming cats and cat colonies, are controlled within all critical habitat that is protected and under a management plan at levels that they do not pose a threat to beach mice.
5. County or local government regulations or other protection mechanisms as set forth in the downlisting criteria for Factor D have adequate compliance and enforcement.
6. No captures of house mice occur during standard monitoring for 5 years.

Actions Needed:

1. Monitor status of existing populations and reestablish populations of St. Andrew beach mice.
2. Identify, protect, evaluate and restore St. Andrew beach mouse habitat.
3. Remove or investigate non-native predator threat to St. Andrew beach mice populations.
4. Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands.
5. Remove, minimize, or investigate other natural or manmade threats.
6. Facilitate stewardship of St. Andrew beach mice recovery through increased public awareness and education.

Estimated Cost of Recovery: The implementation of recovery tasks, from which cost estimates can be made over a 5-year period of recovery effort will total approximately $**2,093,500**.

Cost Estimate (in thousands)							
Year	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Yearly Total
FY1	80	92	52	27	298.5	47	596.5
FY2	235	105	34	7	206	20	607
FY3	255	70	24	2	56	10	417
FY4	80	77	24	2	31	10	224
FY5	80	77	24	2	56	10	249
Grand Totals	730	421	158	40	647.5	97	2093.5

Date of recovery: The estimated date for recovery completion is 2029, provided that funds are available to accomplish the required recovery actions and that the recovery criteria are met.

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PART I. BACKGROUND

A. Status of the Species

The St. Andrew beach mouse (*Peromyscus polionotus peninsularis*) was federally listed as endangered on December 18, 1998 (63 FR 70053). Prior to Federal listing, the Florida Fish and Wildlife Conservation Commission (FWC) listed the St. Andrew beach mouse (SABM) as endangered (Chapter 39-27.002 FL Admin. Code). This subspecies has a recovery priority of 3c, meaning it has a high degree of threat, high potential for recovery, and it is a subspecies.

The Service determined, at the time of listing, it was not prudent to designate critical habitat for this subspecies. On September 29, 2003, the Center for Biological Diversity filed suit against the Service alleging that the Service violated the Endangered Species Act by failing to designate critical habitat for the St. Andrew beach mouse. In response to this litigation, the Service agreed to reevaluate their critical habitat determination. Critical habitat was designated on October 12, 2006 (71 FR 60238).

An attempt was made to quantify the percent decline of this subspecies when it was listed. Analysis of historic habitat showed approximately 41 linear miles (mi) (66 kilometers (km)) of suitable habitat encompassed the range of the mouse (63 FR 70053). By the mid 1990s only about 12.4 mi (20 km) of St. Joseph Peninsula were known to be occupied (Gore, *in litt*., 1994, 1995). This indicated a 68% reduction in its historic distribution (63 FR 70053). An effort to reestablish a population of the St. Andrew beach mouse at East Crooked Island, Bay County, Florida, was initiated around the time of listing (Moyers *et al.* 1999); however, the above figure did not take this into account since the success of the reintroduction was not known at the time (63 FR 70053).

The best documentation of the species' decline can be seen from trapping and/or tracking surveys[1] conducted at various times throughout its range. By the mid- to late 1980s, concerns were raised when trapping efforts failed to result in captures at West Crooked Island (Gore, *in litt*., 1987). By 1990 the St. Andrew beach mouse appeared to occupy only a small portion (approximately 11.8 mi (18 km)) of its original range: the west end of East Crooked Island and within St. Joseph Peninsula State Park (Gore, *in litt*., 1990). The St. Andrew beach mouse's apparent decline was observed into the mid-1990s. In 1994 the population on East Crooked Island was "presumed to be extinct" (Wooten and Holler 1999), leaving only one known population on St. Joseph Peninsula (Moyers *et al.* 1999), occupying only the northern portion of the peninsula (Gore, *in litt*., 1994, 1995). Subsequent reintroduction efforts in 1997-1998 appear to have reestablished a population on East Crooked Island (Moyers *et al.* 1999). Of the 83.3 km estimate of current suitable habitat within the historic range of the SABM, 44.5 km remains occupied. (Loggins et.al 2008).

[1] The surveys presented herein had variable effort and coverage. As a result, the absence of mice can not be definitively stated, unless extensive survey effort and coverage were conducted at that site. Results presented here are based on the stated results of the cited literature.

Like the other beach mouse subspecies found along the northern Gulf coast the main threats to this subspecies include coastal development, recreational use of dunes, hurricanes (James 1992, Holler 1992), and non-native predators, particularly feral cats (Bowen 1968, Humphrey and Barbour 1981, Van Zant and Wooten 2003

B. Species Description and Taxonomy

The St. Andrew beach mouse is a member of the genus *Peromyscus*. *Peromyscus* can usually be identified "by their large ears and eyes and their white underparts" (Whitaker and Hamilton 1998). Within the genus *Peromyscus, Peromyscus polionotus*, oldfield mice (James 1992), are differentiated from other *Peromyscus* by their small body size and their small hind feet, usually 0.71 inches (in) (18 millimeters (mm)) or less. They are further differentiated by their light pelage (fur) and their habitation of sandy soils in the southeast (Whitaker and Hamilton 1998). There are 16 recognized subspecies of *Peromyscus polionotus*; of these subspecies eight are adapted to living in dune ecosystems (James 1992). These subspecies are commonly called "beach mice" (Howell 1939). The St. Andrew beach mouse is one of five subspecies of beach mice that inhabit the northern Gulf of Mexico coast, hereafter, Gulf coast (James 1992). It was first described and given its trinomial name (*P. p. peninsularis*) by Howell (1939) based on a type (location) specimen taken from St. Andrew Point Peninsula (located on what is currently referred to as East Crooked Island) in Bay County, Florida.

All beach mice are characterized by white feet, large ears, and large black eyes (Hall 1981). The St. Andrew beach mouse's fur is a pale, buff/brown color on its head and back with extensive pure white coloration on its underparts, sides, feet, face, and tail (Howell 1939). They have two distinct rump color patterns, tapered or squared (Bowen 1968). Their average size is: head and body length, 2.95 in (75 mm); tail length, 2.05 in (52 mm); and hind foot length, 0.73 in (18.5 mm) (James 1992).

Beach mouse subspecies can be differentiated from each other by the non-overlapping geographic distributions of the subspecies and pelage coloration (Bowen 1968). Howell (1939) noted that the St. Andrew beach mouse is more similar in appearance to the Santa Rosa beach mouse (*P. p. leucocephalus*) than the other Gulf coast subspecies, but it is darker in coloration on its ears and back.

The sub-specific classification of beach mice was based on the geographic variations in pelage characteristics and skeletal measurements. These variations were thought to be genetically based (Bowen 1968). Wooten and Holler (1999) conducted genetic analyses, using microsatellite data to look at the historic relationship of the two known populations of St. Andrew beach mouse (St. Joseph Peninsula State Park and Crooked Island) and the population of Choctawhatchee beach mouse (*P. p allophyrs*) found on Shell Island in Bay County. Their results indicated a rather complex genetic relationship between these populations. When comparing the alleles of the three populations they found the St. Joseph Peninsula State Park population's alleles were unique and its allele frequencies are substantially different from that of the Choctawhatchee beach mouse population on Shell

Island. They found, however, that all the alleles of the St. Andrew beach mouse population on Crooked Island were found in both of the other two populations. Furthermore, they found two of the alleles were "uniquely shared" with either the St. Andrew beach mouse population on St. Joseph Peninsula State Park or the Choctawhatchee beach mouse population on Shell Island. These results revealed that beach mice inhabiting Crooked Island East historically may have had some genetic exchange with beach mice inhabiting Shell Island (Choctawhatchee beach mice). However, the analyses did not suggest that beach mice inhabiting Crooked Island East should not be classified as St. Andrew beach mice. Recent genetic research, based on DNA sequencing, (Van Zant 2006) suggests that Crooked Island East was historically inhabited by Choctawhatchee beach mice, contradicting the accepted historic ranges of the subspecies. These findings have yet to be peer reviewed.

C. Population Trends and Distribution

The St. Andrew beach mouse is the eastern most beach mouse subspecies occurring along the northern Gulf coast (James 1992). Based on historic collection records from St. Andrew Point, Cape San Blas, St. Joseph Spit, locations near the town of Port St. Joe and near Money Bayou, Bowen (1968) constructed the currently accepted historic range for the St. Andrew beach mouse. Its range is defined as extending from the East Pass of St. Andrew Bay (Crooked Island) in Bay County, Florida, southward along the mainland coastline adjacent to St. Joseph Bay, to St. Joseph Peninsula and east to Money Bayou along the Gulf of Mexico in Gulf County, Florida (Bowen 1968, James 1992) (Figure 1).

Figure 1. Historic range of the St. Andrew beach mouse (*Peromyscus polionotus peninsularis*). General range is depicted in shaded area. Shoreline data depicted in the map is based on 1993 data.

Prior to the 1980s, there were two known populations of St. Andrew beach mice. One population was found on St. Joseph Peninsula, which included St. Joseph Peninsula State Park, and the other was located on the eastern portion of Crooked Island (Moyers *et al.* 1999). In 1975, Hurricane Eloise fragmented Cooked Island into two separate land bodies, forming eastern and western segments now known as East Crooked Island and West Crooked Island, respectively (James 1987, Moyers *et al.* 1999). Trapping efforts conducted by Tyndall Air Force Base (AFB) in 1985 and 1986 on West Crooked Island failed to capture any mice (Gore, *in litt*., 1987). Moyers *et al.* (1999) reported that no St. Andrew beach mouse tracks had been found on West Crooked Island as recently as 1998 (Figure 2). During the mid to late 1980s, trapping and track survey efforts conducted on East Crooked Island showed mice were still present on the eastern segment of the island (Gore, *in litt*., 1987, 1990; James 1987; Figure 2). By 1992-1993, trapping efforts were unsuccessful in producing captures of St. Andrew beach mice on East Crooked Island and the population was, therefore, thought to be extirpated (Gore, *in litt.*, 1994; Alabama Cooperative Fish and Wildlife Research Unit, *in litt*., 1997). Due to the apparent extirpation of the Crooked Island population, leaving only one known population of St. Andrew beach mice at St. Joseph Peninsula, concern for the subspecies' conservation grew. The Service gave high priority to the reestablishment of a second population on East Crooked Island (Moyers *et al.* 1999). Plans to reintroduce St. Andrew beach mice, using individuals from the St. Joseph Peninsula State Park population, were initiated in 1994 (Moyers *et al.* 1996; Figure 2). Reintroduction

of 43 individuals from St. Joseph Peninsula State Park took place in November 1997 (16 individuals) and January 1998 (27 individuals), and December 1998 (4 individuals). Subsequent monitoring efforts to assess the effectiveness of the reintroduction resulted in the capture of 38 individuals in February 1998 and 34 individuals in May 1998 (Moyers *et al.* 1999). Trapping efforts in 2000 and 2002 resulted in the capture of 132 individuals and 41 individuals, respectively (Lynn, unpub. data 2000a; Lynn, *in litt*., 2002). Furthermore, in April 2001, 55 St. Andrew beach mice were captured on private lands south of Tyndall AFB property (Moyers and Shea, *in litt*., 2002). Recent work by the Florida Fish and Wildlife Conservation Commission (FWC) have found St. Andrew beach mice on the Tyndall AFB property of East Crooked Island (Slaby, *in litt*., 2005). Surveys conducted on East Crooked Island between May 2005 and January 2007 found beach mice were present on Tyndall AFB property and also on adjacent private lands southeast of Tyndall AFB property (Loggins *et al*., *in litt*., 2007). Loggins *et al*. (*in litt*., 2007) estimated an average of 59.5 +/- 4% of East Crooked Island was occupied by St. Andrew beach mice. These results seem to indicate that St. Andrew beach mice have become reestablished on East Crooked Island.

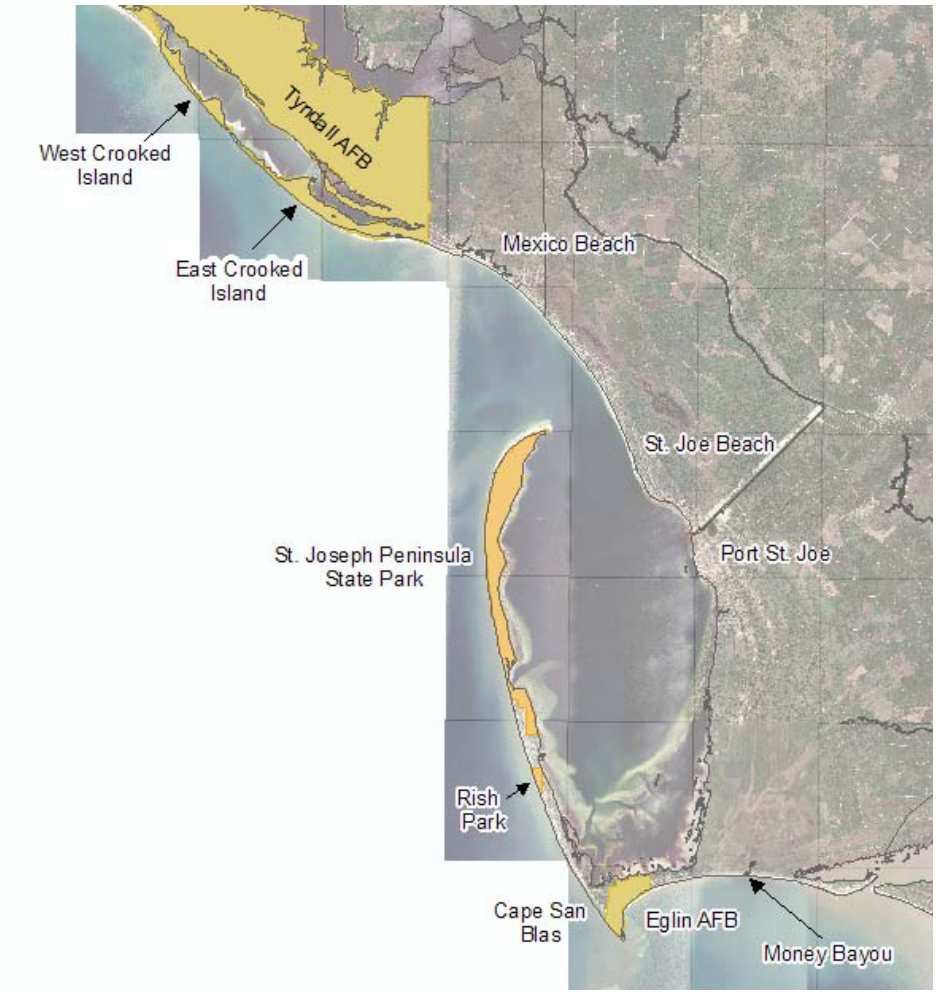

Figure 2. Reference location map within the range of the St. Andrew beach mouse.

Trapping and track surveys were also conducted on St. Joseph Peninsula from the mid 1980s through the early 2000s. These efforts showed a continued presence of St. Andrew beach mice on St. Joseph Peninsula State Park (James 1987; Gore, *in litt*., 1990, 1995; Bates 1992; Moyers *et al.* 1996, 1999; Loggins *et al*., *in litt*., 2007). South of the Park and at Cape San Blas, Gore (*in litt*., 1990) was unable to capture any St. Andrew beach mice during his trapping effort in 1989. In 1992 and 1993, St. Andrew beach mice were captured south of the Park and north of Cape San Blas (Gore, *in litt*., 1994). Trapping in 1996, at Rish Park and neighboring private parcels, showed a continued presence of St. Andrew beach mice south of the St. Joseph Peninsula State Park, (Holler, *in litt*., 1996; Loggins *et al*., *in litt*., 2007; Figure 2). In November 2004, track surveys south of the Park showed a presence of beach mice from the Park boundary south to approximately the "stump hole" (the area on the Peninsula, just north of Cape San Blas, where the peninsula constricts (Figure 3)) vehicle access point at the reinforced rock portion of Highway 30E (J. Gore, FWC, pers. comm., 2005). Surveys conducted again between 2005 and 2007 south of the Park showed a presence of mice (Loggins *et al*., *in litt*., 2007). Tracking surveys in 2005 by the FWC showed that mice were present at St. Joseph Peninsula State Park (Slaby, *in litt*. 2005). Surveys conducted between May 2005 and April 2006 within the State Park showed the continued presence of beach mice (Loggins *et al*., *in litt*., 2007). Loggins *et al*. (*in litt*., 2007) estimated an average of 61.0 +/- 9% of St. Joseph Peninsula State Park was occupied by St. Andrew beach mice.

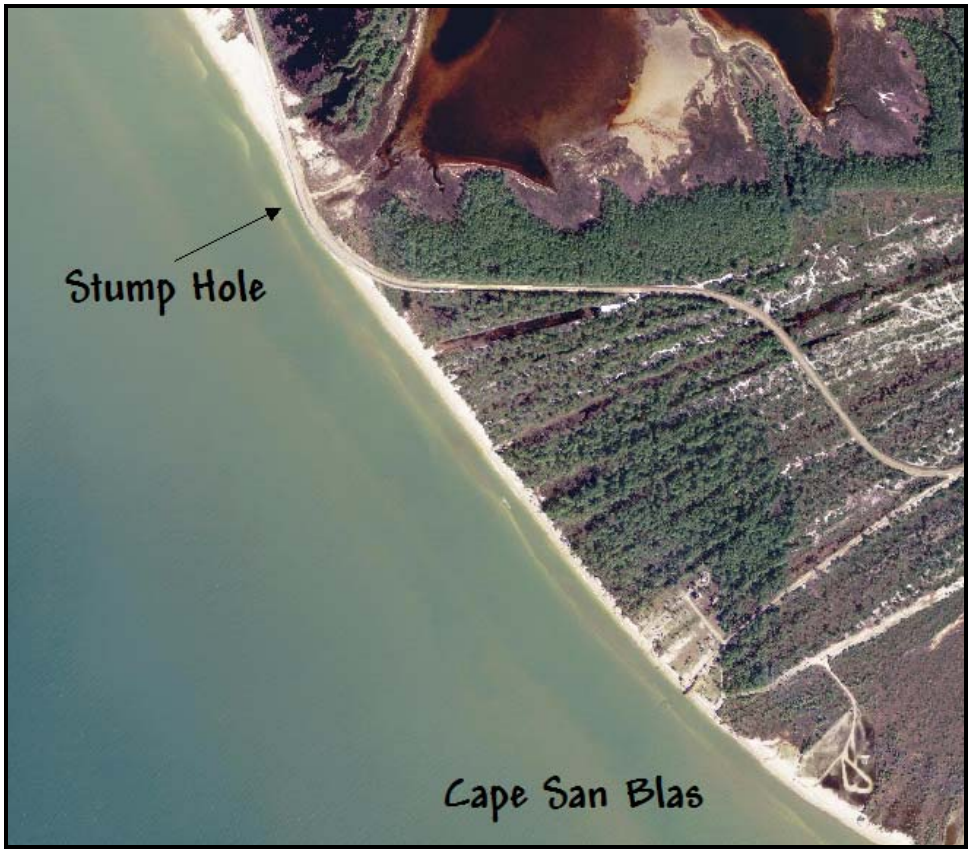

Figure 3. "Stump hole" area north of Cape San Blas.

Track and/or trapping surveys were conducted outside areas supporting the two known populations of St. Andrew beach mice. None of these other survey efforts were successful in identifying mouse activity or capturing St. Andrew beach mice (James 1987, between Tyndall AFB and St. Joseph Peninsula State Park in 1987; Gore, *in litt*., 1990, east of Mexico Beach in 1988; Gore, *in litt*., 1994, at Money Bayou in 1989, and again east of Mexico Beach in 1990 and 1992; Lamont *et al.* 1997, at Cape San Blas, Eglin Air Force Base (AFB) in 1994; Moyers and Shea, *in litt*., 2002, at St. Joe Beach and at Dixie Bell Curve, Gulf County in 2001; and J. Gore, pers. comm., 2005, from Money Bayou area to Cape San Blas area, Eglin AFB in November 2003; Loggins *et al*., *in litt*., 2007, at Cape San Blas, Eglin AFB in May 2006; Figure 2).

Over time, the eastern end of Shell Island has slowly expanded southward, due to accretion of sand. This resulted in the complete connection of West Crooked Island and Shell Island at East Pass in 1998 (Lynn *in litt*., 2004). This land bridge provided the opportunity for Choctawhatchee beach mice inhabiting Shell Island to expand their range into the unoccupied northern-most historic range of the St. Andrew beach mouse on West Crooked Island (Moyers *et al.* 1999). Subsequently, tracks, possibly from beach mice, were seen on the east side of the closed pass (J. Gore and G. Wallace, FWC, pers. comm., 2000; Lynn *in litt*., 2004; J. Mobley, Tyndall Air Force Base, pers. comm., 2000; L. Patrick, FWS, pers. comm., 2000). The presence of Choctawhatchee beach mice on West Crooked Island was confirmed by trapping in 2000 and continued to persist on West Crooked Island based on trapping in 2002 ,2003 and 2007(Lynn, *in litt*., 2004). Recent trapping and tracking tube work (Loggins et al. 2008) confirms the presence of SABM in 2008.

D. Life History/Ecology

Basic life history and ecology information for the St. Andrew beach mouse is limited. Where possible, we used published information specifically on the St. Andrew beach mouse; where this is not possible, information was taken from the published literature for other Gulf Coast beach mouse subspecies.

Reproduction. Studies suggest that *P. polionotus* are generally monogamous (Foltz 1981, Lynn 2000b), apparently forming pair bonds for life (Blair 1951). It appears, however, that some paired males may also mate with unpaired females (S. Sneckenberger, FWS, pers. comm., 2005). Breeding activity is greatest during the fall and winter months (Blair 1951, Rave and Holler 1992).

Female *P. polionotus* can become sexually mature as early as around 30 days old (Clark 1938). Gestation ranges from 23 to 24 days or 25 to 31 days for lactating females (Whitaker and Hamilton 1998). Litters average 3-4 in size, but can range from one to five individuals, with litter size tending to be positively correlated to female size (Caldwell and Gentry 1965a). Over a lifetime, under laboratory conditions, a female beach mouse can produce 80 young or more (Bowen 1968).

Longevity. Rave and Holler (1992) found, of the mice they trapped, 63% of the mice lived 4 months or less, 37% lived 5 months or longer, and 21 individual mice lived 12-20 months

beyond first capture. There is no significant difference in survival rates between males and females. However, mice that disperse from their natal grounds persisted significantly longer (males: 138 ± 19 days; females: 125 ± 18 days) than mice that remain in their natal grounds (males: 96 ± 10 days; females: 92 ± 8 days) (Swilling 2000).

Population dynamics. Demographic data from beach mouse populations in Alabama suggest a 10-year cycle of fluctuation (Appendix C) (Auburn University, Unpublished data; Swilling et al. 1998; Sneckenberger 2001). The physical and biological cues influencing the population fluctuations are not known. Rainfall patterns and trends in food resource availability may be involved as they have widespread effects on beach mouse populations. Food resource levels affect survival, reproduction and rainfall patterns, which determine water table levels and the flooding and drying of wetlands, influence the amount of habitat available to beach mice.

Movements. *P. polionotus* exhibit a typical nocturnal behavior (Wolf and Esher 1978). Beach mice are most active during stormy, rainy, and dark nights, while their activity levels decreased during periods of increasing moonlight (Blair 1951). Under periods of the full moon, *P. polionotus* surface activity decreased by around 70%. Furthermore, under a three-quarter moon, half moon, and quarter moon, surface activity levels decreased by 56%, 32%, and 23%, respectively (Wolfe and Summerlin 1989).

Swilling and Wooten (2002) looked at the dispersal distance of subadult Alabama beach mice (*P. p. ammobates*). They found the average dispersal distance was 525.6 +/- 853.0 feet (ft) (160.2 +/- 260.0 meters (m)). The average dispersal distance of Santa Rosa beach mice was 1415 +/- 89 ft (431.3 +/- 27 m), with a minimum distance of 980 ft (299 m) and a maximum distance of 1970 ft (600 m) observed (Blair 1951).

Home range. Beach mice appear to inhabit a single home range during their lifetime (Blair 1951). The sizes of home ranges reported by others varied among species/subspecies and technique used to determine home range size. The mean home range size of Santa Rosa beach mice ranged from 1.97 +/- 0.26 acres (ac) (0.80 +/- 0.11 hectares (ha)) to 10.66 +/- 1.46 ac (4.31 +/- 0.59 ha) (Blair 1951). Blair found that home range size was significantly larger during the spring than during the fall in both beach-dune habitat and open areas (4.28 +/- 1.67 ac (1.73 +/- 0.68 ha)). Based on trapping data, Swilling and Wooten (2002) found that the mean home range size of Alabama beach mice was 0.89 ac (0.36 ha). Lynn (2000b) also used trapping data to determine the mean home range size of Alabama beach mice. He found the mean home range size of males was 1.01 +/- 0.16 ac (0.41 +/- 0.06 ha) and for females, 1.36 +/- 0.19 ac (0.55 +/- 0.08 ha). Looking at home range sizes based on trapping data, Novak (1997) found the mean home range size of Choctawhatchee beach mice was 0.78 +/- 0.93 ac (0.32 +/- 0.38 ha). Radio telemetry has also been used for calculating home range size of *Peromyscus*. The results have been found to be comparable to that of live trapping (Wolff 1985). Therefore, Lynn (2000b) also calculated home range size using radio telemetry. His results showed the mean home range size for males was 1.68 +/- 0.27 ac (0.68 +/- 0.11 ha) and for females, 1.73 +/- 0.39 ac (0.70 +/- 0.16 ha)

Females, on average, were less concentrated (individuals/home-range area) than males. Males were most concentrated in May (4.24 resident males/home-range area) and least concentrated during November (1.92 resident males/home-range area). Females were most concentrated in late December (2.56 individuals/home-range area) and least concentrated during early November (1.36 individuals/home-range area) (Blair 1951).

Burrows. Beach mice usually maintain a few burrows (S. Sneckenberger, FWS, pers comm. 2006), often located near the base of a shrub, grass clump or other type of vegetative cover, within their home range (Blair 1951). When constructing a burrow, beach mice appear to select sites with lower soil compaction, steeper dune slopes, greater vegetative cover, more stable daily soil temperatures, higher soil moisture content, and greater height above sea level (Lynn 2000b, Sneckenberger 2001). Ehrhart (1978) found the burrows of the Pallid beach mouse (*P. p. decoloratus*) were made up of three main parts: "1) the entrance tunnel, usually descending obliquely for some distance and then continuing straight into the bank, 2) a nest chamber, formed at the end of the level portion of the entrance tunnel at a depth of 0.6 to 0.9 m. (2-3 ft.), and 3) an 'escape tunnel,' which rises steeply from the nest chamber to within about 2.5 centimeters (cm.) (1 in.) of the surface."

Food Habits. The frontal dunes provide a more diverse food resource for the beach mouse than does the scrub habitat, although the food is cyclic in its availability. Scrub dunes provide a more stable, but less diverse, food source and are believed to provide a food source for times when food resources in the frontal dune systems are low (Sneckenberger 2001). Sneckenberger (2001) found no significant difference in the calorie, protein, or fat content of the food plants in each habitat. Diets are driven by the availability of food within the habitat and food item shifts both seasonally and yearly (Moyers 1996).

No diet studies have been conducted on St. Andrew beach mice specifically; however, studies have been conducted on other beach mice subspecies along the northern Gulf Coast (Blair 1951, Ehrhart 1978, Holler 1992, Moyers 1996). Moyers (1996) found that the diets of Perdido Key beach mouse (*P. p. trissyllepsis*), Alabama beach mouse, and Santa Rosa beach mouse were similar (Moyers 1996).

Bluestem (*Schizachyrium scoparium*) and sea oats (*Uniola paniculata*) were most frequently visited (Blair 1951); however, Moyer (1996) found beach mice showed no preference to any food item, instead their selection of food items appeared to be based on availability. The seeds of sea oats and bluestem and the fruits of dune spurge (*Chamaesyce bombensis*), ground cherry (*Physalis angustifolia*), and evening primrose (*Oenothera humifusa*) are utilized in autumn, while sea rocket (*Cakile lanceolata*), dune toadflax (*Linaria floridana*), and evening primrose make up the spring diet (Moyers 1996). Furthermore, insects, primarily Coleoptera beetles (Holler 1992), fire ants (*Solinopsis invicta*) and harvester ants (*Pogonomyrmex badius*) (Moyers 1996) have been found to make up a part of the beach mouse diet (Ehrhart 1978, Moyers 1996).

E. Habitat Characteristics/Ecosystem

The coastal dune ecosystem is comprised of a series of dunes and intervening areas referred to as frontal dunes (comprised of the primary and secondary dunes), inter and intra-dunal swales, and scrub dunes (Figure 4). The frontal dunes are closest to the shoreline. They are the most recently formed dunes, and are highly dynamic. Beach mice inhabit the complex of coastal dune systems composed of frontal dunes and adjacent inland scrub dunes (Blair 1951, Bowen 1968, Holliman 1983, Holler 1992, James 1992, Moyers *et al.* 1996, Sneckenberger 2001).

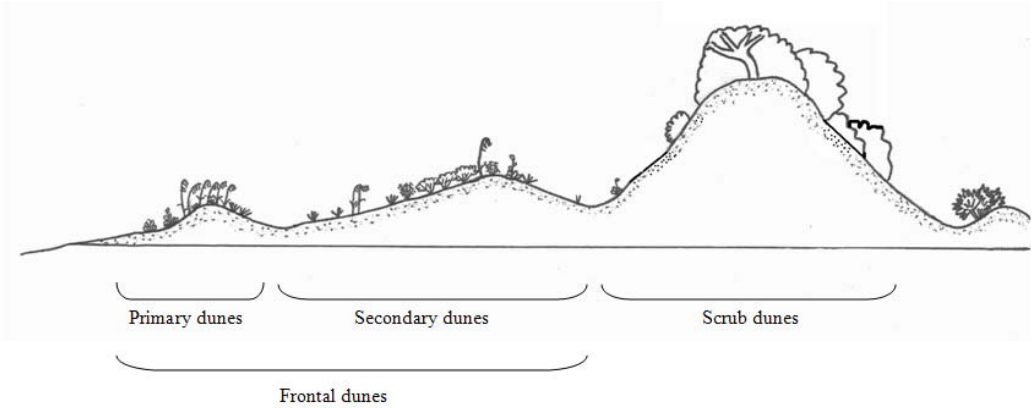

Figure 4. Generalized dune system profile for the Gulf Coast.

The final listing rule provides a detailed description of the dune habitat in which this subspecies occurs (63 FR 70053):

> "The foreslope of primary dunes grades into the developing frontal dunes on the open beach. Frontal dunes on the Gulf Coast are sparsely vegetated, usually by sea oats (*Uniola paniculata*), bluestem (*Schizachyrium maritimum*), beach grass (*Panicum amarum*), and sea rocket (*Cakile constricta*). Primary dunes also support stands of these species and include other broad-leaved plants such as seaside pennywort (*Hydrocotyle bonariensis*), seashore elder (*Iva imbricata*), and beach morning glory (*Ipomea stolonifera*) (Clewell 1985). Secondary dunes consist of one or more dune lines landward of the primary dune with a similar, though denser, vegetative cover. Interdunal swales are wet or dry depressions between primary and secondary dunes, while intradunal swales occur within primary dunes as a result of wave action, storm surges, and wind erosion. Wet swales are those whose water table is at or near the surface. Swale vegetation includes plants found on primary and secondary dunes as well as salt meadow cordgrass (*Spartina patens*), rushes (*Juncus* sp.), sedges (*Cyperus* sp.), and saltgrass (*Distichlis spicata*). Scrub dunes are the oldest of the dune habitat types and are dominated by woody plants including saw palmetto (*Serenoa repens*), myrtle oak (*Quercus myrtifolia*), sand live oak (*Q. geminata*), sand pine (*Pinus clausa*), slash pine (*P. elliottii*), seaside rosemary (*Ceratiola ericoides*), greenbrier (*Smilax* sp.), and bush goldenrod (*Chrysoma pauciflosculosa*). Reindeer moss (*Cladonia leporina*) often covers otherwise bare dune surfaces. Some primary and secondary dune vegetation is also present but at reduced densities (Blair 1951, Gibson and Looney 1992). Size and density of understory and overstory vegetation may vary."

The primary and secondary dunes were considered optimal beach mice habitat since it is there that the mice were thought to generally reach their highest densities (Blair 1951, Meyers 1983, Holler 1992). Because the scrub dunes appeared to support lower densities of beach mice, this habitat was believed to be of lower quality (Blair 1951, Bowen 1968). As a result, the scrub dunes were not considered to be of great importance to beach mice (Swilling 2000) and little attention was paid to this habitat (Sneckenberger 2001). More recent research has illustrated that beach mice use interior scrub habitat on a permanent basis, and that this habitat has an invaluable role in the persistence of beach mouse populations after storm events (Swilling *et al.* 1998; Sneckenberger 2001). Recent studies have also shown no significant difference between the two habitat types in availability of food resources or burrow sites, beach mouse body mass, survival rate, reproductive rate, and home range size (Swilling 2000; Sneckenberger 2001).

The habitat in which the two known/primary populations of St. Andrew beach mice occur differ primarily in the dune structure. In St. Joseph Peninsula State Park the mice inhabit "well-developed high front dunes," where sea oats are the dominant plant cover and the higher secondary dunes are vegetated by sea oats and rosemary (James 1992; Figure 5). The high primary dunes, in which mice were found, were made up of a matrix of open sand and herbaceous cover (James 1987). On Crooked Island, the mice inhabit the low frontal dunes and even lower secondary dunes that are vegetated by bunch grass (*Andropogon*) and beach grass (*Panicum*) (James 1992; Figure 6).

Figure 5. Dune habitat at St. Joseph Peninsula State Park. Photo by Paul A. Lang/FWS

Figure 6. Dune habitat on East Crooked Island. Photo by Paul A. Lang/FWS

Loggins et al. (2008) conducted surveys of beach mice habitat (primary, secondary and scrub dune habitats) along the St. Joseph Peninsula, at Eglin AFB's Cape San Blas property, and across East Crooked Island between May 2005 and January 2007. They described the habitat at each of the sites surveyed as follows: East Crooked Island, the habitat was "generally of good quality"; Cape San Blas, the habitat was "narrow and generally of poor quality"; St Joseph Peninsula south of the State Park, the habitat was "highly fragmented and of varying quality"; St. Joseph Peninsula State Park, the habitat quality was not noted; however, mice were detected in all habitats surveyed, likely indicating higher quality habitat. Ideal habitat is best described as an undisturbed, intact and functioning system of unconsolidated marine substrate, beach sand, primary natural sand dunes, secondary and scrub dunes.

F. Critical Habitat

Critical habitat was designated for the St. Andrew beach mouse on October 12, 2006 (71 FR 60238). Based on our current knowledge of the life history, biology, and ecology of the species and the requirements of the habitat to sustain the essential life history functions of the species, we have determined that the critical habitat primary constituent elements (PCE) for Gulf Coast beach mice include:

1. A contiguous mosaic of primary, secondary and scrub vegetation and dune structure, with a balanced level of competition and predation and few or no competitive or predaceous nonnative species present, that collectively provide foraging opportunities, cover, and burrow sites.

2. Primary and secondary dunes, generally dominated by sea oats that despite occasional temporary impacts and reconfiguration from tropical storms and hurricanes provide abundant food resources, burrow sites, and protection from predators.

3. Scrub dunes, generally dominated by scrub oaks, that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane induced storm surge.

4. Functional, unobstructed habitat connections that facilitate genetic exchange, dispersal, natural exploratory movements, and recolonization of locally extirpated areas.

5. A natural light regime within the coastal dune ecosystem, compatible with the nocturnal activity of beach mice, necessary for normal behavior, growth and viability of all life stages.

We have designated critical habitat on lands that have been determined to be essential to the conservation of St. Andrew beach mice. An area is considered essential if it possesses one or more of the primary constituent elements and one of the following characteristics: (1) supports a core population of beach mice; (2) was occupied by St. Andrew beach mice at the time of listing; or (3) is currently occupied by the beach mouse and is an area essential to the conservation of the species because it represents an existing population needed for conservation.

Three units were designated for the St. Andrew beach mouse: East Crooked Island Unit (SABM-1) in Bay County, Palm Point Unit (SABM-2) in Gulf County, and St. Joseph Peninsula Unit (SABM-3) in Gulf County (Figure 6).

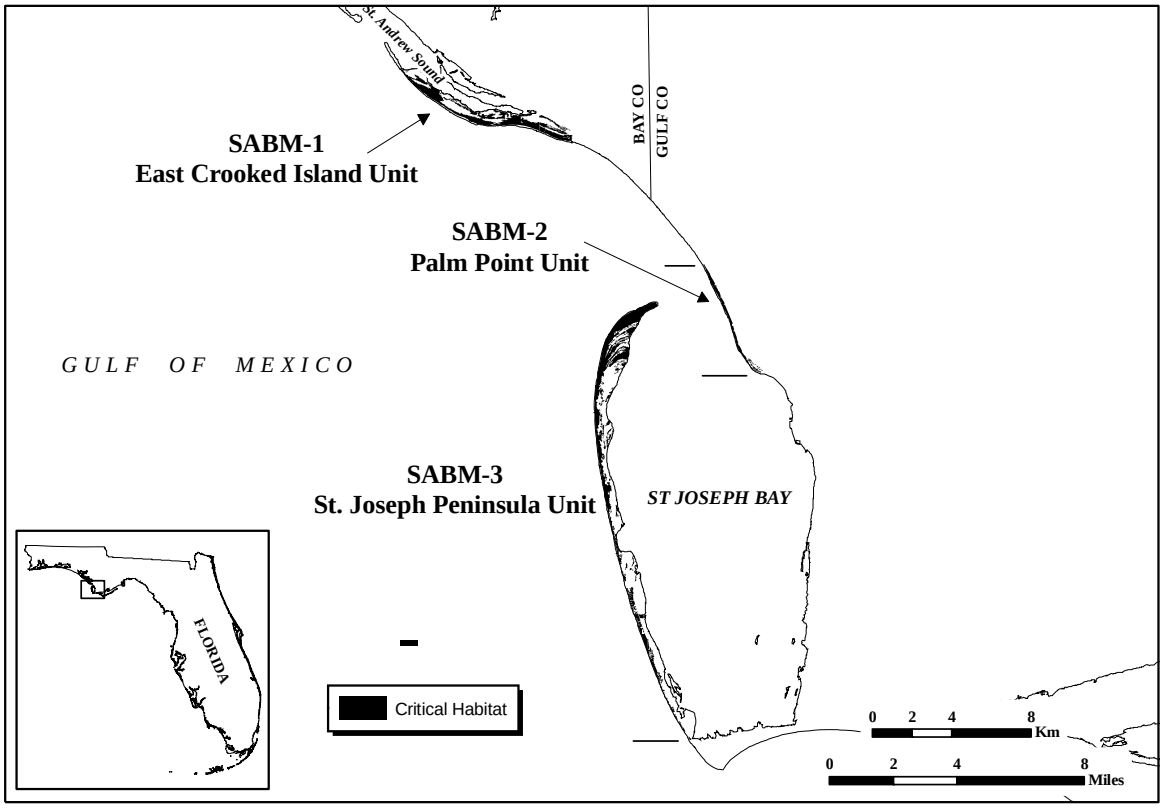

Figure 6. Critical habitat units for the St. Andrew beach mouse.

The three units total 2,490 acres (1,008 ha) found on Federal, State and Local or Private land within Bay and Gulf counties (Table 1).

Table 1. Critical habitat units designated for the St. Andrew beach mouse

St. Andrew Beach Mouse Critical Habitat Units	Federal Acres	State Acres	Local and Private Acres	Total Acres
1. East Crooked Island Unit	649	0	177	826
2. Palm Point Unit	0	0	162	162
3. St. Joseph Peninsula Unit	0	1280	222	1502
Total	649	1280	561	2490

The East Crooked Island Unit (SABM–1) consists of 826 acres in Bay County, Florida. This unit encompasses essential features of beach mouse habitat on East Crooked Island from the entrance of St. Andrew Sound to 1 mi (1.6 km) west of Mexico Beach, and the area from the MHWL (mean high water line) to the seaward extent of the maritime forest (not including Raffield Peninsula). Beach mouse habitat in this unit consists of primary, secondary, and scrub dune habitat and possesses all five PCEs. St. Andrew beach mice were known to inhabit the unit in 1986 and 1989 (James 1992), though the population was presumably extirpated after 1989 due to impacts from hurricanes. The East Crooked Island population

was reestablished with donors from St. Joseph State Park in 1997. This unit was occupied at the time of listing. Recent live-trapping confirms present occupation of mice (Moyers and Shea 2002, Service 2002b, Loggins et al. 2008). This unit maintains connectivity along the island and this unit is essential to provide a donor population following storm events.

The majority of this unit is federally owned (Tyndall AFB), while the remaining habitat is privately owned. Threats specific to this unit that may require special management considerations include artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational and military use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

The Palm Point Unit (SABM–2) consists of 162 acres of private lands in Gulf County, Florida. This unit encompasses habitat from Palm Point 1.25 mi (2.0 km) northwest of the inlet of the Gulf County Canal to the southeastern boundary of St. Joe Beach and the area from the MHWL to the seaward extent of the maritime forest. We consider beach mice to have been present in this unit at the time of listing, because St. Andrew beach mice were documented in the area by Bowen (1968). Since St. Andrew beach mouse habitat is limited to only two other areas, protecting this mainland site located within the species' historic range is needed for the subspecies' long-term persistence. As other viable opportunities are limited or nonexistent, this unit is essential to reduce the threats of stochastic events to this subspecies. Furthermore, as this unit is on the mainland, it is somewhat buffered from the effects of storm events. This area provides frontal and scrub dune habitat (PCEs 2 and 3), but may provide limited connectivity between habitats. Threats specific to this unit that may require special management considerations include habitat fragmentation, habitat loss, artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high residential use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

The St. Joseph Peninsula Unit (SABM–3) consists of 1,502 acres in Gulf County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of St. Joseph Peninsula State Park (Park) as well as south of the Park to the peninsula's constriction north of Cape San Blas (also known as the "stumphole" region) and area from the MHWL to the seaward extent of the maritime forest. Beach mouse habitat in this unit consists of primary, secondary, and scrub dune habitat, and provides a relatively contiguous expanse of habitat within the historic range of the St. Andrew beach mouse. This unit possesses all five PCEs and was occupied at the time of listing. St. Andrew beach mice were known to inhabit this unit in 1986 and 1987 (James 1992), 1989, 1992, 1993, and 1994 (Gore 1994). In addition, recent tracking efforts suggest that mice continue to occupy private lands south of the Park. The Park alone does not provide sufficient habitat to allow for population expansion along the peninsula, which may be necessary for a population anchored by the tip of a historically dynamic peninsula. A continuous presence of beach mice along the peninsula is the species' best defense against local and complete extinctions due to storm events. The population of St. Andrew beach mice inhabiting this unit appears to possess unique genetic variation and displays greater than expected genetic divergence from other populations (Wooten and Holler 1999).

Portions of this unit are managed by the Florida Park Service, while the remaining area is privately owned. Threats specific to this unit that may require special management considerations include artificial lighting, habitat fragmentation and habitat loss, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decreases in habitat quality. The population inhabiting this unit may also be particularly susceptible to hurricanes due to its placement within St. Joseph Bay (the peninsula is a thin barrier peninsula with a north–south orientation).

G. Reasons for Listing/Threats

Section 4(a) of the ESA set forth legislation for the listing of species that are determined to be either threatened or endangered with extinction. Threats to the species are identified at the time of listing by five general factors (referred to as "listing factors"). In order to create continuity between the final listing rule and the recovery plan, the threats that were identified at the time of listing are addressed below. Furthermore, changes to these threats are noted and any new threats are presented.

The primary threats to St. Andrew beach mice were noted as "severe storms, coastal land development and its associated activities, and non-storm related, natural shoreline erosion" (63 FR 70053). These continue to threaten the St. Andrew beach mice; however, additional threats have been identified. The known threats facing this subspecies are presented below.

Listing Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Land Development. Development continues to occur along the coastline of the Gulf of Mexico. Land development tends to destroy the secondary and scrub dunes (63 FR 70053). Typically, hurricanes wash away the primary dunes, leaving vast areas of open sand, where dunes once existed, and islands of secondary dunes surrounded by water. Beach mice appear to take refuge on these "islands" and within the scrub dunes (Swilling *et al.* 1998). It is from these dunes that the beach mice appear to repopulate the frontal dunes as they recover from a storm's impact (Swilling *et al.* 1998, Sneckenberger 2001). When development destroys or degrades these dune systems, beach mice are not able to find refuge from the storm's impact within these dune systems. Furthermore, land development can segregate the population into small groups isolating them from one another (Meyers 1983). Overall these could result in a greater likelihood that the population may be extirpated or reduced in numbers to a point that they may not be able to recover (63 FR 70053).

Military Exercises on East Crooked Island. In 1987, James (1987) noted that military exercises conducted on Tyndall AFB's lands on East Crooked Island were severely impacting the dune systems. These military exercises, noted at the time of listing, have ceased. Measures are in place to address other proposed military missions on East Crooked Island (see Conservation Measures).

Dune Encroachment. Dune encroachment by vehicles and pedestrians, in the form of driving on or walking over dunes, was identified as a threat to the St. Andrew beach mouse (63 FR 70053). These activities result in the destruction and/or degradation of the dune habitat, killing vegetation, and compaction of the soil (Figure 7). This leads to the potential for blowouts in the dunes from wave and wind action at these points (Kimball *in litt*., 1996). The degree or severity to which this occurs is dependent upon the type of activity and the inherent susceptibility of the system (Leatherman 1979).

Figure 7. Dune walkover by pedestrians showing impact to dune vegetation and dune structure. Photo by Paul A. Lang/FWS

Dune encroachment by vehicles and pedestrians still poses a threat; however, it is believed to be less now than at the time of listing (L. Patrick, pers. comm., 2005). This is due, in part, to management actions that have been conducted on public lands and beach driving regulations established on the St. Joseph Peninsula. Management actions like boardwalks (Figure 8), fencing (Figure 9), signage (Figure 10), etc., have been put in place on public beaches to protect the dunes from dune encroachment (J. Mobley, pers. comm., 2005; H. Mitchell, Florida Department of Environmental Protection (FDEP), pers. comm., 2005; L. Patrick, pers. comm., 2005). For more details on specific management actions related to dune encroachment, see Conservation Measures.

Figure 8. Boardwalk access to the beach (East Crooked Island, Tyndall AFB property). Photo by Paul A. Lang/FWS

Figure 9. Fencing to control and channel pedestrians through the dunes (St. Joseph Penninsula State Park). Photo by Paul A. Lang/FWS

Figure 10. Signage to manage pedestrian walking in the dunes (St. Joseph Penninsula State Park). Photo by Paul A. Lang/FWS

Natural Shoreline Erosion. Throughout the range of the St. Andrew beach mouse, non-storm related shoreline erosion and accretion is seen to some degree along parts of East Crooked Island (J. Gore, pers. comm., 2005), but is greatest from Cape San Blas to St. Joseph State Park (Foster and Cheng 2001). Approximately 485,000 cubic yards (370,809 m^3) per year of beach erodes annually along St. Joseph Peninsula and is re-deposited either at the tip of the Peninsula or at Cape San Blas. This is one of the highest rates within the State of Florida (Coastal Tech and Preble-Rish, Inc. 1998). Although shoreline erosion destroys habitat, it is considered a natural event in which the species that inhabit coastal systems have adapted. When combined with loss of habitat, mainly due to land development, this natural threat is exacerbated. The beach mice would naturally move further inland as the effects of erosion are seen in the frontal dune systems. When development destroys this inland habitat, the mice do not have anywhere to move (J. Gore, pers. comm., 2005).

The combination of impacts to beach mouse habitat can result in the reduction, fragmentation, and isolation of beach mouse populations. This prevents movement of individuals between habitat blocks, ultimately resulting in a reduction or lack of gene flow. This lack of gene flow can result in a reduction of the fitness of the population. Furthermore, fragmentation breaks up the population into small groups further isolating them and potentially making them more susceptible to extinction due to catastrophic events or the combination of cumulative threats (63 FR 70053).

Artificial Lighting. The effects of artificial lighting are well documented for sea turtles (Witherington and Martin 2003); however, the effects of artificial lighting within the habitat of the beach mouse have not been extensively studied. Natural illumination of the dune systems due to moon phases is known to have a direct effect on beach mouse activity. As natural illumination increases beach mice activity levels decrease (Blair 1951, Wolfe and Summerlin 1989). Bird *et al.* (2004) found that beach mice foraging behavior was altered as a result of artificial light. They found mice behavior was altered in two ways: 1) reduction in use of patches around illuminated areas, and 2) reduction in seed harvest. They also suggested that artificial lights may cause habitat fragmentation due to altered movement patterns.

Feral Hogs. As feral hog (*Sus scrofa*) populations continue to grow, more evidence of their destructive activities within the dune systems are being seen on some of the areas in which beach mice occur (J. Mobley, pers. comm., 2005). Feral hogs may pose a potential threat to beach mice, as they are not native to coastal areas, destroy to the habitat as they root-up large areas while foraging. However, little is known at this time as to the degree of the potential threat (J. Gore, pers. comm., 2005).

Listing Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

At the time of listing, this factor was not known to be applicable to the decline of the St. Andrew beach mouse. At the time of the writing of this recovery plan, this factor does not pose a threat to the beach mouse.

Listing Factor C. Disease or predation

Disease and parasites are not known to present a threat to the St. Andrew beach mouse. However, non-native predators, primarily feral cats, do pose a threat to beach mice (Bowen 1968; Humphrey and Barbour 1981; Gore, *in litt*., 1990; Moyers *et al.* 1996; Taylor *et al.* 2005). This threat in conjunction with other threats may result in "significant adverse impacts" to the St. Andrew beach mouse (63 FR 70053).

Feral/Cat Colonies/Free Roaming Domestic Cats. Bowen (1968) reported that feral cats were becoming such a problem that they discontinued trapping wherever they found cat tracks. In fact, they were unable to find any mice tracks or holes over a 2-mi (3.2-km) stretch that corresponded with a 1-mi (1.6-km) stretch of beach abundant with cat tracks. This was not an isolated incident; the results of data collected by Humphrey and Barbour (1981) supported this growing concern. In 2002, Van Zant and Wooten (2003) tracked a house cat for two days that consumed a beach mouse fitted with a radio collar. This added credence to the notion that feral cats preyed on beach mice. Gore (*in litt*., 1994) lists the introduction of house cats, in addition to habitat loss, as one of the "most serious threats to beach mice populations." When the effects of predation by domestic house cats on the Alabama beach mouse were modeled, the results showed a tremendous impact on the population.

Other Non-native Predators. Other non-native predators, such as red foxes (*Vulpes vulpes*) and coyotes (*Canis latrans*), are thought to be potential predators of beach mice (Meyers 1983, Van Zant and Wooten 2003). Their tracks have been seen within dune systems where St. Andrew beach mice are known to occur (Bates 1992). Non-natives move into natural systems for many reasons; vacuums created by the absence of native predators, non-natives out-compete natives and/or drive them off, high numbers of non-natives enter an area as a result of nearby development, etc. Both coyote and red fox are known to predate sea turtles and shorebird nests (Leland 1997, Daniel 2002, Northwest Florida Partnership 2002). However, the degree to which they pose a threat to the St. Andrew beach mouse is unknown. The concern is that these non-native predators are not part of the natural system in which beach mice existed; they have moved into these areas relatively recently and, therefore, pose a potentially additive threat to the subspecies (63 FR 70053).

Listing Factor D. The Inadequacy of Existing Regulatory Mechanisms

Currently there are both state and/or local level regulatory mechanisms (laws, ordinances, policies, directives, etc.) in place related to many of the threats identified for the St. Andrew beach mouse. These regulations were developed for the general protection of the environment or for the common good of the people. They were not designed specifically with beach mice in mind. Therefore, many of them are inadequate in their current state to remove threats facing the St. Andrew beach mouse. While the intent of these mechanisms is good, there are various reasons why many of them may be inadequate: 1) The language may not be protective enough for the conservation of the beach mouse (e.g., land development); 2) They may not be fully implemented or enforced due to limitations in staffing or expertise and or public unpopularity, or 3) They may not be effective in their primary intent.

Beach Driving. One of the threats listed under Factor D at the time of listing was lack of enforcement of regulations restricting people from driving vehicles within the dunes on Eglin AFB's property at Cape San Blas. Beach driving can compact the sand, exacerbate erosion of dunes, and result in lost and/or degraded habitat quality. The limited ability to keep people from driving within the dunes was attributed to the lack of enforcement personnel and the difficulty of enforcement due to the distance from the main base (63 FR 70053). In 2003, Ordinance 2003-7, an amendment to Gulf County Ordinance 97-02 (Gulf County Board of Commissioners 2003), established the enforcement of their beach driving ordinance on Eglin AFB land at Cape San Blas by Gulf County. In addition to enforcement responsibility being provided by Gulf County, lack of enforcement is not believed to be a threat, because St. Andrew beach mice are not currently known to inhabit Cape San Blas (Eglin Air Force Base 2002) and have not been found there during surveys (Lamont *et al.* 1997; J. Gore, pers. comm., 2005). It is doubtful that the limited enforcement of dune driving was a factor in the disappearance of St. Andrew beach mice from Eglin AFB property at Cape San Blas (Gore, pers. comm., 2006). However, if reestablishment of St. Andrew beach mice on Eglin AFB property at Cape San Blas were to occur in the future, the enforcement of beach/dune driving restrictions within the dune systems would need to be reassessed to determine if beach driving would pose a threat to the mice.

Coastal Barrier Resources Act. In recognizing the importance of coastal barrier islands along the Atlantic and Gulf coasts, Congress passed the Coastal Barrier Resources Act (CBRA) of 1982 and Coastal Barrier Improvement Act (CBIA) in 1991. The purpose of CBRA is "…to minimize the loss of human life, wasteful expenditure of Federal revenues, and the damage to fish, wildlife, and other natural resources associated with the coastal barriers along the Atlantic and Gulf coasts by restricting future Federal expenditures and financial assistance which have the effect of encouraging development of coastal barriers, by establishing a Coastal Barrier Resources System (CBRS), and by considering the means and measures by which the long-term conservation of these fish, wildlife, and other natural resources may be achieved" (Coastal Barrier Resources Act 1982). Congress established CBRS units for which the CBRA applies. Within the known range of St. Andrew beach mice the following units were established: P30/P30P (Cape San Blas unit, which includes all of St. Joseph Peninsula) and P31 (St. Andrews unit, which includes East and West Crooked Islands). Despite CBRA's restrictions on Federal funding, development has continued within these designated barrier islands. However, many private insurance companies ceased providing insurance for homes in areas the Federal Emergency Management Agency (FEMA) reclassified in 2002 as "higher risk" flood zones (Niemi, K. 2006) . As a result, many people are unable to obtain insurance for their homes within the Cape San Blas unit. In 2003, Congressman Boyd introduced H.R. 3333 to the 108th Congress that proposed making exempt any areas within units P30 (Cape San Blas unit) and FL-92 (Indian Peninsula unit) from limitations imposed by CBRA on Federal expenditures and financial assistance. It also proposed making exempt the limitations imposed by the National Flood Insurance Act of 1968 on flood insurance coverage (H.R. 3333, 2003). The bill was referred to the Subcommittee on Housing and Community Opportunity. No further action was reported (Library of Congress 2007a). In July 2005, Congressman Boyd introduced H.R. 3280 to the 109th Congress. H.R. 3280 contained the same language as H.R. 3333 Congressman Boyd introduced to the 108th Congress (H.R. 3280 2005). As reported by the Library of Congress (2007b) the following actions took place: The bill was referred to both the Committee on Financial Services and the Committee on Resources. The Committee on Financial Services then referred the bill to the Subcommittee on Housing and Community Opportunity. No further action was reported within the Subcommittee on Housing and Community Opportunity. The Committee on Resources referred the bill to the Subcommittee on Fisheries and Oceans. The Subcommittee held a hearing in April 2006 on this proposed bill. The Service testified at the hearing reaffirming the appropriate designation of P30 and FL-92 as defined by the law at the time of designation (U.S. Fish and Wildlife Service 2006). No further action was reported for H.R. 3280 (Library of Congress 2007b).

If unit P30 was removed from the CBRS, the landowners in that unit within beach mice habitat would be eligible for Federal assistance. Furthermore the limitations of the National Flood Insurance Act placed on these landowners would be removed, allowing them to receive flood insurance (National Flood Insurance Act 1968). By removing the restrictions CBRA and the National Flood Insurance Act places on these lands, in effect, the disincentive to develop this area would be removed. This could make the area more desirable for development; thereby, seriously compromising the original intent of CBRA to: "…minimize the loss of human life, wasteful expenditure of Federal revenues, and the damage to fish,

wildlife, and other natural resources associated with the coastal barriers…" (Coastal Barrier Resource Act 1982).

Feral Cats/Feral Cat Colonies. Both Gulf and Bay counties have ordinances that address animal control (98-11 and 89-20, respectively) (Gulf County Board of Commissioners 1998, Bay County Board of Commissioners 1994); however, these ordinances do not specifically address or prohibit feral cat colonies. While it is unlawful to abandon pets or other animals on state or private property without the express permission of the landowner, enforcement is relatively non-existent. Advocates of feral cat colonies are very passionate and vocal and there is little political will to enforce laws or ordinances regarding pets and feral cats.

Land Development. Bay County has passed land development regulations "to protect and promote the public health, safety, comfort, convenience, prosperity, and general welfare of residents, landowners, and businesses within the County and to protect and preserve the natural, cultural, and historic resources therein" (Bay County Board of Commissioners 2004). These codes include regulations on construction in coastal areas; however, they are general (e.g., "shall make every effort to avoid damaging dunes") and do not provide guidance on how to minimize impact to dunes. Specific language is needed to guide landowners and developers within these systems so as to maintain connectivity between the dunes and minimize impacts to the habitat.

Gulf County's Unified Land Development Regulations set forth requirements for land development within the county. These regulations address a wide variety of land development issues. Some of these relate directly to the protection of the natural resources and the coastal areas. While some level of protection of coastal areas exists, these regulations tend to be general (Gulf County 1996). In order for these land development regulations to provide protection and/or the removal of some of the threats to the St. Andrew beach mouse, Gulf County land development regulations need to have clearer, more specific language. This language must provide clear, detailed guidance on how to protect and minimize impacts to the coastal dune systems. Without the more detailed regulations and enforcement, development will continue to pose one of the greatest threats to the recovery of the St. Andrew beach mice since the habitat on private lands is very important in providing connectivity and resiliency of the beach mice populations.

Listing Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Hurricanes. Natural habitat alteration, as a result of severe tropical storm events, poses a threat to beach mice. Hurricanes potentially could result in catastrophic impacts to beach mice and their habitat given their very limited distribution (FWS 1987, Gore, *in litt*., 1994). Every year the threat of a hurricane(s) hitting within the range of the St. Andrew beach mouse is eminent. From 1851 to 2004 there have been a total of 55 hurricanes (27 Category-1, 16 Category-2, 12 Category-3, 0 Category-4, and 0 Category-5) that have hit northwest Florida (Blake *et al.* 2005).

In the past 30 years, several major hurricanes, in particular, have impacted the St. Andrew beach mouse. In 1975, Hurricane Eloise cut through Crooked Island, separating the island

into two disjunct segments (James 1987, Moyers *et al.* 1999). Subsequent trapping efforts on the western part of the island did not yield captures of beach mice (Gore, *in litt*., 1987; Moyers *et al.* 1999). The population on the eastern part of the island continued to exist into the mid to late 1980s (Gore, *in litt*., 1987, 1990; James 1987). By 1992-1993, however, mice did not appear to be present on the eastern part of the island and the population was believed to be extirpated (Gore, *in litt*., 1994; Alabama Cooperative Fish and Wildlife Research Unit, *in litt*., 1997). Hurricanes Elena and Kate hit the Gulf Coast in 1985, causing extensive damage to the dune systems within the range of the St. Andrew beach mouse. These hurricanes created "huge blowouts in the high dunes of the St. Joseph spit" (James 1992). In 1995, the Gulf Coast was hit by another major hurricane, Hurricane Opal. Hurricane Opal impacted the dune systems throughout the St. Andrew beach mouse's range (Gore, *in litt*., 1995, Moyers *et al.* 1999), severely eroding the beaches and dune system (Leadon 1996). Gore (*in litt*., 1995) estimated that 40% of the available habitat along each kilometer was lost due to the washing away of the frontal dunes, resulting in a loss of potentially half the St. Andrew beach mouse population. In 1998 Hurricanes Earl and Georges caused severe erosion to the eastern portion of Crooked Island. Hurricane Earl caused minor erosion along the northern 7.5 mi. (12.0 km) of St. Joseph Peninsula and minor to major erosion south of the State Park to Cape San Blas (Leadon *et al.* 1999). Six years later Hurricane Ivan made landfall just west of Pensacola, FL. The western end of Mexico Beach (just east of East Crooked Island) sustained moderate/minor beach erosion, while the St. Joseph Peninsula just south of the State Park to Cape San Blas sustained major beach and dune erosion (Leadon 2004). However, since the extent of the impact to dune habitat was concentrated south of the Park, the St. Andrew beach mouse was relatively unaffected by the passage of Hurricane Ivan (L. Patrick, pers. comm., 2005). This was not the case, however, in 2005 when Hurricane Dennis caused extensive coastal erosion and flooding throughout the entire St. Joseph Peninsula (FDEP 2005).

House Mouse Another potential threat to St. Andrew beach mice is from house mice (*Mus musculus*). House mice may pose a competitive threat to beach mice (63 FR 70053) and have been documented in St. Andrew beach mice habitat (Gore *in litt*., 1987, 1990, 1994). However, the competitive relationship between beach mice and house mice is not clearly understood (63 FR 70053; Gore *in litt*., 1990). There appears to be an inverse relationship between densities of house mice and inland oldfield mice (Caldwell and Gentry 1965b, Gentry 1966). This relationship takes the form of a mutually exclusive distribution pattern (Humphrey and Barbour 1981). At some sites, historically occupied by St. Andrew beach mice, only house mice or predominantly house mice have been found (Gore, *in litt*., 1987). Diminished beach mouse populations in areas coinciding with expanded house mouse populations may be an indirect result rather than a direct result of competition between the two species (S. Sneckenberger, pers. comm., 2007). The presence of house mice is associated with human activities (i.e., trash, habitat alteration, etc.) and houses or other buildings (Whitaker and Hamilton 1998). This degraded habitat quality, due to human activity, may be the driving force that leads to reductions in beach mice populations (S. Sneckenberger, pers. comm., 2007); after which house mice invade the disturbed areas (Briese and Smith 1973). Therefore, the presence of house mice within known or former St. Andrew beach mouse habitat may actually be an indicator of degraded beach mice habitat. The degree to which house mice pose a threat to beach mice populations is unclear (63 FR

70053). With continued land development within beach mice habitat, however, this potential threat may increase as more human development usually correlates with higher incidence of house mice.

Intra-specific Cross-breeding. A new, potential threat to the St. Andrew beach mice on East Crooked Island is the presence of Choctawhatchee beach mice on West Crooked Island. In 2000, Choctawhatchee beach mice were confirmed to have expanded their range from Shell Island into unoccupied St. Andrew beach mice habitat on West Crooked Island via a land bridge created when East Pass closed and the islands joined together (Lynn, *in litt.*, 2004. There is concern that East Crooked Island and West Crooked Island might join back together again at some point in time removing the separation of the two subspecies. This would result in the potential for cross-breeding of Choctawhatchee and St. Andrew beach mice. Currently, we do not know the implications of this threat; therefore, research needs to look at the genetic effect of this potential threat (S. Sneckenberger, pers. comm. 2007).

H. Threat Assessment

A threat assessment was conducted for the St. Andrew beach mouse. It was based, in part, on The Nature Conservancy's (2000) site conservation assessment guidance for ranking stressors. This threat assessment provided a means for identifying the relative priority of each threat by ranking the known threats based on a predetermined group of parameter categories that assessed the degree of the threat, the extensiveness of the threat, and the manageability of the threat. In development of the assessment, all the known threats (stressors) were listed along with their identified source (Table 2). These were related back to the five listing factors, in order to maintain consistency between the final listing rule and the recovery plan. The parameter categories (severity, scope, management) were broken down into threat assessment parameters that further describe different aspects/measures of the parameter categories. In order to determine the relative priority/rank of the known threats, each of the threat assessment parameters were assigned ranking values. The ranking values were a measurement of the threat level for that parameter. These values were subsequently assigned a corresponding numeric equivalent for which the threats would be scored. The threats were scored according to the relative degree that the threat parameter applied. Once all stressors were assigned ranking values an overall score was calculated. The overall score took into account the perceived severity of the threat, the pervasiveness of the threat, and the manageability of the threat. This provided an overarching priority for each of the stressors (the higher the score, the higher the overall priority). While this is helpful in determining the relative priority of the threats, it can also mask the relative degree of threat an individual stressor poses to the subspecies, since the overall score takes into account management of the threat. Therefore, by subdividing the overall score into its components (a threat score and a management score) we were able to look at the components separately, which can be helpful in obtaining a better understanding of the threats and prioritizing recovery actions based on an individual's or agency's roles and responsibilities. For instance, a land manager may select recovery actions that address threats that have higher management scores, while a resource biologist at a state or federal level, for instance, may choose to implement recovery actions that have higher threat scores (see Appendix B).

A total of twelve stressors/threats were assessed in the threat assessment. Ranking values were determined based on current literature, expert opinion, or a combination of the two. Overall scores could range from a total of 24 (highest priority) to a low of 7 (lowest priority). Based on the threat assessment, the overall scores for the identified threats to the St. Andrew beach mouse ranged from a low of 12 (non-native predators and feral hogs) to a high of 23 (feral cats – which included free roaming domestic cats and feral cat colonies). Feral cats pose a high degree of threat to the subspecies. In the PHVA analysis conducted for the ABM, the addition of one feral cat that consumed one beach mouse per day to the model resulted in the extinction of the ABM every time the model was run (Traylor-Holzer et al. 2005). Additionally, feral cats pose a threat to one or more areas within the St. Andrew beach mouse range in any given year. Implementation and enforcement of management actions such as feral and free ranging cat removal and non native predator control, has a high likelihood of greatly reducing or possibly removing the threat as long as vigilance is maintained.

Artificial illumination due to artificial lighting and habitat destruction due to land development are the second and third ranked threats, respectively. These two threats differ primarily in their management priority. While land development poses a higher level of threat (Threat Priority Rank Score: 15 for land development and 14 for artificial illumination), artificial illumination is a more manageable threat.

For a detailed description of the parameter categories, threat assessment parameters, the ranking values and their numeric equivalents, and how the scores were calculated see Appendix B.

Table 2. Threat assessment for the St. Andrew beach mouse

Threat/Stressor[1]	*Source(s)*	*Listing Factor*	*Severity*			*Scope*		*Management*		*Score*		
			Level of Impact	*Immediacy*	*Likelihood*	*Spatial Extent*	*Temporal Extent*	*Response*	*Feasibility*	*Threat*	*Management*	*Overall*
Predation	Cats[2]	C,D	High	Current	High	Partial	Continuous	High	Feasible	16	7	23
Artificial Illumination	Artificial lights	A	Medium	Current	Moderate	Partial	Continuous	High	Feasible	14	7	21
Habitat Destruction	Land development	A,D	High	Current	Moderate	Partial	Continuous	Medium	Possible	15	5	20
Dune encroachment	Pedestrian	A,D	Medium	Current	Low	Partial	Continuous	High	Feasible	13	7	20
Dune encroachment	Vehicle	A,D	Low	Current	Low	Partial	Continuous	High	Feasible	12	7	19
Habitat Destruction	Hurricanes	E	Medium	Current	Moderate	Entire	Seasonal	Medium	Possible	14	3	17
Habitat Degredation/ Inter-specific competition	House mouse	E	Low	Potential	Low	Partial	Continuous	Medium	Feasible	11	6	17
Dune encroachment	Military exercises - TAFB	A	Low	Potential	Low	Local	Seasonal	High	Feasible	9	7	16
Habitat Destruction	Shoreline erosion	A	Low	Current	Low	Partial	Continuous	Low	Possible	12	2	14
Intra-specific cross breeding	Choctawhatchee beach mouse	E	Low	Potential	Low	Local	Continuous	Unknown	Possible	10	3	13
Non-native predators	Red foxes, coyotes	C	Unknown	Potential	Low	Unknown	Unknown	High	Feasible	5	7	12
Habitat Destruction	Feral hogs	A	Unknown	Potential	Low	Unknown	Unknown	High	Feasible	5	7	12

[1]Some of the ranking values may differ for a given threat depending on whether they are considered for public lands or for private lands or whether they are considered at the population level or the subspecies level. The ranking values, in this assessment, were based on how the threat relates to the subspecies on private and public lands collectively and how the threat relates to the subspecies at the population and subspecies levels collectively.

[2]Cats are defined as including feral cats, feral cat colonies, and free roaming domestic cats.

I. Conservation Measures

A variety of conservation measures have been completed and/or are being implemented for the protection of coastal dune habitats. These measures may or may not be directly related to the protection of St. Andrew beach mice. However, regardless of the intent of these measures they are all of benefit to the conservation of the St. Andrew beach mouse.

Reestablishment. In the wake of the apparent extirpation of the East Crooked Island population (Gore, *in litt*., 1994; Alabama Cooperative Fish and Wildlife Research Unit, *in litt*., 1997), the Service began plans in 1994 to reestablish this population (Moyers *et al.* 1999). Even though there remained a large and apparently healthy population at St. Joseph Peninsula State Park (Bates 1992; Gore, *in litt*., 1995; Moyers *et al.* 1996), there was concern that some extinction factor (i.e., hurricane) or combination of extinction factors (i.e., hurricanes and habitat destruction) may impact the remaining population and result in the subsequent extinction of the subspecies (Moyers *et al.* 1999). Plans to translocate mice from the St. Joseph Peninsula State Park population in 1996 to East Crooked Island were delayed due to the extensive damage to the dune systems on East Crooked Island caused by Hurricane Opal (Moyers *et al.* 1996). In cooperation with Auburn University, reintroduction efforts eventually took place during the winter of 1997-1998 when a total of 43 individuals were translocated. By 1998 mice were present on East Crooked Island and recruitment was seen, indicating that the population had established itself (Moyers *et al*. 1999). Based on most recent trapping efforts, St. Andrew beach mice continue to exist on East Crooked Island Moyers and Shea, *in litt*., 2002; (Lynn, *in litt*., 2004; Slaby, *in litt.*, 2005, Loggins *et al*., *in litt*., 2007). This effort resulted in the reestablishment of a second known population of St. Andrew beach mice (Moyers *et al*. 1999).

Eglin Air Force Base. Eglin AFB owns 750 ac (303.5 ha) of land at Cape San Blas (Eglin Air Force Base 2002). Beach mice have not been found on Cape San Blas (Gore *in litt*., 1990, 1994; Lamont et al. 1997; J. Gore, pers. comm., 2005) since the first specimens taken from this area (Bowen 1968). The management of Cape San Blas is addressed in Eglin AFB's Integrated Natural Resources Management Plan (INRMP) (Eglin Air Force Base 2007) and their Threatened and Endangered Species Component Plan (Eglin AFB 2006). The purpose of the plan is to "provide interdisciplinary strategic guidance for natural resources management on Eglin AFB for the period 2007-2011." Habitat loss from storms, erosion, and human disturbance may have contributed to the decline of beach mice, since they occur in well-developed dunes with sea oat vegetation and higher back dunes with live oak and rosemary. Because Eglin's Cape San Blas property has some of the last remaining high quality dune habitat in the area, there is the possibility that it could support St. Andrew beach mouse in the future. Eglin posts these high quality dune areas with "Keep Out - Endangered Species" signs to protect this habitat. Eglin's intent is to provide quality habitat for the St. Andrew beach mouse if it were to migrate to Eglin property. There is also the possibility that the beach mouse might be translocated to Eglin's Cape San Blas property. Tracking tubes will be used to monitor the presence of St. Andrew beach mice at Cape San Blas.

While no management activities are being implemented at Cape San Blas specifically related to beach mice (B. Miller, Eglin Air Force Base, pers. comm., 2005), other management activities involving coastal areas and other coastal species that are being implemented may benefit St. Andrew beach mice if they are found on their property or reintroduced. Eglin AFB is participating in the non-native predator control program through the Service/U.S. Department of Agriculture Endangered Species Protection program. In their INRMP they have identified beach driving as an issue at Cape San Blas. They currently are addressing this issue in coordination with the Service and Gulf County. At present, Gulf County Ordinance 97-02, which regulates beach driving, encompasses Cape San Blas (Gulf County Board of Commissioners 1997). Ordinance Amendment 2003-09 provides for the enforcement of Gulf County Ordinance 97-02 on Eglin AFB property (Gulf County Board of Commissioners 2003).

Florida Department of Environmental Protection. The FDEP's Florida Park Service (FPS) is another primary landowner within the historic range of the St. Andrew beach mouse. They own and manage St. Joseph Peninsula State Park. In December 2000 (FDEP 2000), FPS drafted a management plan that sets forth the "policy and direction for the management of St. Joseph Peninsula State Park as a unit of Florida's state park system." As stated in the management plan, a primary goal is to "Continue to implement natural systems management, whereby primary resource management emphasis is placed on restoring and maintaining the natural processes that shape the structure, function and species composition of the natural communities of the park." There are 10 objectives listed in support of this overall goal. One objective states the park would "designate protected zones" which includes the St. Andrew beach mouse habitat. A second objective is the monitoring of state and Federal listed species. To this end the park is involved in monthly track surveys for St. Andrew beach mice (H. Mitchell, FDEP, pers. comm., 2005). Signs of beach mice activity continue to be seen within the park. A third objective is to "Continue and improve cooperative programs with other state and federal agencies in order to improve habitat, decrease visitor impacts on listed species…" (FDEP 2000). In meeting this objective, the Park is managing beach and dune habitat through the planting of sea oats where necessary to recover the dune systems. It is also protecting the dunes from recreational users by constructing boardwalks over the dunes (H. Mitchell, pers. comm., 2005). Another objective stated in the management plan is to "Continue effective exotic plant and animal removal programs" (FDEP 2000). The park has established an active non-native predator control program, including the removal of coyotes, red foxes, and feral cats (FDEP 2000; H. Mitchell, pers. comm., 2005).

Florida Fish and Wildlife Conservation Commission. The FWC, with funding from the Service, initiated a project in 2004 to determine the presence and absence of St. Andrew beach mice throughout its range (Slaby, *in litt*., 2005). The FWC found SABM present in St. Joseph Peninsula State Park and Crooked Island east, and portions of the St. Joseph Peninsula south to private lands north of Cape San Blas. No SABM were detected between Cape San Blas and Crooked Island East (Loggins et.al. 2008). The FWC has also been working with St. Joseph State Park providing technical assistance for their track survey monitoring program (J. Gore, pers. comm., 2006).

Gulf County. Gulf County Ordinance 97-02 strictly prohibits the driving of any vehicles in, on, or over any coastal sand dunes within the County. Furthermore, it prohibits driving in, on, or over vegetation. Beach access, for individuals issued a Beach Driving Permit, is limited to only four designated access points; all other access is prohibited (Gulf County Board of Commissioners 1997).

Gulf County adopted Ordinance 98-11 (Animal Control Ordinance) in May 1998. This ordinance sets forth regulations for animal owners as to the control of their animals (as defined by the Ordinance, "an animal shall mean dog, cat, or other domestic animal fowl of any nature"). It stipulates that unrestrained animals off of the owner's property shall be considered "at large" and that "at large" animals are subject to impoundment by the Gulf County Animal Control Authority …" (Gulf County Board of Commissioners 1998).

Gulf County has also constructed boardwalks at Cape Palm and Salinas Park. These boardwalks provide protection of the dunes from pedestrians walking directly on the dune in order to access the beaches (L. Patrick, pers. comm., 2005).

St. Joe Company. St. Joe Company currently has St. Andrew beach mice inhabiting their Mexico Beach property, which is part of East Crooked Island south of Tyndall AFB. Additionally, St. Joe is proposing to develop a St. Andrew beach mouse reestablishment and management plan for St. Joe Beach as a conservation measure for development activities proposed at Mexico Beach. This would establish a third population of St. Andrew beach mice. They also own property at St. Joe Beach; however, currently St. Andrew beach mice are not known to inhabit this land. St. Joe Company is actively managing their dune habitat to protect and conserve these systems (S. Shea, pers. comm., 2005). These management activities include the monitoring of St. Andrew beach mice at Mexico Beach on a quarterly basis and St. Joe Beach on an annual basis. They also have taken measures to prevent beach driving in order to protect the dunes from being destroyed by vehicular traffic. In addition they are actively controlling non-native predators on their property (Moyers and Shea, *in litt*., 2002).

Tyndall Air Force Base. Tyndall AFB is one of the primary landowners within the known range of the St. Andrew beach mouse. They manage a majority of the land on East Crooked Island. Tyndall AFB has engaged in many coastal dune restoration and protection activities on East Crooked Island that have directly or indirectly benefited the St. Andrew beach mouse (J. Mobley, pers. comm., 2005). James (1987) noted that military exercises conducted on Tyndall AFB were responsible for the degradation of dunes on East Crooked Island in the early to mid-1980s. Presently no military activities are conducted by Tyndall AFB on these beaches; however, other branches of the military have requested to conduct their military activities there. Tyndall AFB requires an Environmental Assessment (in accordance with the National Environmental Policy Act) for all of these proposed activities. In addition, a formal base review of the proposed exercise, which includes the review by Tyndall Natural Resources Branch (NRB), is initiated. Tyndall NRB set requirements, based on the proposed activity, which must be followed in order for the exercise to be conducted. The primary objective of the requirements is to ensure the protection of the coastal dune systems and their associated coastal species, which includes the beach mouse. Tyndall AFB also restricts

beach driving on its property, except in special situations (emergencies, resource management activities, military exercises). All personnel must follow beach driving instructions that were developed based on a biological opinion, provided to Tyndall AFB by the Service in 1998, regarding mission related vehicle access and driving on the beach at Tyndall AFB. This restriction is actively enforced by Tyndall NRB Law Enforcement.

In addition to the management of proposed military exercises on the beach and the restriction of beach driving, non-native predator control is being conducted on the Base. This management activity is conducted via a partnership of Federal, state, and public land managers, including the Service, to protect threatened and endangered species in northwest Florida through the control of non-native predators on coastal public lands. Although the primary focus is the protection of sea turtles on the Base, the St. Andrew beach mouse benefits from this work since several of the species (coyotes, red foxes, feral cats, and feral hogs) have been noted as potential threats to beach mice (Bowen 1968; Humphrey and Barbour 1981; Gore, *in litt*., 1990; Moyers *et al*. 1996; 63 FR 70053).

Tyndall AFB has implemented several coastal dune conservation efforts which have resulted in the establishment of large, vegetated dunes (Lynn 2002). These efforts have included: 1) the construction of a boardwalk at the east end of East Crooked Island in 2001-2002 to direct recreational users to the beach and protect the dunes, 2) the placement of fencing along the boardwalk to keep users from getting off the boardwalk, and 3) the installation of sand fences and the planting of sea oats to encourage the establishment of dunes. The apparent benefit of these activities may be indicated by the continued presence of St. Andrew beach mice on East Crooked Island, as evidenced by recent surveys conducted by the FWC (Slaby, *in litt*., 2005).

Finally, Tyndall AFB has completed their INRMP (Tyndall 2006). Their Threatened and Endangered Species Management Plan calls for the continuation of the following actions to manage beach mice: rebuild dunes; maintain boardwalk system to eliminate disturbance of dunes by pedestrian traffic; minimize light pollution of dunes; vehicle control; monitor mice with annual tracks survey and biennial trapping in cooperation with FWS and FWC; predator control including feral cat (PIT tag monitoring of cats and dogs on base in cooperation with Vet); and maintain law enforcement presence. Critical habitat has been designated on Tyndall AFB for the SABM at east Crooked Island as Tyndall's INRMP had not been approved by the Service at the time of designation.

Other Measures. Emergency response to coastal erosion within St. Andrew beach mouse habitat, due to Hurricane Ivan, has included FEMA and State-funded berm projects. Additional funds have been provided by the State of Florida in 2005 to determine the feasibility of a beach restoration project on St. Joseph Peninsula (P. Flood, FDEP, pers. comm., 2005).

PART II: RECOVERY

A. Recovery Strategy

The St. Andrew beach mouse was once thought to range throughout dune systems along the coastline from Crooked Island in Bay County, around the tip of St. Joseph Peninsula to Money Bayou in Gulf County (Bowen 1968, Howell 1939, Hall 1981). Over the years this subspecies' range decreased to only one known population by the early 1990s (Gore, *in litt*. 1994, Holler, *in litt*., 1997). This was approximately a 68% reduction in its historic distribution (63 FR 70053). Due to concerns for the subspecies, its range was expanded through reintroduction efforts during 1997 and 1998. This effort resulted in the establishment of an additional population, making a total of two known populations (Holler, *in litt*., 1996; Moyers et al. 1999; Lynn, *in litt*., 2002; Moyers and Shea, *in litt*., 2002). Although this expanded the species' distribution, because of the reduced range and habitat fragmentation due to development, this subspecies faces additional, multiple threats (e.g., hurricanes, increased predation pressures by non-native species, particularly feral cats, impacts to dunes from recreation and unrestricted beach access, etc.) to its long-term persistence. Achieving long-term viability of the St. Andrew beach mouse will depend upon maintaining existing populations, establishing additional populations throughout its historic range, and removing or minimizing those known threats so that existing and reestablished populations can survive and persist in the wild.

This recovery plan outlines how this will be accomplished through recovery actions that address the known threats to the St. Andrew beach mouse. The recovery of this subspecies will depend on the partnership and cooperation of multiple Federal, state, and local governments and private landowners.

B. Recovery Goals

The recovery goal for the St. Andrew beach mouse is to perpetuate the long-term viability of the subspecies in the wild. This goal is represented by the delisting (i.e., removal) of the subspecies from the Federal List of Endangered and Threatened Wildlife (50 CFR 17.11). The interim recovery goal is to downlist from endangered status to threatened status.

C. Recovery Objectives

The recovery goal will be accomplished through four primary, overarching, objectives:

1. Reestablish additional populations: Species that have a small number of populations, as does the St. Andrew beach mouse, have a greater risk of extinction due to random events (i.e., tropical storms) (Shaffer and Stein 2000). In order to protect against or reduce the likelihood of such random events causing the extinction of a species, multiple populations distributed throughout their range are needed (Shaffer and Stein 2000). Therefore, a primary priority of this recovery program is to reestablish as many self sustaining populations as possible on the

remaining continuous blocks of suitable habitat within its historic range. This builds in the redundancy and resiliency necessary to ensure long-term survival of a species (Shaffer and Stein 2000).

2. Threat Minimization or Removal: The St. Andrew beach mouse is faced with multiple threats to its populations. These threats range from those that directly eliminate individuals to those that destroy or degrade the habitat in which the species lives. Although individually some of these threats may not pose a significant risk to the existence of the subspecies, in combination they threaten the existence of this subspecies. To ensure the long-term conservation of existing and reestablished populations, these threats need to be minimized or eliminated. Therefore recovery actions which remove or minimize the known threats to the St. Andrew beach mouse are additional priorities of this recovery program.

3. Habitat Protection and/or Restoration: Habitat is key to the existence of any species. If a species does not have habitat or their habitat is degraded to a point that it is no longer suitable, the species will decline and eventually go extinct. Several of the known threats to the St. Andrew beach mouse impact its habitat directly. These threats work to fragment the habitat within the mouse's historic range, resulting in smaller and smaller areas available for the mice that are generally spread further and further apart. This results in the further isolation of populations due to the lack of suitable habitat connecting these populations. We need to strive to protect and/or restore key areas that will provide for the necessary connectivity to reverse the negative impact fragmentation has on species.

4. Public Outreach/Education: The St. Andrew beach mouse cannot be fully recovered without the active participation of private landowners. Conservation of beach mouse habitat on private lands would support the populations on public lands. One of the keys to the successful recovery of the St. Andrew beach mouse is an education program for and stewardship by the public. Meyers (1983) noted the importance education and outreach plays in the conservation of beach mice subspecies. He stated that few people know about these mammals and that coordinated efforts between Federal and state agencies can help to inform people of beach mice and their needs as well as the significance of the coastal dune habitat to protection of homes, businesses, and livelihoods.

D. Recovery Criteria

Reclassification from Endangered to Threatened Status (Downlisting)

The St. Andrew beach mouse will be considered for downlisting to threatened status when the following measures are achieved:

Demographic Criteria. Demographic criteria (1 and 2) provide a means of measuring the fitness of the St. Andrew beach mouse subspecies, which measures

the success of the conservation actions implemented for its recovery. Criteria are intended to take into account the natural cyclic nature of beach mice populations. See Appendix C for justification on the designated time period listed within the demographic criteria.

1. A stable or increasing population trend is maintained at St. Joseph Peninsula State Park and East Crooked Island on Tyndall Air Force Base over a 10 year period based on data obtained from accepted, standardized, monitoring methods.

2. An additional viable or self-sustaining population is reestablished at St. Joe Beach that shows a stable or increasing trend, after the initial repopulation of unoccupied habitat, over a 10 year period based on data obtained from accepted, standardized, monitoring methods.

3. At least 87%[2] of designated St. Andrew beach mice critical habitat is protected and under a management plan that addresses conservation of beach mice. The plans, at a minimum, address the following:
   a) Impact of commercial/residential development and recreational use including pedestrians and motorized vehicles to beach mice habitat..
   b) Impact of shoreline erosion to beach mice habitat.
   c) Impact of artificial lighting on beach mice habitat.
   d) Control of feral cats and hogs in beach mice habitat.

4. Non-native predators, including free roaming cats and cat colonies, are controlled in areas with known populations of beach mice (Tyndall Air Force Base's property at East Crooked Island, St. Joseph Peninsula State Park, and their respective adjacent private lands) at levels in which they do not pose a threat to beach mice.

5. County or local government, within the range of the St. Andrew beach mouse, have regulations or other protection mechanisms that:
   a) Minimize impacts to dunes in beach mice habitat due to recreational use.
   b) Prohibit free-roaming cats and cat colonies.
   c) Minimize impacts of commercial and residential developments in primary, secondary, and scrub dunes. Measures include minimizing footprints; preserving connectivity between primary, secondary and scrub dunes; using native landscaping; and constructing boardwalks over dunes for beach access.
   d) Minimize impacts of artificial lighting in beach mice habitat by requiring sea turtle lighting, in areas visible from the beach and wildlife lighting, in areas not visible from the beach.

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[2] This is the percent of St. Andrew Beach mouse critical habitat that is state or federally managed land.

6. Emergency response plan is prepared to prevent extirpation of any population of St. Andrew beach mice from tropical storms/hurricanes and other disasters.
7. If determined to be necessary, an Action Plan is prepared to address the potential threat of cross-breeding with Choctawhatchee beach mice from W. Crooked Island.
8. Capture of house mice in beach mouse habitat shows a declining trend over a period of 10 years and no new infestations are found within the range of the St. Andrew beach mouse.

Removal from the List of Endangered and Threatened Species (Delisting)

The St. Andrew beach mouse will be considered for delisting when all the downlisting criteria have been met and the following delisting criteria are achieved.

Demographic Criteria. Criteria (1 and 2) are intended to take into account the natural cyclic nature of beach mice populations.

1. A stable or increasing population trend is maintained at St. Joseph Peninsula State Park, East Crooked Island on Tyndall Air Force Base, and St. Joe Beach over a 20-year period based on data obtained from accepted, standardized, monitoring methods.

2. An additional viable population is reestablished at Cape San Blas, Eglin Air Force Base, and has a stable or increasing population trend over a 10 year period based on data obtained from standardized monitoring methods.

3. At least 87% of designated St. Andrew beach mice critical habitat is protected and under a management plan that addresses conservation of beach mice, priority is given to those lands that provide connectivity. The plans, at a minimum, manage for the following:
   a) Impact of commercial/residential development and recreational use including pedestrians and motorized vehicles to beach mice habitat..
   b) Impact of shoreline erosion to beach mice habitat.
   c) Impact of artificial lighting on beach mice habitat.
   d) Control of feral cats and hogs, including free ranging cats in beach mice habitat

4. Non-native predators, including free roaming cats and cat colonies, are controlled within all critical habitat that is protected and under a management plan at levels that they do not pose a threat to beach mice.

5. County or local government regulations or other protection mechanisms as set forth in the downlisting criteria for Factor D have adequate compliance and enforcement.

6. No captures of house mice occur during standard monitoring for 5 years.

E. Threats Tracking Table

The threat tracking table is used as a planning tool to ensure that the identified threats are being addressed by recovery criteria and that, in turn, each of these threats are adequately addressed by recovery actions. Each of the identified threats are categorized by its corresponding listing factor. This is done in an effort to build continuity between the listing package and the recovery plan. Because some threats may apply to multiple factors (i.e., land development causes habitat destruction and can be the result of inadequate regulatory mechanisms), some threats are listed more than once. The recovery criteria and recovery action(s) developed are presented in relation to their corresponding threat. This table also allows the stakeholders a quick reference to the recovery criteria and the subsequent actions that were developed to address the threats.

Table 3. Threat tracking table of the current and previously identified threats for the St. Andrew beach mouse, by the five listing factors, with their associated recovery criteria and recovery actions.

THREAT TRACKING TABLE			
LISTING FACTOR	**THREAT**	**RECOVERY CRITERIA**	**RECOVERY ACTION**
Factor A			
	Land Development	3,5	Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands; Facilitate stewardship of St. Andrew beach mice recovery through increased public awareness and education (Actions: 4.1.4, 4.1.5, 4.1.6, 6.2)
	Military Exercises on East Crooked Island	*Threat removed since listing*	
	Dune Encroachment	3,5	Identify, protect, evaluate and restore St. Andrew beach mouse habitat; Facilitate stewardship of St. Andrew beach mice recovery through increased public awareness and education (Actions: 2.2.1.1a, 2.2.1.1b, 2.2.1.1c, 2.2.1.2a, 2.2.1.2b, 2.2.2.1, 2.2.2.2, 2.2.3, 6.2)
	Natural Shoreline Erosion	3	Identify, protect, evaluate and restore St. Andrew beach mouse habitat (Action: 2.4.1, 2.4.2)
	Artificial Lighting	3,5	Remove, minimize, or investigate other natural or manmade threats (Action: 5.3.1.1 – 5.3.1.3, 5.3.2.1 – 5.3.2.3)

THREAT TRACKING TABLE (cont'd)			
LISTING FACTOR	**THREAT**	**RECOVERY CRITERIA**	**RECOVERY ACTION**
Factor A cont'd			
	Feral Hogs	3	Remove or investigate non-native predator threat to St. Andrew beach mice populations (Action: 3.3)
Factor B			
	None At Present		
Factor C			
	Feral Cats/Cat Colonies/Free Roaming Cats	4,5	Remove or investigate non-native predator threat to St. Andrew beach mice populations; Facilitate stewardship of St. Andrew beach mice recovery through increased public awareness and education (Actions: 3.1.1 – 3.1.4, 6.2)
	Other Non-native Predators	4	Remove or investigate non-native predator threat to St. Andrew beach mice populations (Action: 3.2)
Factor D			
	Beach Driving	3,5	Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands (Actions: 4.1.1)
	Coastal Barrier Resources Act	5	Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands (Actions: 4.1.6)
	Feral Cats/Cat Colonies/Free Roaming Cats	4,5	Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands (Actions: 4.1.2)
	Land Development	3,5	Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands (Actions: 4.1.4, 4.1.5, 4.1.6)

THREAT TRACKING TABLE (cont'd)			
LISTING FACTOR	**THREAT**	**RECOVERY CRITERIA**	**RECOVERY ACTION**
Factor E			
	Hurricanes	6	Remove, minimize, or investigate other natural or manmade threats (Actions: 5.1.1, 5.1.2)
	Intra-specific Cross-breeding	7	Monitor status of existing populations and reestablish populations of St. Andrew beach mice; Remove, minimize, or investigate other natural or manmade threats (Actions: 1.3.1, 5.4.1, 4.4.2)
	House Mouse	8	Remove, minimize, or investigate other natural or manmade threats (Action: 5.2.1.1, 5.2.1.2, 5.2.1.3, 5.2.2.1, 5.2.2.2)

Listing Factors:
Factor A: The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range
Factor B: Overutilization for Commercial, Recreational, Scientific, Educational Purposes (not a factor)
Factor C: Disease or Predation (no known diseases)
Factor D: The Inadequacy of Existing Regulatory Mechanisms
Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence

F. Recovery Action Outline

1. Monitor status of existing populations and reestablish populations of St. Andrew beach mice
   - 1.1. Implement long-term monitoring programs
     - 1.1.1. Establish monitoring program for all known populations on St. Joseph Peninsula State Park (Florida Parks Service), East Crooked Island (Tyndall Air Force Base), East Crooked Island (St. Joe Company)
     - 1.1.2. Establish monitoring programs for reestablished populations as well as areas where reintroduction has occurred but presence is not confirmed.
   - 1.2. Reestablish populations at sites within known historic range
     - 1.2.1. Reestablish population at Cape San Blas and at St. Joe Beach
       - 1.2.1.1. Prepare reintroduction plan for reestablishment of mice at St. Joe Beach
       - 1.2.1.2. Prepare reintroduction plan for reestablishment of mice at Cape San Blas
       - 1.2.1.3. Determine which existing population(s) is best source for reestablishment program
       - 1.2.1.4. Translocate St. Andrew beach mice to St. Joe Beach and Cape San Blas
     - 1.2.2. Investigate reestablishment of additional populations
       - 1.2.2.1. Identify additional reestablishment sites
       - 1.2.2.2. Prepare feasibility study for establishing populations at additional reestablishment sites, if additional potential sites are found
       - 1.2.2.3. Implement a captive breeding feasibility study
   - 1.3. Increase genetic understanding of St. Andrew beach mice populations
     - 1.3.1. Investigate the genetic differences between Choctawhatchee beach mice on West Crooked Island and St. Andrew beach mice on East Crooked Island
     - 1.3.2. Conduct further genetic analyses of historic populations on Crooked Island
     - 1.3.3. Further investigate the genetic variation within and among St. Andrew beach mice populations

2. Identify, protect, evaluate and restore St. Andrew beach mouse habitat
   - 2.1. Map and evaluate current habitat
     - 2.1.1. Map all suitable habitat throughout its range
     - 2.1.2. Determine the condition of the suitable habitat
     - 2.1.3. Determine areas of occupied and unoccupied suitable habitat
   - 2.2. Protect and monitor dunes from vehicular driving and pedestrians crossing
     - 2.2.1. Protect dunes from pedestrian crossing
       - 2.2.1.1. Construct boardwalks or other accepted methods to cross dunes on public lands and public access sites
         - 2.2.1.1a Map sites where dunes are impacted by pedestrians and determine appropriate sites for public access
         - 2.2.1.1b Install boardwalks or appropriate dune crossovers at all public access sites without boardwalks

2.2.1.1c Investigate other methods of providing beach access that protects the dunes and survives storm events
2.2.1.2. Install appropriate dune crossovers for beach access at private and commercial developments
2.2.1.2a Identify developments in need of boardwalks
2.2.1.2b Establish boardwalks where the needs have been identified
2.2.2. Protect dunes from vehicular driving
2.2.2.1. Map dunes impacted by vehicular driving
2.2.2.2. Increase enforcement and implement preventive measures where possible
2.2.3. Establish or continue monitoring program to document impacts to dunes from vehicular driving and pedestrian crossing
2.2.4. Research the degree feral hogs pose a threat to beach mice habitat and implement removal program if deemed necessary
2.3. Restore dune systems
2.3.1. Map dune systems in need of restoration
2.3.2. Develop restoration plan for dune systems on public lands
2.3.3. Restore dune systems on public lands
2.3.4. Develop or update existing restoration guidance for dune systems on private lands
2.3.5. Restore dune systems on private lands
2.3.6. Establish a monitoring program to assess the effectiveness of restoration efforts
2.4. Identify, map, and monitor areas where shoreline erosion is occurring adjacent to known, occupied beach mice habitat
2.4.1. Investigate options for shoreline erosion protection if monitoring indicates a threat
2.4.2. Implement option(s) for shoreline erosion protection, if deemed feasible

3. Remove or investigate non-native predator threat to St. Andrew beach mice populations
3.1. Remove free-roaming cats, feral cats, and cat colonies from areas with known or reestablished beach mice populations
3.1.1. Identify areas where cats are present
3.1.2. Continue to implement cat removal program on public lands
3.1.3. Identify areas with no cat removal program and establish a removal program
3.1.4. Monitor effectiveness of free ranging cat (domestic and feral removal) efforts
3.2. Research the degree of threat other non-native predators (i.e., coyote and red fox) pose to known beach mice populations and implement removal program as appropriate

4. Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands
4.1.1. Work with Bay County to provide protection of all beaches and dunes, within the county, from vehicular driving

4.1.2. Work with Bay and Gulf counties to adopt a feral cat removal program and mechanism(s) prohibiting feral cat colonies and free roaming cats
4.1.3. Work with Bay and Gulf counties, where applicable, to require boardwalk access to all beaches from single-family, multi-family, and commercial developments
4.1.4. Work with Gulf and Bay counties, where applicable, to establish regulations for residential construction within the primary, secondary, and scrub dunes that minimize impacts to dunes and provide for connectivity of beach mice habitat
4.1.5. In partnership with Gulf and Bay counties, the Service consults on all development within the coastal dune system to provide guidance to the landowner on ways to minimize impacts to coastal dune system
4.1.6. Monitor and enforce compliance with regulatory mechanisms for land development, cats, dune vehicular driving, and boardwalks
4.1.7. Determine, in the Service's review, whether designation of CBRA units P30/P30P met the definition of the Act and/or whether there was a technical error in mapping at the time of designation as requested by Congress

5. Remove, minimize, or investigate other natural or manmade threats
5.1. Minimize the potential catastrophic effect of tropical storm and hurricane events on the St. Andrew beach mouse
5.1.1. Develop and implement emergency response plan, if warranted
5.1.2. Establish a monitoring program for the effectiveness of the emergency response plan
5.2. Minimize and investigate the threat of house mice populations within coastal dune systems
5.2.1. Minimize the occurrence of house mice within known beach mice habitat
5.2.1.1. Install animal proof garbage containers on public lands and public beach access sites
5.2.1.2. Work with private landowners to remove or minimize factors that attract house mice
5.2.1.3. Monitor the effectiveness of conservation efforts to reduce occurrence of house mice within beach mice habitat
5.2.2. Conduct further research on house mice inhabiting beach mice habitat
5.2.2.1. Conduct research on the competitive effects of house mice on beach mice within a natural setting
5.2.2.2. Conduct research on condition of the coastal dune habitat in which house mice occur
5.3. Minimize and investigate the effects of artificial lighting on beach mice
5.3.1. Conduct further research on the effects of various artificial light regimes on beach mice behavior
5.3.1.1. Determine what artificial lighting regimes have the greatest and least effect on beach mice behavior
5.3.1.2. Determine the effects of artificial lighting on the long term survival of beach mice

5.3.1.3. Investigate the effects of artificial lighting relative to fragmentation of beach mouse habitat at the landscape level

5.3.2. Minimize the effects of artificial light on public and private lands within the coastal dune systems inhabited by beach mice

5.3.2.1. Install approved sea turtle lighting or dark sky lighting within the dunes on public lands

5.3.2.2. Work with public land managers to develop plans for their areas that address artificial light pollution in coastal dune systems on public lands

5.3.2.3. Work with private landowners and local governments in coastal areas to replace conventional, artificial lighting with sea turtle or wildlife lighting

5.4. Determine the potential threat of the closing of the channel separating Choctawhatchee beach mice on West Crooked Island from St. Andrew beach mice on East Crooked Island

5.4.1. Develop a management plan to prevent the hybridization of Choctawhatchee beach mice and St. Andrew beach mice at West and East Crooked Island, respectively, if deemed to pose a threat

5.4.2. Implement management plan to prevent the hybridization of Choctawhatchee beach mice and St. Andrew beach mice at West and East Crooked Island, respectively, if deemed to pose a threat

6. Facilitate stewardship of St. Andrew beach mice recovery through increased public awareness and education

6.1. Develop a public outreach plan for addressing threats to St. Andrew beach mice and to the coastal dune systems they inhabit

6.1.1. Investigate what outreach materials/efforts are currently available and determine their target audience

6.1.2. Identify what areas and/or issues are not being addressed by current outreach materials/efforts

6.1.3. Determine the effectiveness of existing outreach efforts

6.1.4. Develop a coordinated outreach program effort for various target audiences

6.2. Continue outreach efforts that increase the public's awareness of factors relating to identified threats to the St. Andrew beach mice

6.3. Establish partnership with Bay and Gulf counties' Environmental Services/ Permitting sections.

G. Recovery Action Narrative

1. Monitor status of existing populations and reestablish populations of St. Andrew beach mice.

1.1. Implement long-term monitoring programs. A long-term monitoring program would be established for a period of 10 years to determine the status and trend of the St. Andrew beach mouse population over time. The monitoring program would use currently accepted protocol and procedures for monitoring beach mice. Information gathered from the monitoring program would be used, in part, toward determining if recovery benchmarks have been achieved.

1.1.1. Establish monitoring program for all known populations on St. Joseph Peninsula State Park (Florida Parks Service), East Crooked Island (Tyndall Air Force Base), East Crooked Island (St. Joe Company). Sites known to be currently occupied by beach mice would be monitored to determine their status and trends.

1.1.2. Establish monitoring programs for reestablished populations. A long-term monitoring program at sites with reestablished populations would be conducted to determine the effectiveness of the reestablishment program.

1.2. Reestablish populations at sites within known historic range. The establishment of additional populations would help protect the St. Andrew beach mouse from the threat of extinction due to potential catastrophic effects of storms. By establishing multiple populations the likelihood of a single event completely wiping out the subspecies is greatly reduced.

1.2.1. Reestablish population at Cape San Blas and at St. Joe Beach. Two sites have been identified as potential reestablishment sites: Cape San Blas, Eglin AFB and St. Joe Beach, St. Joe Company. These sites were selected because data indicated St. Andrew beach mice historically occupied the site (Howell 1939), because of the presence of suitable habitat and, in the case of St. Joe Beach, as mitigation for development elsewhere in occupied SABM habitat.

1.2.1.1. Prepare reintroduction plan for reestablishment of mice at St. Joe Beach. A reintroduction plan would explain how the reestablishment would be accomplished: when mice will be released, where mice will be released, what donor population will be used for the release, what type of release will be used, how many mice will be released, etc.

1.2.1.2. Prepare reintroduction plan for reestablishment of mice at Cape San Blas. A reintroduction plan would explain how the reestablishment would be accomplished: when mice will be released, where mice

will be released, what donor population will be used for the release, what type of release will be used, how many mice will be released, etc

1.2.1.3. Determine which existing population(s) is best source for reestablishment program. In order for a reestablishment program to be initiated a source population must be identified. This source population must be healthy enough to withstand the withdrawal of individuals for its population without adversely impacting its long-term viability.

1.2.1.4. Translocate St. Andrew beach mice to St. Joe Beach and Cape San Blas. Upon completion of Action Items 1.2.1.1, 1.2.1.2, and 1.2.1.3 reestablishment of populations at Cape San Blas, Eglin AFB and St. Joe Beach, St. Joe Company will be conducted.

1.2.2. Investigate reestablishment of additional populations. The establishment of populations in addition to those identified in Action 1.2.1 would help in the long-term recovery of the St. Andrew beach mouse.

1.2.2.1. Identify additional reestablishment sites. Identify existing land within the historic range, based on data obtained from Action 2.1.1, which would potentially be suitable for reestablishing an additional population(s).

1.2.2.2. Prepare feasibility study for establishing populations at additional reestablishment sites, if additional potential sites are found Initiate a feasibility study of those sites identified in Action 1.2.2.1 which looks at habitat quality, amount of habitat, presence of threats, etc. to determine the potential success of a reestablishment project at each site.

1.2.2.3. Implement a captive breeding feasibility study. In order to supplement the stock of mice potentially being reestablished at additional sites, there may be a need to establish a captive breeding program. A study into the feasibility of establishing a captive breeding program would be necessary to determine if such a program would be successful or not.

1.3. Increase genetic understanding of St. Andrew beach mice populations. A better genetic understanding of the St. Andrew beach mouse subspecies would aid in guiding the recovery of this subspecies.

1.3.1. Investigate the genetic differences between Choctawhatchee beach mice on West Crooked Island and St. Andrew beach mice on East Crooked Island. In the light of the current potential for Choctawhatchee beach mice to

expand their range if the channel that separates East and West Crooked Island naturally closes, a better understanding of the genetic differences of these two subspecies is necessary. This information would help to understand the implications of species introgression if the channel naturally closes and the range of the two subspecies subsequently overlaps and they interbreed.

1.3.2. Conduct further genetic analyses of historic populations on Crooked Island. By having a better genetic understanding of the original specimens that occupied Crooked Island prior to their extirpation we would be better equipped to manage the proper genetic stock on Crooked Island. This would be accomplished by conducting further genetic research, using the latest genetic research technologies, on the museum specimens of St. Andrew beach mice collected on Crooked Island at the time it was first discovered.

1.3.3. Further investigate the genetic variation within and among St. Andrew beach mice populations. While we have some understanding of the genetic makeup of the St. Andrew beach mice populations we need further studies to help determine whether loss of genetic variation is a threat to the subspecies and which populations would be an appropriate donor for any reestablishment efforts.

2. **Identify, protect, evaluate and restore St. Andrew beach mouse habitat.**

2.1. Map and evaluate current habitat. Mapping existing habitat, determining its current condition, and occupancy would provide valuable information that could be used for various conservation efforts. This information would aid in identification of potential reestablishment sites, prioritize areas for acquisition or other landowner conservation tools, identification of linkages for connectivity of populations, identify areas for restoration, etc.

2.1.1. Map all suitable habitat throughout its range. The first priority in identifying current beach mice habitat is to map suitable habitat. Due to the geographic extent of the mapping effort, initial mapping will need to be done in a GIS, using the latest available, high-resolution, aerial photography and, if necessary, other spatial data sets. However, this must be combined with extensive ground-truthing to validate the data, due to the limitation of identifying habitat remotely. The Service and the Florida FWC have independently initiated mapping of suitable habitat. Coordination needs to occur so that a single beach mice suitable habitat data layer is developed. This data would directly support Action 1.2.2.1.

2.1.2. Determine the condition of the suitable habitat. Once the suitable habitat is mapped (Action 2.1.1.). The current condition (habitat quality) of these areas needs to be determined. As new technologies are developed, some of

this work may be possible through GIS and Remote Sensing; however, there will still be the need to conduct statistically-sound sampling to validate the GIS/Remote Sensing analysis and/or to classify the current condition of the mapped suitable habitat. This information would support Action 1.2.2.2 and 2.3.1.

2.1.3. Determine areas of occupied and unoccupied suitable habitat. Using current survey data collected throughout the range of the St. Andrew beach mice, areas of occupied and unoccupied suitable habitat need to be identified. This information in combination with the quality of the habitat will help to determine what recovery tools should be used within the area.

2.2. Protect and monitor dunes from vehicular driving and pedestrians crossing. Impacts to dunes by vehicles and pedestrians continue to be an issue that needs to be addressed to aid in the recovery of the St. Andrew beach mouse. People walking directly over and vehicles driving on the dunes destroy the dunes by killing vegetation and compacting the soil. This leads to blowouts in the dunes from wave and wind action (Kimball *in litt*., 1996). The degree or severity to which this occurs is dependent upon the type of activity and the inherent susceptibility of the system (Leatherman 1979).

2.2.1. Protect dunes from pedestrian crossing.

2.2.1.1. Construct boardwalks or other accepted methods to cross dunes on public lands and public access sites. Boardwalks are currently the accepted means of effectively and safely provide access to beaches while protecting the dunes (NPS 2000). Boardwalks keep people from walking on and through dunes which cause the loss of vegetation. This loss of vegetation allows the dune to erode and eventually result in the destruction of the dune (Walton and Skinner 1983). The design of boardwalks may vary depending on the situation. Walton and Skinner (1983) provide blueprints for the design of boardwalks for heavy and light foot traffic.

2.2.1.1a Map sites where dunes are impacted by pedestrians and determine appropriate sites for public access. An important step in protecting the dunes is to identify areas impacted by pedestrians crossing. These sites are known to be weak points in the dune system (Kimball *in litt*., 1996) that could result in the erosion of the dunes and the subsequent loss of effectiveness of the dunes to protect interior beach mouse habitat (NPS 2000). These sites need to be mapped so that future efforts could be initiated to construct boardwalks if none are present (see Action 2.2.1.1b) or fenced off to keep pedestrians off of the dunes. In addition, sites need to be identified where it is appropriate to provide public access.

2.2.1.1b Install boardwalks or appropriate dune crossovers at all public access sites without boardwalks. In order to accomplish Action 2.2.1.1 it is necessary to identify public access points within St. Andrew beach mice habitat that do not have boardwalks for public access and install boardwalks or appropriate dune crossovers at these sites.

2.2.1.1c Investigate other methods of providing beach access that protects the dunes and survives storm events. Because of the impacts of recent, frequent storms to dune crossover structures, other methods to provide public access while protecting the dunes need to be investigated.

2.2.1.2. Install appropriate dune crossovers for beach access at private and commercial developments. In order to establish habitat connectivity between public lands and adjacent private lands, private landowners within St. Andrew beach mice need to implement appropriate measures to require construction of appropriate dune crossovers to access the beach from their property.

2.2.1.2a Identify developments in need of boardwalks. Developments needing boardwalks, because of the impacts patrons or the residence are having on the dunes through accessing the beach, need to be identified. This would allow for areas that are being degraded and resulting in fragmentation of habitat to be targeted for actions established in Action 2.2.1.2b.

2.2.1.2b Establish boardwalks where the needs have been identified. The success of maintaining connectivity of St. Andrew beach mice habitat on public lands and private lands in part depends on the construction of boardwalks in areas identified as causing fragmentation of beach mice habitat.

2.2.2. Protect dunes from vehicular driving.

2.2.2.1. Map dunes impacted by vehicular driving. Areas within the dunes, which are impacted by vehicular driving, need to be identified and mapped. Once identified and mapped these areas can be targeted for additional conservation measures to better protect the dunes. By mapping these areas the success of protection measures could be monitored over time (Action 2.2.3.).

2.2.2.2. Increase enforcement and implement preventive measures. In areas that vehicular driving on or within the dunes has been identified, increased enforcement efforts need to be initiated. In all other areas,

current enforcement efforts need to be continued, with other appropriate measures implemented as needed.

2.2.3. Establish or continue monitoring program to document impacts to dunes from vehicular driving and pedestrian crossing. To effectively protect the dune systems within St. Andrew beach mouse habitat from impacts due to pedestrian crossing or vehicular driving, monitoring programs must be established or continued. These programs would need to determine if implemented measures are effective in keeping pedestrians and vehicles from impacting the dunes.

2.2.4. Research the degree feral hogs pose a threat to beach mice habitat and implement removal program if deemed necessary. Feral hog activities could have a significant impact on beach mouse habitat. Feral hog signs are being seen in some of the coastal dune systems (J. Mobley, pers. comm., 2005); however, the threat they pose to the St. Andrew beach mouse is not known. Research is needed to understand whether feral hogs pose a direct threat to the mice from habitat destruction. Ongoing monitoring should include attention to the presence of feral hogs and detection of any habitat damage from hogs.

2.3. Restore dune systems. The restoration of habitat is an important component of the recovery of the St. Andrew beach mouse. Because of the subspecies' limited range, impacts to existing habitat could greatly affect the overall health of the populations. Efforts to restore habitat that has been impacted by human activities or by natural events should be accomplished to provide the highest quality habitat over its range.

2.3.1. Map dune systems in need of restoration. The data developed in Action 2.1 would provide the basis for identifying those dune systems that are in need of restoration.

2.3.2. Develop restoration plan for dune systems on public lands. Each agency managing land with St. Andrew beach mice habitat should develop a restoration plan, if they have not done so, that defines standards and procedures for conducting dune restoration projects based on accepted dune restoration guidelines.

2.3.3. Restore dune systems on public lands. Restoration projects need to be prioritized and initiated for dune systems identified in Action 2.3.1 using standards and procedure established in Action 2.3.2.

2.3.4. Develop or update existing restoration guidance for dune systems on private lands. Restoration guidance that helps private landowners restore their coastal dune habitat is important. The development or update of existing documents that describe standard, accepted methods to restore coastal dunes, cost associated with these restoration efforts, sources of funding for

restoration projects in the form of landowner incentive programs, grants, sources for technical assistance, etc.

2.3.5. Restore dune systems on private lands. Provide assistance to private landowners seeking to restore their dune systems.

2.3.6. Establish a monitoring program to assess the effectiveness of restoration efforts. Establishing a monitoring program is an important component of any restoration effort. Without developing a monitoring program for restoration efforts, the effectiveness of these efforts would not be known. Monitoring needs to consist of consistent, standardized protocol for measuring the quality of coastal dune habitat. Part of this monitoring effort should include regular surveys to document signs of beach mice activity within the area.

2.4. Identify, map, and monitor areas where shoreline erosion is occurring adjacent to known, occupied beach mice habitat. The extent that shoreline erosion threatens St. Andrew beach mice populations is not well known. In order to get a better understanding of the potential threat, it is necessary to identify and map those areas where shoreline erosion is occurring within St. Andrew beach mice habitat. These sites then need to be monitored over time to determine the level of threat shoreline erosion poses to the St. Andrew beach mouse. If shoreline erosion poses a threat to a population(s) of St. Andrew beach mouse, then a management plan could be developed to address the threat if it is deemed necessary.

2.4.1. Investigate options for shoreline erosion protection if monitoring indicates a threat. If monitoring efforts of shoreline erosion indicate that there is a significant threat to beach mice, various measures need to be investigated to determine which measures would have the least impact to the habitat.

2.4.2. Implement option(s) for shoreline erosion protection, if deemed feasible. If shoreline erosion protection is determined to be necessary, the option(s) that are deemed feasible for protecting beach mice habitat from shoreline erosion shall be implemented.

3. Remove or investigate non-native predator threat to St. Andrew beach mice populations.

3.1. Remove free-roaming cats, feral cats, and cat colonies from areas with known or reestablished beach mice populations. Cats are known to prey on beach mice. It is believed that feral cats have caused, or in-part, have caused the extinction/extirpation of beach mice populations (Bowen 1968, Traylor-Holzer et al. 2005). Traylor-Holzer et al. (2005) found, when modeling the effects of cats on Alabama beach mouse population, that just one cat taking one beach mouse per day within a model unit (defined as “discrete Alabama beach mouse habitats having

distinct geographic features and/or similar threats…") would result in the extinction of that population.

3.1.1. Identify areas where cats are present. Surveys need to be conducted within St. Andrew beach mouse habitat to determine if and where cats/cat colonies are present so that removal programs could be initiated at these locations.

3.1.2. Continue to implement cat removal program on public lands. Where cat removal programs are established, these programs need to continue in order to keep cats from establishing themselves on public lands.

3.1.3. Identify areas with no cat removal program and establish a removal program. The establishment of a cat removal program on both public and private lands within St. Andrew beach mouse habitat is necessary in order to minimize or remove this threat. Traylor-Holzer et al. (2005) noted that if a cat removal program is "not routinely and comprehensively utilized, the effects of cats may become catastrophic," as indicated by their model runs. Therefore, those areas that do not have a cat removal program, but have a cat problem need to be identified and a removal program established.

3.1.4. Monitor effectiveness of free ranging cat (domestic and feral removal) efforts**.** A monitoring program needs to be established in order to monitor if cats are being effectively removed from areas known to have a cat problem. The results of this monitoring program would feed back into the removal program(s) to provide an adaptive mechanism.

3.2. Research the degree of threat other non-native predators (i.e., coyote and red fox) pose to known beach mice populations and implement removal program . Coyote and red fox are known or thought to predate beach mice (Van Zant and Wooten 2003); however, the degree to which they pose a threat to beach mice populations is unknown. Research is needed to determine if these non-native predators pose a serious threat to the existence of the St. Andrew beach mice populations.

4. Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands

4.1.1. Work with Bay County to provide protection of all beaches and dunes, within the county, from vehicular driving. The beach driving ordinance for Bay County provides restrictions for driving motor vehicles on beaches between "Alternative Highway 98 (Front Beach Road) and the water's edge of the Gulf of Mexico." This does not include those beaches in the eastern portion of the county between Highway 98 and the water's edge of the Gulf of Mexico.

4.1.2. Work with Bay and Gulf counties to adopt a feral cat removal program and mechanism(s) prohibiting feral cat colonies and free roaming cats. Feral cat removal programs could be an effective tool for minimizing the threat of feral cats to the St. Andrew beach mouse. For the long-term management of feral cats county level mechanisms need to be established prohibiting feral cat colonies and the support of such colonies. Without these mechanisms in place cats would continue to be a problem that necessitates management through removal programs.

4.1.3. Work with Bay and Gulf counties, where applicable, to require boardwalk access to all beaches from single-family, multi-family, and commercial developments. Mechanisms requiring the construction of boardwalks to access the beaches from both commercial and residential developments are important in protecting the dunes and allowing them to develop naturally. Boardwalks minimize the impact of dune crossings by beach goers and help maintain connectivity of habitat throughout its extent.

4.1.4. Work with Gulf and Bay counties, where applicable, to establish regulations for residential construction within the primary, secondary, and scrub dunes that minimize impacts to dunes and provide for connectivity of beach mice habitat. Land development within dune systems fragments and destroys beach mice habitat. In order to minimize the impact of development within the primary and secondary dune habitats land development mechanisms are needed. These mechanisms would still allow landowners to develop within the coastal dune system, but in a manner that reduces impacts to the habitat, while providing regulations that would increase the protection of their building(s). These mechanisms would include, but are not limited to: Site structures as far landward as possible to preserve the primary dune habitat; Site structures to preserve connectivity between primary, secondary and scrub dunes within property and adjacent property (see Appendix C for single-family homes and Appendix D for multi-family or commercial developments).

4.1.5. In partnership with Gulf and Bay counties, the Service consults on all development within the coastal dune system to provide guidance to the landowner on ways to minimize impacts to coastal dune system. Currently Bay and Gulf counties do not require landowners, who desire to build within the coastal dune system, to obtain review and guidance on minimization of impacts to the coastal dune habitat within their property. In partnership with these counties such consultation needs to be established as part of the formal land development process for private lands within the coastal dune system. This action will help to ensure that development within these areas minimizes impact to the St. Andrew beach mouse.

4.1.6. Monitor and enforce compliance with regulatory mechanisms for land development, cats, dune vehicular driving, and boardwalks. Since the goal

of these ordinances is to remove or minimize the current, identified threats to the St. Andrew beach mouse, it is important that a program is established to monitor compliance. This would allow for the effectiveness of these regulations to be tracked and the identification of the reappearance of the identified threats which could then be addressed.

4.1.7. Determine, in the Service's review, whether designation of CBRA units P30/P30P met the definition of the Act and/or whether there was a technical error in mapping at the time of designation as requested by Congress. The Service will continue to review the designation of CBRA units P30/P30P, as requested by Congress, to determine whether the unit(s), when designated, met the definition of the Act and whether there were any errors in mapping the unit(s).

5. Remove, minimize, or investigate other natural or manmade threats.

5.1. Minimize the potential catastrophic effect of tropical storm and hurricane events on the St. Andrew beach mouse. Hurricane season occurs between June and November of each year. There is the potential threat that a hurricane(s) may develop and strike near the known range of the St. Andrew beach mouse, with the greatest likelihood during August through October and September the peak (Traylor-Holzer et al. 2005). This is also the period of greatest stress to the St. Andrew beach mouse – warm weather and low food availability. Due to the limited range of this subspecies, the potential for one hurricane to strike and cause catastrophic effects to the entire range of the St. Andrew beach mouse exists. Although this threat can not be completely removed some steps can be taken to minimize the threat. Establishing multiple populations (see Action 1.2) and developing a plan that would set forth an emergency response would help to minimize the likelihood this subspecies would be wiped out by a storm event(s). Numerous discussions have taken place to address the most efficient and effective means of reducing the threat of catastrophic storm events, including taking a portion of the population into captivity, captive breeding, etc. However, solutions are still being evaluated.

5.1.1. Develop and implement emergency response plan. An emergency response plan would consist of steps needed to protect and conserve the subspecies when the threat of a storm is eminent. This plan should include, but not be limited to: provisions for a captive population, restoration of impacted habitat, implementation of a supplemental feeding program, and initiation of survey and monitoring activities post-storm.

5.1.2. Establish a monitoring program for the effectiveness of the emergency response plan. In order to determine if the above plan is effective, a monitoring program would need to be developed and implemented. The results of this monitoring program could then be used to update and refine the emergency response plan if necessary.

5.2. Minimize and investigate the threat of house mice populations within coastal dune systems. Briese and Smith (1973) suggested that house mice invade beach mice habitat that has become degraded or that provides structures suitable for their habitation. The presence of house mice in beach mice habitat has been suggested to pose a competitive threat to beach mice (63 FR 70053). However, the situation is not fully understood.

5.2.1. Minimize the occurrence of house mice within known beach mice habitat. Some simple and cost-effective measures could be taken to minimize those factors that benefit house mice, thereby discouraging them to inhabit beach mouse habitat.

5.2.1.1. Install animal proof garbage containers on public lands and public beach access sites. House mice feed on a variety of foods, which includes many human food items and their refuse (Whitaker and Hamilton 1998). In order to minimize a potential food source for house mice, public land managers need to continue to install animal proof garbage containers and replace those non-animal proof garbage containers that still exist. This would also have the added benefit of minimizing a food source for other species that could become nuisances (e.g., raccoons).

5.2.1.2. Work with private landowners to remove or minimize factors that attract house mice. By eliminating or minimizing things that attract or benefit house mice within private lands (i.e., abandoned buildings, non-animal proof garbage container, etc.), house mice would be less likely to establish themselves in the coastal dune systems.

5.2.1.3. Monitor the effectiveness of conservation efforts to reduce occurrence of house mice within beach mice habitat**.** A monitoring program needs to be established to monitor the status of house mice in St. Andrew beach mice habitat. The results of this monitoring program would aid in determining the effectiveness of management practices.

5.2.2. Conduct further research on house mice inhabiting beach mice habitat. In order to better understand whether house mice pose a threat to beach mice further research is needed.

5.2.2.1. Conduct research on the competitive effects of house mice on beach mice within a natural setting. Research is needed to further investigate the competitive effect of house mice on beach mice. Research should address questions like: Do house mice directly cause the decline of beach mice? Is a decline in beach mice due to the habitat degradation regardless of the presence of house mice? Do house mice utilize the same food? etc.

5.2.2.2. Conduct research on condition of the coastal dune habitat in which house mice occur. Briese and Smith (1973) suggested that house mice invade areas that are disturbed; however, further research is needed to determine the type(s) and degree of disturbance that are present where house mice occur within beach mice habitat. This information would allow for the development of specific management practices, if necessary, to effectively minimize or keep house mice from invading beach mouse habitat.

5.3. Minimize and investigate the effects of artificial lighting on beach mice. Artificial lighting is known to effect beach mice behavior (Bird et al. 2004); however, the effects and type of lighting are not fully understood. Currently not all communities within the St. Andrew beach mouse range have implemented ordinances requiring wildlife friendly lighting within the coastal dune systems (L. Patrick, pers. comm., 2005).

5.3.1. Conduct further research on the effects of various artificial light regimes on beach mice behavior. Research on the effects of artificial light on beach mice behavior is limited; however, it is believed to pose a potential threat. With a better understanding of the effects of various artificial light regimes on beach mice behavior, measures could be implemented to better manage the impact artificial light pollution may pose to beach mice.

5.3.1.1. Determine what artificial lighting regimes have the greatest and least effect on beach mice behavior. A full understanding of the effects different artificial lighting regimes have on beach mice has not been conducted. Research has shown that long-wavelength light, used to minimize impacts to sea turtles, affects the behavior of beach mice (Bird et al. 2004). However, we do not know what artificial lighting regime minimizes the impact to beach mice behavior; therefore, studies are needed to address this.

5.3.1.2. Determine the effects of artificial lighting on the long term survival of beach mice. A long-term study is needed to determine if and how artificial lighting effects the survival of beach mice populations. This would help in determining the degree to which artificial lighting poses a threat to the beach mice.

5.3.1.3. Investigate the effects of artificial lighting relative to fragmentation of beach mouse habitat at the landscape level. It is unknown if the effect of artificial lighting poses a threat to beach mice at a landscape level by further fragmenting suitable habitat. If artificial lighting did have a fragmenting effect on suitable habitat, it could negate the benefits of protecting habitat to provide connectivity between populations.

5.3.2. Minimize the effects of artificial light on public and private lands within the coastal dune systems inhabited by beach mice. By managing artificial lighting in beach mice habitat, based on information obtained from research, the effects of this factor could be minimized. This needs to be implemented on both private and public lands in order to provide the greatest conservation benefit to the subspecies.

5.3.2.1. Install approved sea turtle lighting or dark sky lighting within the dunes on public lands. Public land managers need to continue to install sea turtle lighting in areas visible from the beach and dark sky lighting in areas not visible from the beach on public lands within the coastal dune systems inhabited by beach mice. In addition, they should replace those light sources that do not meet the standards of full cutoff lighting, as defined by International Dark-Sky Association (International Dark-Sky Association 2002).

5.3.2.2. Work with public land managers to develop plans for their areas that address artificial light pollution in coastal dune systems on public lands. In order to minimize the threat of artificial lighting on beach mice in the long term public land managers need to develop management plan/guidelines that address artificial light pollution within the coastal dune systems on their lands.

5.3.2.3. Work with private landowners and local governments in coastal areas to replace conventional, artificial lighting with sea turtle or wildlife lighting. Private landowners and local governments are a key partner in minimizing the effects of artificial lighting in beach mice habitat. In order to more completely minimize this potential threat, agencies must work with private landowners and local governments to replace existing conventional, artificial lighting with sea turtle lighting in areas visible from the beach and wildlife lighting in areas not visible from the beach.

5.4. Determine the potential threat of the closing of the channel separating Choctawhatchee beach mice on West Crooked Island from St. Andrew beach mice on East Crooked Island. The threat of the closing of the channel that now separates Choctawhatchee beach mice on West Crooked Island from St. Andrew beach mice on East Crooked Island needs to be determined.

5.4.1. Develop a management plan to prevent the hybridization of Choctawhatchee beach mice and St. Andrew beach mice at West and East Crooked Island, respectively, if deemed to pose a threat. The development of a management plan defining management actions to prevent the hybridization of Choctawhatchee beach mice on West Crooked Island and St. Andrew beach

mice on East Crooked Island is necessary if monitoring efforts show that the channel separating the two subspecies is naturally closing.

5.4.2. Implement management plan to prevent the hybridization of Choctawhatchee beach mice and St. Andrew beach mice at West and East Crooked Island, respectively, if deemed to pose a threat. The management plan for preventing the hybridization of Choctawhatchee beach mice and St. Andrew beach mice at West and East Crooked Island, respectively, would need to be implemented when and if the channel separating the two subspecies closes

6. Facilitate stewardship of St. Andrew beach mice recovery through increased public awareness and education.

6.1. Develop a public outreach plan for addressing threats to St. Andrew beach mice and to the coastal dune systems they inhabit. The key to the success of the conservation and recovery of the St. Andrew beach mouse depends greatly on the development of an effective outreach program. Without the education of the general public, private landowners, commercial landowners, etc. recovery of this species is less likely. The following actions would help to develop an effective outreach plan.

6.1.1. Investigate what outreach materials/efforts are currently available and determine their target audience. A thorough search of the current outreach material and efforts related to beach mice, coastal dune ecosystems, and other coastal dune system information is necessary. The target audience for each of these materials/efforts needs to be determined.

6.1.2. Identify what areas and/or issues are not being addressed by current outreach materials/efforts. This information would help to identify areas lacking in outreach materials/efforts and target audiences that are not receiving the information.

6.1.3. Determine the effectiveness of existing outreach efforts. This action could be difficult to accomplish, but it is very important. A lot of outreach efforts have been conducted, but it is unknown if they have they been effective in getting the information out to the right audience and if the message was delivered effectively. This information could help in refine how an outreach plan is crafted to more effectively reach audiences that are most important.

6.1.4. Develop a coordinated outreach program effort for various target audiences. Due to the limited personnel, funding, and workloads of most agencies, it is important that a coordinated outreach program be developed for the various target audiences. This would reduce duplication of efforts, minimize efforts result in little return, and identify and utilize the strengths of each organization/agency to develop outreach materials/efforts.

6.2. Continue outreach efforts that increase the public's awareness of factors relating to identified threats to the St. Andrew beach mice. Many current outreach efforts related to those factors that have been identified as threats to the St. Andrew beach mice are occurring. These efforts need to continue while an outreach plan is being developed.

6.3. Establish partnership with Bay and Gulf counties' Environmental Services/ Permitting sections. Greater communication and close coordination between the Service and the county planning/environmental services sections are crucial in order to more efficiently and effectively address ESA related concerns and requirements associated with new developments and other construction in beach mice habitat. This increased cooperation will also help provide the public with a more consistent message about their responsibilities as set forth by the ESA when developing in beach mice habitat.

PART III. IMPLEMENTATION SCHEDULE

The following implementation schedule outlines the recovery actions with associated time and cost estimates for the St. Andrew beach mouse recovery program. The schedule is a guide for meeting the recovery objectives and criteria within this plan. It provides the action number; a description of the action to be performed; and an assigned priority for the recovery action. It also identifies the agency(s) and/or other parties that are the best candidates for accomplishing the recovery action.

The schedule is laid out by the overarching recovery actions and associated actions needed to help achieve the overarching recovery action. Recovery action priorities, time and cost estimates, and responsible parties are not assigned to the overarching recovery actions. The reader should refer to the recovery narrative outline for a full description of all identified recovery actions. Implementation of all actions listed in the implementation schedule will lead to recovery. Initiation of these actions is subject to availability of funds.

Key to Action Priority Numbers (Column 3)

Priority #	Priority Definition
1	Any action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
2	Any action that must be taken to prevent a significant decline in the species population, habitat quality, or some other significant negative impact short of extinction.
3	All other actions necessary to provide full recovery.

Key to Acronyms for Agencies and Organizations

ANNERR = Apalachicola National Estuarine Research Reserve
BC = Bay County
COE = U.S. Army Corps of Engineers, Mobile District
EAFB = Eglin Air Force Base
FDEP = Florida Department of Environmental Protection
FPS = Florida Park Service
FWCC = Florida Fish and Wildlife Conservation Commission
FWS = U.S. Fish and Wildlife Service
GC = Gulf County
NGO = Universities and/or other non-government
SJC = St. Joe Company
TAFB = Tyndall Air Force Base
USDA = USDA Wildlife Services

Key to Definitions for Terms Used

Continual	Task will be implemented on an annual or periodic basis once it is begun.
Ongoing	Task is currently being implemented and will continue until actions are no longer necessary for recovery.
TBD	Cost cannot be determined at this time; cost is dependent upon outcome of other recovery action(s).

IMPLEMENTATION SCHEDULE FOR THE ST. ANDREW BEACH MOUSE (*PEROMYSCUS POLIONOTUS PENINSULARIS*)

Recovery Action #	Recovery Action Description	Priority #	Recovery Action Duration	Responsible Parties[1]		Cost Estimates (in $1000)					
				Lead	Other	FY1	FY2	FY3	FY4	FY5	Total Cost
1.0	**Monitor status of existing populations and reestablish additional populations of St. Andrew beach mice**										
1.1.1	Establish monitoring program at known populations	2	10 yrs	FWCC	FPS, FWS, SJC	40	40	40	40	40	200
1.1.2	Establish monitoring programs for reestablished populations	2	10 yrs	FWCC	FWS, SJC	-	-	40	40	40	120
1.2.1.1	Prepare reintroduction plan for reestablishment of mice at St. Joe Beach	2	1 yr	FWS	SJC, FPS	-	5	-	-	-	5
1.2.1.2	Prepare reintroduction plan for reestablishment of mice at Cape San Blas	2	1 yr	FWS	EAFB, FPS	-	-	5	-	-	5
1.2.1.3	Determine which existing population(s) is best source for reestablishment projects	2	2 yr	FWS	FWCC, FPS	40	40	-	-	-	80
1.2.1.4	Translocate St. Andrew beach mice to St. Joe Beach and Cape San Blas	2	2 yr	FWS	EAFB, SJC	-	-	-	-	-	0
1.2.2.1	Identify additional, potential reestablishment sites	3	1 yr	FWS	FWCC, NGO	-	-	10	-	-	10
1.2.2.2	Prepare feasibility study for establishing populations at additional reestablishment sites, if additional potential sites are found	3	1 yr	FWS	FWCC	-	-	5	-	-	5
1.2.2.3	Implement a captive breeding feasibility study	3	1 yr	FWS	FWCC	-	-	5	-	-	5
1.3.1	Investigate genetic differences between Choctawhatchee beach mice on West Crooked Island and St. Andrew beach mice on East Crooked Island	3	2 yrs	FWS	NGO	-	50	50	-	-	100
1.3.2	Conduct further genetic analyses of historic populations on Crooked Island	3	2 yrs	FWS	NGO	-	50	50			100
1.3.3	Further investigate the genetic variation within and among St. Andrew beach mice populations	3	2 yrs	FWS	NGO		50	50			100
	Total for Objective 1					***80***	***235***	***255***	***80***	***80***	***730***
2.0	**Identify, protect, evaluate and restore St. Andrew beach mouse habitat**										
2.1.1	Map suitable habitat throughout range	2	1 yr	FWCC	FWS	15	-	-	-	-	15

IMPLEMENTATION SCHEDULE FOR THE ST. ANDREW BEACH MOUSE (*PEROMYSCUS POLIONOTUS PENINSULARIS*)											
Recovery Action #	**Recovery Action Description**	**Priority #**	**Recovery Action Duration**	**Responsible Parties**[1]		**Cost Estimates (in $1000)**					
				Lead	**Other**	**FY1**	**FY2**	**FY3**	**FY4**	**FY5**	**Total Cost**
2.1.2	Determine condition of suitable habitat	2	1 yr	FWCC	EAFB, FPS, FWS, SJC, TAFB	-	20	-	-	-	20
2.1.3	Determine occupied and unoccupied suitable habitat	2	1 yr	FWCC	FWS	-	-	20	-	-	20
2.2.1.1a	Map sites where dunes are impacted by pedestrians and determine appropriate sites for public access	2	Ongoing	FWS	BC, EAFB, FPS, GC, SJC, TAFB	3	1	1	1	1	7
2.2.1.1b	Install boardwalks or appropriate dune crossovers at all public access sites without boardwalks	2	Continual	FPS	BC, GC, TAFB	3	TBD	TBD	TBD	TBD	3
2.2.1.1c	Investigate other methods of providing beach access that protects the dunes and survives storm events	3	2 yrs	FPS	NGO	10	10	-	-	-	20
2.2.1.2a	Identify developments in need of boardwalks	2	Continual	BC, GC		2	2	2	2	2	10
2.2.1.2b	Establish boardwalks where the needs have been identified	2	Ongoing	BC, GC		2	2	2	2	2	10
2.2.2.1	Map dunes impacted by vehicular driving	3	Continual	FWS	ANERR, BC, FPS, EAFB, GC, SJC, TAFB	3	1	1	1	1	7
2.2.2.2	Continue enforcement efforts, increase enforcement, and measures taken where necessary	3	Ongoing	FWS	ANERR, BC, GC, FPS, SJC, TAFB	2	2	2	2	2	10
2.2.3	Establish or continue monitoring program to document impacts to dunes from vehicular driving and pedestrian crossing	3	5 yrs	FWS	ANERR, FPS, TAFB	2	2	2	2	2	10
2.2.4	Research threat feral hogs pose to beach mice habitat and implement removal program if deemed necessary	3	2 yrs	NGO	USDA	10	10	-	-	-	20

IMPLEMENTATION SCHEDULE FOR THE ST. ANDREW BEACH MOUSE (*PEROMYSCUS POLIONOTUS PENINSULARIS*)											
Recovery Action #	**Recovery Action Description**	**Priority #**	**Recovery Action Duration**	**Responsible Parties**[1]		**Cost Estimates (in $1000)**					
				Lead	**Other**	**FY1**	**FY2**	**FY3**	**FY4**	**FY5**	**Total Cost**
2.3.1	Map dune systems in need of restoration	3	Continual	FWS	ANERR, EAFB, FPS, TAFB	-	-	5	2	2	9
2.3.2	Develop restoration plan for dune systems on public lands	2	1 yr	FWS	EAFB, FPS, TAFB	5	-	-	-	-	5
2.3.3	Restoration of dune systems on public lands	2	Continual	FPS	EAFB, FPS, TAFB	-	-	-	30	30	60
2.3.4	Develop or update existing restoration guidance for dune systems on private lands	3	1 yr	NGO	ANERR, FWS, SJC	10	-	-	-	-	10
2.3.5	Restoration of dune systems on private lands	2	Continual	FWS	ANERR, BC, GC, SJC	-	30	30	30	30	120
2.3.6	Establish a monitoring program to assess the effectiveness of restoration efforts	3	5 yrs	FWS	ANERR, BC, EAFB, FPS, GC, SJC, TAFB	5	5	5	5	5	25
2.4.1	Investigate options for shoreline erosion protection if monitoring indicates a threat.	3	2 yrs	FDEP		20	20				40
2.4.2	Implement option(s) for shoreline erosion protection, if deemed feasible	3	Continual	FDEP		TBD	TBD	TBD	TBD	TBD	TBD
	Total for Objective 2					***92***	***105***	***70***	***77***	***77***	***421***
3.0	**Remove or investigate non-native predator threat to St. Andrew beach mice populations**										
3.1.1	Identify areas where cats are present	1	Continual	FPS	SJC, TAFB	20	2	2	2	2	28
3.1.2	Continue to implement cat removal program on public lands	1	Ongoing	USDA	EAFB, FPS, TAFB	10	10	10	10	10	50
3.1.3	Establish cat removal program on lands without an established program	1	Ongoing	USDA		10	10	10	10	10	50

IMPLEMENTATION SCHEDULE FOR THE ST. ANDREW BEACH MOUSE (*PEROMYSCUS POLIONOTUS PENINSULARIS*)											
Recovery Action #	**Recovery Action Description**	**Priority #**	**Recovery Action Duration**	**Responsible Parties[1]**		**Cost Estimates (in $1000)**					
				Lead	**Other**	**FY1**	**FY2**	**FY3**	**FY4**	**FY5**	**Total Cost**
3.1.4	Monitor effectiveness of free ranging cat (domestic and feral) removal efforts	1	5 yrs	USDA		2	2	2	2	2	10
3.2	Research degree of threat non-native predators pose to beach mice and implement removal program if deemed necessary	2	2 yrs	NGO	USDA	10	10	-	-	-	20
	Total for Objective 3					***52***	***34***	***24***	***24***	***24***	***158***
4.0	**Increase protection of beach mice through the creation, strengthening, and enforcement of regulatory mechanisms to protect coastal dunes and minimize or remove identified threats to the St. Andrew beach mouse on private lands.**										
4.1.1	Work with Bay County to provide protection of all beaches and dunes, within the county, from vehicular driving	3	1 yr	FWS	BC	5	-	-	-	-	5
4.1.2	Work with Bay and Gulf counties to adopt a feral cat removal program and mechanism(s) prohibiting feral cat colonies and at large cats	1	1 yr	FWS	ANERR, BC, FWCC, GC	5	-	-	-	-	5
4.1.3	Work with Bay and Gulf counties, where applicable, to require boardwalk access to all beaches from single-family, multi-family, and commercial developments	1	1 yr	FWS	ANERR, BC, GC	5	-	-	-	-	5
4.1.4	Work with Gulf and Bay counties, where applicable, to establish regulations for residential construction within the primary, secondary, and scrub dunes that minimize impacts to dunes and provide for connectivity of beach mice habitat	2	2 yr	FWS	BC, GC	5	5	-	-	-	10
4.1.5	In partnership with Gulf and Bay counties, the Service consults on all development within the coastal dune system to provide guidance to the landowner on ways to minimize impacts to coastal dune system	2	Ongoing	FWS	BC, GC	-	-	-	-	-	0

IMPLEMENTATION SCHEDULE FOR THE ST. ANDREW BEACH MOUSE (*PEROMYSCUS POLIONOTUS PENINSULARIS*)

Recovery Action #	Recovery Action Description	Priority #	Recovery Action Duration	Responsible Parties[1]		Cost Estimates (in $1000)					
				Lead	Other	FY1	FY2	FY3	FY4	FY5	Total Cost
4.1.6	Monitor and enforce compliance with newly established ordinances for land development, cats, dune vehicular driving, and boardwalks	1	5 yrs	BC, GC		2	2	2	2	2	10
4.1.7	Determine, in the Service's review, whether the designation of CBRA units P30/P30P met the definition of the Act and/or whether there was a technical error in mapping at time of designation	3	Ongoing	FWS		5	TBD	TBD	TBD	TBD	5
	Total for Objective 4					***27***	***7***	***2***	***2***	***2***	***40***
5.0	**Remove, minimize, or investigate other natural or manmade threats**										
5.1.1	Develop and implement emergency response plan	1	1 yr	FWS	ANERR, FWCC	35	-	-	-	-	35
5.1.2	Establish monitoring plan for effectiveness of emergency response plan	1	10 yrs	FWS	FWCC	25	0	25	0	25	75
5.2.1.1	Install animal proof garbage containers on public lands and public beach access sites	2	1 yr	FPS	BC, EAFB, GC, TAFB	7.5	-	-	-	-	7.5
5.2.1.2	Work with private landowners to remove or minimize those factors that attract house mice	2	2 yrs	FWCC	FWS	5	5	-	-	-	10
5.2.1.3	Monitor effectiveness of conservation efforts to reduce occurrence of house mice within beach mice habitat	3	5 yrs	FWCC	FPS, FWS, NGO	1	1	1	1	1	5
5.2.2.1	Conduct research on competitive effects of house mice on beach mice	3	2 yrs	NGO	FWCC, FWS	30	30	-	-	-	60
5.2.2.2	Research conditions of coastal dune habitat inhabited by house mice	3	2 yrs	NGO	FWCC, FWS	60	60	-	-	-	120
5.3.1.1	Determine what artificial lighting regimes have the greatest and least effect on beach mice behavior	2	2 yrs	NGO	FWCC, FWS	30	30	-	-	-	60
5.3.1.2	Determine effects of artificial lighting on long term survival of beach mice	3	5 yrs	NGO	FWCC, FWS	30	30	30	30	30	150
5.3.1.3	Investigate the effects of artificial lighting relative to fragmentation of beach mouse habitat at the landscape level	2	2 yrs	NGO	FWCC, FWS	30	30	-	-	-	60

IMPLEMENTATION SCHEDULE FOR THE ST. ANDREW BEACH MOUSE (*PEROMYSCUS POLIONOTUS PENINSULARIS*)

Recovery Action #	Recovery Action Description	Priority #	Recovery Action Duration	Responsible Parties[1]		Cost Estimates (in $1000)					
				Lead	Other	FY1	FY2	FY3	FY4	FY5	Total Cost
5.3.2.1	Install approved sea turtle lighting or dark sky lighting within the dunes on public lands	2	1 yr	FWS	EAFB, FPS, TAFB	10	-	-	-	-	10
5.3.2.2	Work with public land managers to develop plans for their areas that addresses artificial light pollution in coastal dune systems on public lands	2	1 yr	FWS	EAFB, FPS, TAFB	5	-	-	-	-	5
5.3.2.3	Work with private land owners and local governments in coastal areas to replace conventional, artificial lighting with sea turtle or wildlife lighting	2	2 yrs	FWS	BC, GC	20	20	-	-	-	40
5.4.1	Develop a management plan to prevent the hybridization of Choctawhatchee beach mice and St. Andrew beach mice at West and East Crooked Island, respectively, if deemed to pose a threat	2	1 yr	FWS	FWCC, TAFB	10	-	-	-	-	10
5.4.2	Implement management plan to prevent the hybridization of Choctawhatchee beach mice and St. Andrew beach mice at West and East Crooked Island, respectively, if deemed to pose a threat	2	Continual	FWS	FWCC, TAFB, COE	TBD	TBD	TBD	TBD	TBD	TBD
	Total for Objective 5					***298.5***	***206***	***56***	***31***	***56***	***647.5***
6.0	**Facilitate recovery of St. Andrew beach mice through increased public awareness, education, and stewardship.**										
6.1.1	Investigate outreach materials/efforts currently available and determine their target audience	2	1 yr	FWS	ANERR, NGO	10	-	-	-	-	10
6.1.2	Identify areas/issues are not being addressed by current outreach materials/efforts	2	1 yr	FWS	ANERR, FWCC	5	-	-	-	-	5
6.1.3	Determine effectiveness of existing outreach efforts	2	1 yr	FWS	ANERR, NGO	2	-	-	-	-	2
6.1.4	Develop a coordinated outreach program effort for various target audiences	2	2 yrs	FWS	ANERR, FWCC, NGO	20	10	-	-	-	30

IMPLEMENTATION SCHEDULE FOR THE ST. ANDREW BEACH MOUSE (*PEROMYSCUS POLIONOTUS PENINSULARIS*)											
Recovery Action #	**Recovery Action Description**	**Priority #**	**Recovery Action Duration**	**Responsible Parties[1]**		**Cost Estimates (in $1000)**					
				Lead	**Other**	**FY1**	**FY2**	**FY3**	**FY4**	**FY5**	**Total Cost**
6.2	Continue outreach efforts that increase the public's awareness of factors relating to identified threats to the St. Andrew beach mice	2	Ongoing	FWS	ANERR, FDEP, FWCC	10	10	10	10	10	50
6.3	Establish partnership with Bay and Gulf counties' Environmental Services/ Permitting sections.	1	Ongoing	FWS	BC, GC	-	-	-	-	-	0
	Total for Objective 6					***47***	***20***	***10***	***10***	***10***	***97***

[1]Does not commit identified party to doing the work; it just identifies the best candidate for completing the action

Total Estimated Cost: $2,093,500

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PART V. APPENDICES

Appendix A. List of Acronyms and Glossary of Terms

ACRONYMS

The following are a list of acronyms found throughout this document:

AFB	Air Force Base
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resource System
CFR	Code of Federal Regulations
ESA	The Endangered Species Act of 1973, as amended
FDEP	Florida Department of Environmental Protection
FWC	Florida Fish and Wildlife Conservation Commission
FPS	Florida Park Service (division of FDEP)
FEMA	Federal Emergency Management Agency
FR	Federal Register
FWS	U.S. Fish and Wildlife Service
INRMP	Integrated Natural Resources Management Plan
NMFS	National Marine Fisheries Service
NRB	Natural Resources Branch (Tyndall Air Force Base)
USDA	U.S. Department of Agriculture

GLOSSARY

The following are definitions of terms used within this document:

Cutoff Fixture – a fixture that provides a cutoff (shielding) of the emitted light (IDA 2002).

Dark Sky Lighting – full cutoff fixtures as defined by the International Dark-Sky Association.

Frontal Dunes – dune system comprised of the primary and secondary dunes

Full-Cutoff Shielded Fixtures – a luminaire light distribution where zero candela intensity occurs at an angle of 90^{o} above nadir, and at all greater angles from nadir. Additionally, the candela per 1000 lamp lumens does not numerically exceed 100 (10%) at a vertical angle of 80^{o} above nadir. This applies to all lateral angles around the luminaire. This kind of luminaire emits no light above the horizontal (International Dark-Sky Association 2002).

Primary Dunes – dune line that is furthest seaward

Sea Turtle Lighting – full cutoff fixtures, low pressure sodium, 480 lumen bug bulbs, compact fluorescent, or light-emitting diode (LED).

Secondary Dunes - Dune lines landward of the primary dune just prior to the scrub dunes

REFERENCE

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Appendix B. Threat Assessment Parameters and Ranking Values

Threat assessment parameters and ranking values were defined as (the value within the parentheses ( ), below, denotes the corresponding numeric value assigned):

Severity – measure of the degree or level that a stressor poses a threat to the species or its habitat over time under current conditions.

> Level of Impact – degree reference for severity. Level of Impact is defined as the degree at which the stressor poses a threat. Ranking values were: High (4); Medium (3); Low (2); Unknown (1).
>
> Immediacy - temporal reference for severity. Immediacy is defined as a stressor that is occurring now or is a potential stressor in the future. Ranking values were: Current stressor (2); Potential stressor (1).
>
> Likelihood – likelihood is defined as the likelihood the stressor in itself could cause extinction of the species. This was a way of measuring the degree by which the stressor is an independent stressor or a cumulative/additive stressor. In other words, does it pose an extinction threat by itself or does it pose an extinction threat not by itself, but in combination with other stressors? Ranking values were: High (4) - high likelihood that could cause extinction by itself; Moderate (3) - somewhat likely it could cause extinction by itself; Low (2) - not very likely it will cause extinction by itself; Unknown (1).

Scope – the extent, both spatially and temporally, that a stressor poses a threat to the species.

> Spatial Extent – a spatial reference for scope. Spatial extent is defined as the geographic extent for which the stressor poses a threat to the species. For instance, does the stressor only pose a threat to part of the known range or to the entire range? Ranking values were: Entire (4) - entire range; Partial (3) - more than one part of the range; Local (2) - one part of the range; Unknown (1).
>
> Temporal Extent – a temporal reference for scope. Temporal extent is defined as the seasonal extent for which the stressor poses a threat to the species. For instance, does the stressor only pose a threat to part of the year (e.g., hurricanes) or the entire year (e.g., development)? Ranking values were: Continuous (3) - all the time; Seasonal (2) - part of the year; Unknown (1).

Management – management is defined as a measure of conservation actions taken to preserve, protect, and/or conserve the species.

> Response – the likelihood that a management action(s) to remove the stressor will result in a positive response. Ranking values were: High (4) - high likelihood of responding to management; Medium (3) - medium likelihood of responding to management; Low (2) - low likelihood of responding to management; Unknown (1).

Feasibility – the measure of our ability to develop management for the stressor. This encompasses technical, fiscal, logistical, legal, and/or social roadblocks. Ranking values were: Feasible (3) - Feasible to manage; Possible (2) - Possible to manage; Unfeasible (1) - Not possible to manage.

The threat assessment parameters for each stressor were then given an overall score based on the ranking values.

Score - Score is a priority rank for each stressor. The priority rank score was calculated by summing the values assigned to each threat assessment parameter for each of the stressors. This score attempts to take into account the overall threat a stressor poses to the species and how well these stressors can be abated. This is an attempt to guide us in addressing which stressors in what order.

Threat - Threat priority rank score looks at the overall threat the stressor poses to the species based on severity and scope. By ranking stressors just by severity and scope we are able to identify which stressors are perceived to pose the greatest threat to the species. Management parameters were not figured into this score because it was thought that it would obscure which stressors posed the greatest threat. The overall threat rank was calculated by:

Overall Threat = $SS_1 + SS_2$
where:
SS_1 = Severity Score;
SS_2 = Scope Score

$SS_1 = Li + I + L$
where:
Li = Level of Impact;
I = Immediacy;
L = Likelihood

$SS_2 = Se + Te$
where:
Se = Spatial Extent;
Te = Temporal Extent

Management - Management priority rank score looks at the overall "value" of addressing the threat with some management action. Threat assessment based on severity and scope measures allows us to identify those stressors that are of greatest threat to the species. The management priority rank score allows subsequent prioritization of those stressors based on which ones would give us the best "bang for the buck." This most notably comes into play when two or more stressors obtain the same priority rank score based on severity and scope measures. The management priority rank score allows those equally scored stressors to be prioritized by which

ones would be more effective and feasible to manage. This addresses cost/benefit. The overall management rank was calculated by:

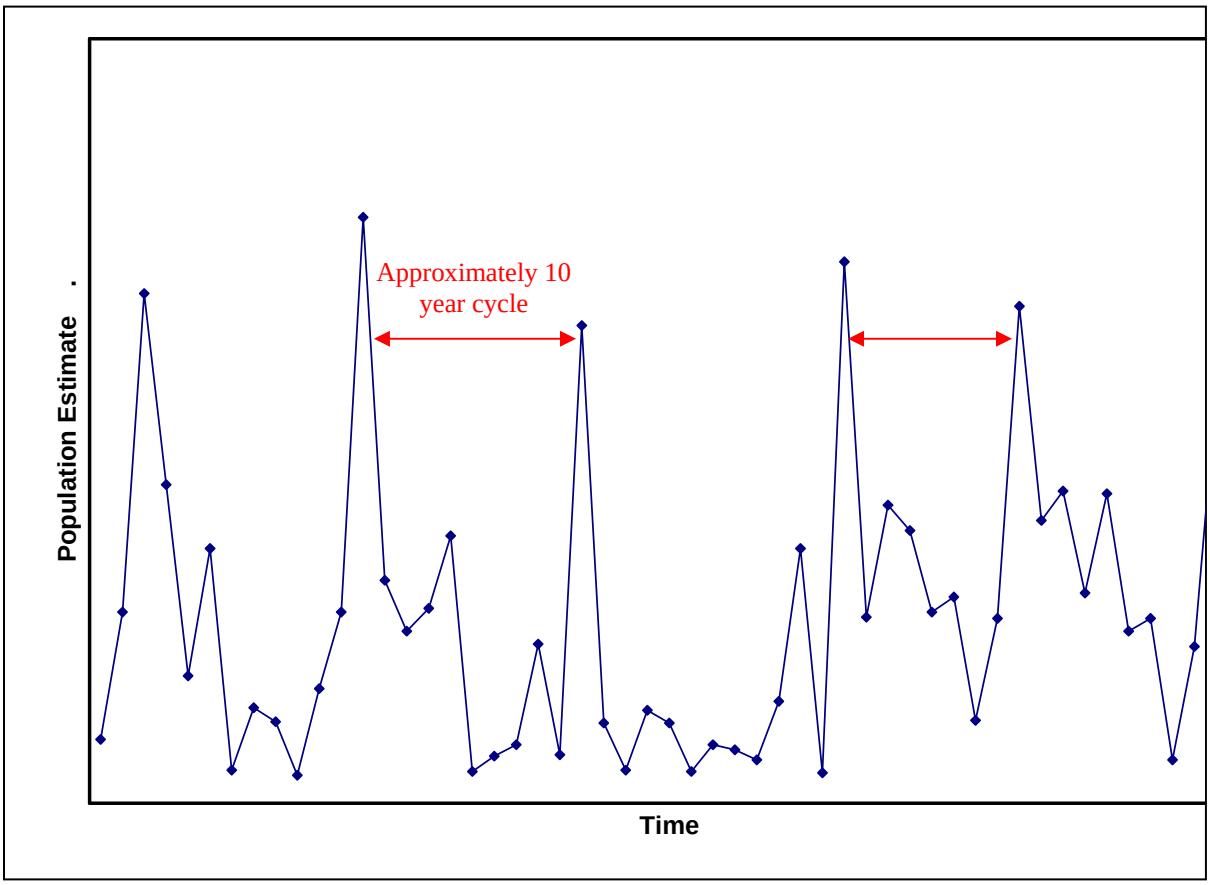
Overall Management = $R + F$
where:
R = Response;
F = Feasibility

Overall - Overall score is the summation of all severity, scope, and management parameter values. This provides the overarching priority of each stressor taking into account the degree of threat and the management of that threat (i.e., the higher the overall score, the higher the priority). The overall rank was calculated by:

Overall = $TS + MS$
where:
TS = Overall Threat Score;
MS = Overall Management Score

Appendix C. The Natural Cyclic Nature of Beach Mice Populations

While beach mice are short-lived species, the cyclic nature of their populations require longer-term monitoring in order to detect trends. In order to accurately assess population dynamics, it is necessary to track the population through several cycles. Consequently, demographic recovery criteria for the St. Andrew beach mouse have been created to detect these trends.



General graphic depicting cyclic nature of beach mice populations over time.

Appendix D. Coastal Construction Conservation Measures to Protect Beach and Dune Habitat for Single-Family Homes

Coastal Construction Conservation Measures to Protect Beach and Dune Habitats

Conservation measures can be implemented that would protect beach and dune habitats of coastal species including sea turtles, beach mice, shorebirds, and dune vegetation. A strong dune system is important for the first line of defense against storms to help protect human lives, property, and upland habitats.

Sea turtles come ashore to nest on the beach from May through October. Optimal nesting habitat is a dark beach free of barriers that restrict their movement. Nesting shorebirds lay their nests, raise their young, and forage for food from April through August. Shorebirds depend upon beach and dune habitats with minimal human disturbance. Wintering shorebirds need the beach and dune habitats to feed and rest escaping the colder weather from the north. Beach mice are nocturnal and forage for food throughout the dune system. Beach mouse habitat can comprise separate or a mixture of habitats including primary, secondary, scrub dunes, and interdunal areas. Beach mice dig burrows mainly in the primary dunes and in other secondary and interior scrub dunes where the vegetation provides cover.

Conservation Measures for Single-family Homes

1. Minimize structure footprint to reduce overall impacts to dune habitats. For beachfront projects, site the structure as far landward as possible to conserve primary dune habitats.

2. Site the construction footprint to preserve connection between primary, secondary, and scrub dune habitats onsite and with adjacent properties

3. Install a minimal size boardwalk over the dunes for beach access. The boardwalk should be designed to allow natural dunes to grow (a minimum of three feet above grade). Avoid creating a weak spot that could blow out in a storm.

4. Landscape using only native plants and soils characteristic of local dune habitats. No lawn sod.

5. Install sea turtle lighting including windows and glass doors around the entire homesite. This will reduce the direct and ambient lighting of the beach and dune habitats within and adjacent to the project site. The lighting plan should be reviewed and approved by the Fish and Wildlife Service.

6. Prohibit free movement of pets in beach and dune habitats. Do not encourage (feed) feral cats in dune habitats.

7. Provide sturdy animal-proof garbage containers to prevent the invasion of house mice and their predators.

8. Post or fence property boundaries that allow movement of native wildlife to and from adjacent habitats and control access by people and pets.

Implementation of these measures will help protect coastal habitat. For additional information please contact:

U.S. Fish and Wildlife Service
1601 Balboa Avenue
Panama City, Florida 32405
(850) 769-0552

Appendix E. Coastal Construction Conservation Measures to Protect Beach and Dune Habitat for Multi-Family or Commercial Developments

Coastal Construction Conservation Measures to Protect Beach and Dune Habitats

Conservation measures can be implemented that would protect beach and dune habitats of coastal species including sea turtles, beach mice, and shorebirds. A strong dune system is important for the first line of defense against storms to help protect human lives, property, and upland habitats.

Conservation Measures for Multi-family or Commercial Developments

1. Minimize development footprint to reduce overall impacts to dune habitats.

2. Site the development as far landward as possible to conserve primary dune habitats.

3. Maximize the quality of non-developed areas within the development by connecting dune habitats and landscaped areas using native vegetation.

4. Limit pedestrian crossing of dune habitat by installing the minimal number and size boardwalks over the dunes for beach access. The boardwalk should be designed to allow natural dunes to grow. Avoid creating a weak spot that could blow out in a storm. .

5. Landscape using only native plants and soils characteristic of local dune habitats.

6. Install sea turtle lighting within the entire development. This will reduce the direct and ambient lighting of the beach and dune habitats within and adjacent to the project site.

7. Prohibit free movement of pets in beach and dune habitats. Do not encourage (feed) feral cats in dune habitats.

8. Provide sturdy animal-proof garbage containers to prevent the invasion of house mice and their predators.

9. Remove all beach chairs, umbrellas, etc., from the beach ***each night*** from May 1 through October 31. These should be moved either to landward of the CCCL or to a storage enclosure seaward of the CCCL .

10. Incorporate the above Conservation Measures as Covenants and Restrictions for the development.

Implementation of these measures will help protect coastal habitat. For additional information please contact:

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