

Perdido Key Beach Mouse
(Peromyscus polionotus trissyllepsis)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Southeast Region
Panama City Field Office
Panama City, Florida

5-YEAR REVIEW
Perdido Key Beach Mouse/*Peromyscus polionotus trissyllepsis*

I. GENERAL INFORMATION

A. Methodology used to complete the review

This review was completed by the Service's lead recovery biologist for the Perdido Key beach mouse (PKBM) located at the Panama City Field Office. Information sources include the Recovery Plan for the Choctawhatchee Beach Mouse, PKBM, and Alabama Beach Mouse (1987), peer-reviewed scientific publications, unpublished reports, ongoing field survey results and information from qualified Service and State biologists, the final rule listing the subspecies, recently revised critical habitat (2006), and peer review comments (Appendix A). All literature and documents used for this review are on file at the Panama City Field Office. All recommendations resulting from this review are the result of thoroughly reviewing all available information on the Perdido Key beach mouse. No part of the review was contracted to an outside party. The public notice for this review was published on September 27, 2006, with a 60-day public comment period.

B. Reviewers

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Daphne Field Office (Cooperator) – Carl Couret, 251-441-5868

Peer Reviewers – Jeff Gore, Ron Loggins, Harold Mitchell, Jeff Van Zant

C. Background

1. FR Notice citation announcing initiation of this review: 71 FR 56545 (September 27, 2006)

2. Species status: Decreasing; Recovery Data Call 2006: Damage to habitat from the tropical storm events of 2004 and 2005, feral cat populations, and continued habitat loss and fragmentation are believed to be causes of the decline observed in trapping data.

3. Recovery achieved: 1 (0-25% recovery objectives achieved); Recovery Data Call 2006

4. Listing history

Original Listing

FR notice: 50 FR 23872

Date listed: June 6, 1985

Entity listed: Subspecies

Classification: Endangered

5. Associated rulemakings

Critical habitat was designated at the time of listing (1985), and revised October 12, 2006 (71 FR 60238).

6. Review History

Recovery Plan, August 12, 1987

Status Review, 1991: In this review (56 FR 56882), different species were simultaneously evaluated with no species-specific, in-depth assessment of the five factors and threats as they pertained to the different species' recovery. The notices summarily listed these species and stated that no changes in the designation of these species were warranted at that time. In particular, no changes were proposed for the status of the PKBM in the review.

Recovery Data Calls: 2000 (declining); 2001 (improving); 2002 (improving); 2003 (improving); 2004 (unknown); 2005 (unknown); 2006 (declining).

7. Species' Recovery Priority Number at start of review (48 FR 43098):

3c

The PKBM is assigned a recovery priority of 3c because the degree of threat to its persistence is high, it is a subspecies with high level of taxonomic distinctness, and its potential for recovery is great if threats can be eliminated or minimized. Recovery of the PKBM is in conflict with economic activities, a factor which further elevates its priority ranking.

8. Recovery Plan or Outline

Name of plan: Choctawhatchee Beach Mouse, PKBM, and Alabama Beach Mouse Recovery Plan

Date issued: August 12, 1987

II. REVIEW ANALYSIS

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

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

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

B. Recovery Criteria

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

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

No, the approved recovery plan for the Perdido Key beach mouse (1987) is not up-to-date in regard to species' status and threats. Recovery criteria may be considered subjective or not measurable, since "self-sustaining" and "protected" and even "occupied" can be difficult to define. The criteria do not address specific threats to the species. Also, as PKBM critical habitat has been revised, the criterion involving a percentage of occupied and protected critical habitat may also warrant modification. Revision of the recovery plan and recovery criteria is recommended. Our recommendations within this review are based on recent demographic information and the five factor or threat analysis.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

No, the five listing factors are not addressed in the current recovery plan's recovery criteria.

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

"Each subspecies of beach mouse can be considered for downlisting to threatened when there are 3 distinct, self-sustaining populations in each of the critical habitat areas, and a minimum of 50% of the critical habitat is protected and occupied by mice."

Since the Recovery Plan was finalized (1987), all populations of PKBM have been extirpated at some time. Through translocation efforts, at least one population has remained viable to present day (see II.C.1.b). Currently, PKBM are present on two public land areas. Translocation efforts will be necessary to establish a third population. Current occupation and densities on adjacent private lands are unknown.

Critical habitat has been recently revised (71 FR 60238). The second criterion (minimum of 50% of critical is protected and occupied by mice) has not been met for either the original critical habitat or the recently revised critical habitat.

C. Updated Information and Current Species Status

1. Biology and Habitat

Recent information concerning their biology and habitat can be found in the revised critical habitat designation (70 FR 74426, 71 FR 60238) and is summarized below.

a. Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends

Long-term trapping data have shown that beach mouse densities are cyclic and fluctuate by magnitudes on a seasonal and annual basis. These fluctuations can be a result of reproduction rates, food availability, habitat quality and quantity, catastrophic events, disease, and predation (Blair 1951; Bowen 1968; Smith 1971; Hill 1989; Rave and Holler 1992; Swilling et al. 1998; Swilling 2000; Sneckenberger 2001). Without suitable habitat sufficient in size to support the natural cyclic nature of beach mouse populations, subspecies are at risk from local extirpation, and may not attain the densities necessary to persist through storm events and seasonal fluctuations of resources.

Unlike many species that have annually-based life cycles and can be sampled annually to determine population parameters, beach mice breed year-round with up to 13 generations (overlapping and asynchronous among individuals) within one year. To calculate demographic and population growth rates for beach mouse populations, trapping would need to occur on a monthly or bi-monthly basis. Furthermore, because of annual and seasonal population fluctuations common to small mammals and differences between sites, abundance data alone carry little meaning, particularly when trapping is incidental. Consequently, as the data we currently collect or have access to are limited, population trends of PKBM are based on occupation or simple comparisons in recent tracking or trapping sessions, sometimes of only one site.

Since its listing in 1985, PKBM population estimates never reached more than 400 to 500 individuals until 2003. Before Hurricane Ivan (2004), trapping survey data led to a population estimate of 500 to 800 which was divided between two populations - the Johnson Beach Unit of Gulf Islands National Seashore (GINS) and Perdido Key State Park (PKSP)(Service 2004). The population of PKBM at Gulf State Park – Florida Point (GSP) was likely extirpated in 1999. In October 2005, following the active hurricane seasons of 2004 and 2005, a trapping effort of less than one-third of the habitat available on public lands yielded captures of less than 30 individuals. Tracking data from June 2006 indicated that about 25 and 32 percent of the available habitat was occupied at PKSP and GINS, respectively (Loggins 2007). Trapping at PKSP and GINS in March 2007 was cancelled after one night following the capture of only one mouse (a fatality) and

very limited sightings of beach mouse sign (tracks, burrows) (Loggins 2007). Tracking data from March 2007 indicated that less than 10 percent and about 28 percent of the available habitat was occupied at PKSP and GINS, respectively (Loggins 2007).

In summary, PKBM appear to be on the decline and/or at disconcertingly low densities. PKSP and GINS sites have not been trapped since October 2005, and tracking tube data suggests that the population has declined since. Furthermore, as the area within PKBM's historic range has experienced continued rapid growth, suitable habitat on private lands has become increasingly fragmented.

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

Apparent survival rate estimates (products of true survival and site fidelity) of beach mice along the Gulf Coasts of Florida and Alabama have demonstrated that their average life span is about nine months (Swilling 2000). Other research indicated that 63% of Alabama beach mice lived (or remained in the trapping area) for four months or less, 37% lived five months or greater, and 2% lived 12 to 20 months (Rave and Holler 1992). Less than half (44 percent) of beach mice captured for the first time were recaptured the next season (Holler et al. 1997). Greater than ten percent of mice were recaptured three seasons after first capture, and four to eight percent were recaptured more than one year after initial capture. Beach mice held in captivity have lived three years or more (Blair 1951; Holler 1995).

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)

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

The effects of Hurricane Frederic (1979) coupled with increased habitat fragmentation due to human development led to the extirpation of all but one population of PKBM (Meyers 1983). Less than 30 individuals at GSP were once the only known existing population of PKBM (Holler et al. 1989). Beach mice from this site were used to re-establish PKBM at GINS between 1986 and 1988; (Holler et al. 1989), and PKBM from GINS were translocated to PKSP in 2000. By that time, the GSP population was considered extirpated (Moyers et al. 1999).

Genetic analysis of post-re-establishment genetic structure in PKBM (prior to the GINS to PKSP translocation) determined the following: (1) founder effect (from GSP to GINS) did impact the GINS subpopulation and loss of rare alleles and allele frequency shifts were noted; (2) a low to moderate level of overall genetic divergence was observed; (3) data suggest that some effects of genetic drift were mediated by continued transfer of individuals; (4) levels of heterozygosity were unexpectedly high given recent history; (5) average level of relatedness among individuals is high which may portend future inbreeding related problems and no substantial evidence of existing close inbreeding was observed in the data; and 6) the overall level of microsatellite variation retained in the GINS subpopulation was higher than anticipated (Wooten and Holler 1999).

c. Taxonomic classification or changes in nomenclature

Since the listing of the PKBM, further research concerning the taxonomic validity of the subspecific classification of beach mice has been initiated and/or conducted. Preliminary results from these studies support the separation of beach mice from inland forms, and support the currently accepted taxonomy (Bowen 1968) that each beach mouse group represents a unique and isolated subspecies.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.)

Historically, PKBM were documented to occur on Perdido Key in coastal dune habitat between Perdido Bay, Alabama and Pensacola Bay, Florida (50 FR 23872). Habitat loss and fragmentation associated with residential and commercial real estate development has reduced the distribution of the Perdido Key beach mouse to a portion of its historic range, and is the primary threat contributing to the endangered status of beach mice (Holler 1992; Humphrey 1992). Coastal development has fragmented the subspecies into two disjunct populations at GINS and PKSP, with the GSP considered extirpated. Private lands between these public areas are fragmented to various extents, but beach mice also have been documented in these areas.

Gulf State Park consists of 115 acres of PKBM habitat in southern Baldwin County, Alabama, on the westernmost region of Perdido Key. PKBM were known to inhabit this unit during surveys in 1979 and 1982, and by 1986 this was the only known existing population of the subspecies (Humphrey and Barbour 1981; Holler et al. 1989). This population of less than 30 individuals was the donor for the reestablishment of PKBM into Gulf Islands National Seashore in 1986. This project ultimately saved Perdido Key beach mice from extinction as the population at Gulf State Park was considered extirpated in 1998 due to tropical storms and predators (Moyers et al. 1999).

Perdido Key State Park consists of 238 acres of PKBM habitat in southern Escambia County, Florida. Trapping efforts in this area were limited in the past. In 2000, a relocation program began to reestablish mice at Perdido Key State Park. This project was considered a success. However, due to damage from storm surge during the 2004 and 2005 storm seasons, PKBM are detected on only 10 percent of the beach mouse habitat available, indicating low densities (Loggins 2007).

Gulf Islands National Seashore consists of 638 acres of PKBM habitat in southern Escambia County, Florida, on the easternmost region of Perdido Key. Beach mouse habitat on GINS provides the longest contiguous expanse of frontal dune habitat within the historic range of the PKBM. PKBM were known to inhabit this unit in 1979, though the population was impacted by Hurricane Frederic (1979) therefore, the unit was unoccupied at the time of listing. However, no beach mice were captured during surveys in 1982 and 1986 (Humphrey and Barbour 1981; Holler et al. 1989). In 1986, PKBM were re-established to GINS as part of State of Florida and Service recovery efforts. In 2000 and 2001, PKBM captured from this site served as donors to re-establish beach mice at PKSP. Due to damage from storm surge during the 2004 and 2005 storm seasons, PKBM are detected on approximately 30 percent of the beach mouse habitat available (Loggins 2007).

Beach mice naturally persist through local extirpations due to storm events or the harsh, stochastic nature of coastal ecosystems. Historically, these areas would be recolonized as population densities increased and dispersal occurred from adjacent populated areas. From a genetic perspective, beach mice recover well from population size reductions (Wooten 1994), given sufficient habitat is available for population expansion after the bottleneck occurs. As residential and commercial development has fragmented the coastal dune landscape, beach mice can no longer recolonize along these areas as they did in the past (Holliman 1983). As a continuous presence of beach mice or suitable habitat along the coastline does not currently exist and any hurricane can impact the entire range of the subspecies, the probability of beach mice persisting would be enhanced by the restoration of contiguous tracts of suitable habitat occupied by multiple independent populations (Shaffer and Stein 2000; Danielson 2005).

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)

The primary and secondary dunes (frontal dunes) were previously considered optimal beach mouse habitat since it is where the mice were thought to 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). Recent evidence, however, has indicated that scrub dunes are an important component of beach mouse habitat (Swilling 2000, Sneckenberger 2001). Furthermore, the scrub dunes appear to serve as refugia for beach mice during and after a tropical storm event (Holliman 1983, Swilling et al. 1998), from which recolonization of the frontal dunes takes place (Swilling et al. 1998, Sneckenberger 2001). The 2006 revision of critical habitat includes scrub dune habitat.

Approximately 1300 acres of Perdido Key beach mouse habitat currently exists. While approximately 76 percent of their remaining habitat is public land, due to recent hurricanes and increasing recreational pressure on public lands, this habitat is in very poor condition. At GSP, scrub habitat is separated from the frontal dunes by a highway in some areas. Consequently, the population inhabiting this unit can be especially vulnerable to hurricane impacts, and therefore further linkage to scrub habitat and/or habitat management would improve connectivity. Improving and/or restoring habitat connections would also increase habitat quality at PKSP and provide more functional connectivity for dispersal, exploratory movements, and population expansion. As the majority of the PKBM habitat at GINS consists of frontal dunes, the population inhabiting this area is particularly threatened by storm events. Threats common to all three public land areas that may require special management considerations include artificial lighting, 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, and/or a decrease in habitat quality.

Maintaining habitat on private lands continues to be imperative to preserve connectivity and allow for population expansion.

f. Other natural factors (hurricanes)

Hurricanes affect beach mouse population densities in frontal dune and scrub habitats. Possible mechanisms for effects include direct mortality of individuals, relocation/ dispersal, and subsequent long-term effects of habitat alterations (i.e., impact on food resource availability and dune structure). Habitat impacts can be widespread, encompassing the range of the subspecies.

Hurricanes affect PKBM habitat in the following ways:

- 1) tidal surge and wave action overwashes habitat leaving a flat sand surface denuded of vegetation;
- 2) sand deposition completely or partially covers vegetation;
- 3) blowouts occurs between the Gulf and bay/lagoon leaving a patchy landscape of bare sand, dune, and scrub habitat;
- 4) the frontal portion of the primary dune habitat is sheared (damage to landward areas varies in severity);
- 5) vegetation is killed by salt spray; and
- 6) islands may be breached entirely and channels from the Gulf to bay/lagoon may be created.

Although hurricanes can significantly alter PKBM habitat and population densities in certain habitats, some physical effects may benefit the subspecies. Hurricanes are responsible for maintaining coastal dune habitat upon which beach mice depend through repeated cycles of destruction, alteration, and recovery of dune habitat. Hurricanes could function to break up population subgroups and force population mixing (Holler et al. 1999). The resultant breeding between members of disparate subgroups increases genetic heterogeneity and could moderate effects of genetic drift and bottlenecks.

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

a. Present or threatened destruction, modification or curtailment of its habitat or range:

Due to coastal development, from the PKBM's historic range of 15 miles of coastal dune habitat encompassing approximately 2000 acres, an estimated 9 miles of habitat with relatively low fragmentation remains. All populations of PKBM on public lands have been extirpated at one time. Through translocation efforts, at least one population has remained viable to present day (see II.C.1.b). Currently, PKBM are present on two public land areas. Less than 1300 acres of PKBM habitat remains in entirety, which includes heavily fragmented habitat on private lands. Much of the remaining coastal dune habitat is degraded due to fragmentation from residential and commercial development, impacts from tropical storms, recreational pressure, introduction of non-native predators, and other anthropogenic factors.

The conservation of multiple large, contiguous tracts of habitat is a key to the persistence of beach mice. At present, large parcels exist mainly on public lands. Protection, management, and conservation of beach mice on public areas have been complicated by increased recreational use by humans as public lands are rapidly becoming the only natural areas left on the coast. Where protection of large contiguous tracts of beach mouse habitat along the coast is not possible, establishing multiple independent populations is the best defense against local and

complete extinctions due to storms and other stochastic events (Shaffer and Stein 2000; Oli et al. 2001; Danielson 2005). Protecting multiple populations increases the chance of at least one population within the range of a subspecies will survive episodic storm events and persist while vegetation and dune structure recover.

Isolation of small populations of beach mice also reduces or precludes gene flow between populations and can result in the loss of genetic diversity. Demographic factors such as predation (especially by domestic cats), diseases, and competition with house mice, are intensified in small, isolated populations which may be rapidly extirpated by these pressures. Especially when coupled with events such as tropical storms, reduced food availability, and/or reduced reproductive success, isolated populations may experience severe declines or extirpation (Caughley and Gunn 1996).

Habitat connectivity also becomes essential where mice occupy fragmented areas lacking one or more habitat types. If scrub habitat is lacking from a particular tract, adjacent or connected tracts with scrub habitat are necessary for food and burrow sites when resources are scarce in the frontal dunes, and are essential to beach mouse populations during and immediately after hurricanes. Trapping data suggests that beach mice occupying the scrub following hurricanes recolonize the frontal dunes once vegetation and some dune structure have recovered (Swilling et al. 1998; Sneckenberger 2001). Similarly, when frontal dune habitat is lacking from a tract and a functional pathway to frontal dune habitat does not exist, beach mice may not be able to attain the resources necessary to expand the population and reach the densities necessary to persist through the harsh summer season or the next storm (Sneckenberger 2001). Functional pathways may allow for natural behavior such as dispersal and exploratory movements, as well as gene flow to maintain genetic variability of the population within fragmented or isolated areas. To that end, contiguous tracts or functionally connected patches of suitable habitat are essential to the long-term conservation of beach mice.

Several projects are underway that aid in the recovery of PKBM. Following Hurricane Ivan, Escambia County (with some FEMA funding) constructed a protective, vegetated berm seaward of beachfront condominiums on Perdido Key. This man-made dune will likely expedite the recovery of PKBM habitat by creating dune topography and supplying sand to the area. In a project funded by the Service, the Florida Department of Environmental Protection (FDEP) collects cuttings and seeds from coastal dune plants that are unavailable at nurseries, raises the plants in a greenhouse, and revegetates the state and federal parks with the young plants. As the project's first priority, PKSP received plants before any other park and has been the site of two planting events to date. Rebuilding of the dune walkovers at PKSP was also partially funded by the Service. These structures provide structured access to the beach and minimize impacts to habitat.

b. Overutilization for commercial, recreational, scientific, or educational purposes

Not known as a threat at the time of listing or at present. Although scientific research does involve trapping and taking genetic samples (i.e., tail snips), there has not been a significant loss of AIBM to scientific purposes.

c. Disease or predation

Beach mice have a number of natural predators including the coachwhip (*Masticophis flagellum*), corn snake (*Elaphe guttata guttata*), pygmy rattlesnake (*Sistrurus miliarius*), Eastern diamondback rattlesnake (*Crotalus adamanteus*), short-eared (*Asio flammeus*) and great-horned owl (*Bubo virginianus*), great blue heron (*Ardea herodias*), northern harrier (*Circus cyaneus*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*) skunk (*Mephitis mephitis*), weasel (*Mustela frenata*), and raccoon (*Procyon lotor*) (Blair 1951; Bowen 1968; Holler 1992; Novak 1997; Moyers et al. 1999; Van Zant and Wooten 2003). Predation in beach mouse populations that have sufficient recruitment and habitat availability is natural and not a concern.

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

A predator control program has been implemented since 1996 on coastal public lands across northwest Florida. The program is ongoing, and a permanent USDA position was established in northwest Florida to conduct the control work (Northwest Florida Partnership 2000; Daniel et al. 2002). Feral cats remain a threat to all beach mouse populations.

Diseases and parasites pose no known threat to beach mouse populations at this time.

d. Inadequacy of existing regulatory mechanisms

Numerous guidelines, conservation measures, and regulatory mechanisms are in place to minimize impacts to PKBM and their habitat. Construction guidelines and best management practices for road projects developed by the Service are provided to developers, consultants, and the Florida Department of Transportation. These guidelines offer recommendations aimed to minimize impacts pre-construction, during construction, and in operation and management

following construction. Such measures include prohibiting cats and unleashed dogs, providing controlled access to the beach, use of predator-proof refuse containers, prohibiting use of clay materials in roadbeds within coastal areas, and use of wildlife-friendly lighting.

Perdido Key beach mice are also a state-listed species. The Florida Fish and Wildlife Conservation Commission's mandate is that proposed projects must show a benefit to the species in order for a permit issuance. Coastal dunes are protected from pedestrian traffic on state and federal lands (through the Florida Administrative Code 62D-2 2.013(2) and national seashore-specific laws and policies, respectively), but there are no such regulations pertaining to coastal dunes on private lands.

Escambia County has an ordinance that addresses animal control, though feral cats are prevalent on Perdido Key. The ordinance states that cats must be "confined to your property or under direct control if it is off your property." Pets are not permitted to roam at large off one's property; nor are they permitted on the public beaches. Animal Control has also been a partner in addressing the number of feral and free roaming cats found on PKSP. The USDA and/or the PKSP call the Animal Control once a cat has been trapped and they collect the cat and determine if it is suitable for adoption.

A Perdido Key conservation fund was set up as a voluntary mitigation option based on *A Conservation Strategy for the Perdido Key Beach Mouse*, which outlined measures needed to conserve the subspecies (FWC et al. 2005). The conservation objectives for the strategy are to create, enhance, and maintain PKBM and habitats in PKSP, GINS, and GSP; and restore, enhance, and maintain beach mice and contiguous PKBM habitat in the primary, interdunal, secondary, and scrub dune systems within and between GINS, PKSP, and GSP. As part of this intergovernmental agreement, Escambia County adopted an ordinance that prohibits building or placing structures seaward of the 1975 Coastal Construction Control Line. This is estimated to permanently protect 5 acres of PKBM habitat.

While land acquisition is a component of the Conservation Strategy, funding for land acquisition within the Conservation Fund is minimal, keeping the cost of the initial and annual contributions low. Consequently, avoidance and minimization on each project site to the extent practicable must be accomplished before using the conservation fund to offset impacts.

e. Other natural or manmade factors affecting its continued existence:

Hurricanes affect beach mouse population densities in various habitats. Possible mechanisms for effects include direct mortality of individuals, relocation/dispersal, and subsequent long-term effects of habitat alterations (i.e., impact on food resource availability and dune structure). Habitat impacts can be widespread, encompassing the range of the subspecies.

Hurricanes affect PKBM habitat in the following ways:

- 1) tidal surge and wave action overwashes habitat leaving a flat sand surface denuded of vegetation;
- 2) sand deposition completely or partially covers vegetation;
- 3) blowouts occurs between the Gulf and bay/lagoon leaving a patchy landscape of bare sand, dune, and scrub habitat;
- 4) the frontal portion of the primary dune habitat is sheared (damage to landward areas varies in severity);
- 5) vegetation is killed by salt spray; and
- 6) islands may be breached entirely and channels from the Gulf to bay/lagoon may be created.

Although hurricanes can significantly alter PKBM habitat and population densities in certain habitats, some physical effects may benefit the subspecies. Hurricanes are responsible for maintaining coastal dune habitat upon which beach mice depend through repeated cycles of destruction, alteration, and recovery of dune habitat. Hurricanes could function to break up population subgroups and force population mixing (Holler et al. 1999). The resultant breeding between members of formerly isolated subgroups increases genetic heterogeneity and could moderate effects of genetic drift and bottlenecks.

Artificial lighting increases the risk of predation and influences beach mouse foraging patterns and natural movements as it increases their perceived risk of predation. This alteration in behavioral patterns causes beach mice to avoid otherwise suitable habitat and decreases the amount of time they are active (Bird et al. 2004). Escambia County has provided the Service with a draft lighting ordinance that would cover Perdido Key. The Service has partnered with the State of Florida to produce a website to assist property owners and local governments locate and purchase wildlife lighting. We have also provided the Escambia County Marine Extension Program with funds to coast share with property owners to change their lighting to wildlife lighting.

Because of the increasing recreational use of Perdido Key beaches, educating the property owners and visitors on the importance of threatened and endangered species conservation is important. The Service funded the design and distribution of "Share the Shore" signs for installation on coastal public lands. Both the National Park service and Florida Park service have installed the signs at beach access points.

D. Synthesis

No change is recommended to the classification or priority ranking of the endangered Perdido Key beach mouse. The degree of threat to its persistence remains high. It is a subspecies with high level of taxonomic distinctness, and its potential for recovery is

considerable if threats can be eliminated or minimized. Recovery of the Perdido Key beach mouse is in conflict with some economic activities, more so today than at the time of listing, which further elevates its priority ranking.

The approved recovery plan for PKBM (1987) does contain recovery criteria, though it is not up-to-date in regard to species' status and threats. Impacts to PKBM and PKBM habitat quality have increased in the recent past from feral cat populations and residential and commercial development. With the additional stress of recent active hurricane seasons, beach mouse habitat is in poor condition and populations are currently fragile. Specifically, about 1300 acres of PKBM habitat remains on Perdido Key. Tracking data from March 2007 indicated that less than 10 percent and about 28 percent of the available habitat was occupied at PKSP and GINS, respectively (Loggins 2007).

Regulatory mechanisms are in place to track impacts to PKBM habitat and aid in minimizing impacts from development on public lands. However, the subspecies' requirements for corridor size and level of tolerance for fragmentation are unknown. Predator control programs have been in place on public lands since 1996, though non-native predators continue to pose a major threat to beach mice.

III. RESULTS

A. Recommended Classification

No change is needed

B. New Recovery Priority Number n/a

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

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

A. Recovery Coordinator

A full time beach mouse recovery coordinator position should be filled. Without such a position, few of the recommendations suggested can be accomplished for PKBM as well other beach mouse subspecies. Furthermore, this position would allow for Field Office coordination and consistency with permitting aspects, monitoring and trapping protocols, permit compliance, research, and recovery activities such as translocations and outreach. This would also allow for more informed and consistent guidance presented to land managers and local governments.

B. Revise Recovery Plan

The 1987 Recovery Plan should be revised and updated to reflect the current status and threats to the PKBM, and recovery criteria, objectives, and tasks should be developed or revised.

C. Population and Habitat Assessment program

A monitoring program should be developed and implemented for PKBM. This plan should include clear goals and objectives that the data collected would be used to achieve. Aspects of this program may include habitat mapping; obtaining demographic, landscape, or dispersal data; estimating future population trends or the likelihood of extinction; assessing management options; developing criteria for recovery; or evaluating future research priorities. A monitoring program is necessary for several other recommendations listed, particularly the Emergency Response Plan, land acquisition, translocation, and habitat management projects.

D. Emergency Response Plan

A contingency plan should be developed to outline actions taken in case of severe threats to the persistence of PKBM (i.e., forecasted category 5 hurricane, feral cat population increase, population crash)(Traylor-Holzer and Lacy 2007).

E. Land Acquisition

Appropriate parcels for land acquisition should be identified using LIDAR data (to identify high-elevation habitat) and current knowledge of PKBM movements and habitat use. The Service in concert with state and county staff has identified a potential parcel that would benefit the recovery of the PKBM.

F. Corridor size persistence, HCP, genetic studies

Research should be conducted to investigate the effectiveness of corridors currently set aside in HCPs. Studies should determine the minimum dimensions needed by PKBM to ensure movement of individuals and genetic exchange through corridors. Further genetic analyses using more loci should be conducted to provide further insight into current PKBM populations.

G. Translocation

Multiple core populations of PKBM are crucial for their long-term persistence. A comprehensive translocation plan is needed to identify key sites, set criteria for when translocations are needed, consider genetic as well as demographic characteristics of the donor and recipient populations, and should include an assessment of the suitability of the recipient habitat (i.e., habitat quality, have feral cats and other threats been minimized or removed). Public-private partnerships and easements should also be explored.

H. Outreach/ Education

Opportunities to convey the importance of coastal dune habitat to the public should be sought and pursued. Additional "Share the Shore" signs have been purchased by the Service and will be distributed in the summer of 2007. In

addition, an outreach/education program focused on the threats feral cats pose to wildlife should also be developed.

I. Hurricane response studies

One project is underway to determine how beach mice recolonize areas after storm events. Further research should be implemented to determine the response of beach mice to storm events. This may include placing transmitters on beach mice immediately prior to a hurricane event to determine whether (or to what extent) beach mice retreat to the scrub dunes, remain in their burrows, or perish. A study to investigate the effects of revegetation and habitat modification on beach mouse habitat use and foraging patterns following storm events should be conducted.

J. Fertilization, habitat quality improvement projects

Habitat restoration projects should be developed and implemented to improve the habitat quality of areas recovering from hurricane damage. Previous studies have shown that sand fencing and application of fertilizer have yielded greater vegetative cover and greater densities of beach mice (Boyd et al. 2004).

The State greenhouse project should be continued to conduct research on cultivating and to produce commercially unavailable vegetation for dune restoration of PKBM habitats.

Additional research on the effects of artificial lighting on beach mice should be undertaken. The research should focus on the different types of “wildlife lighting lamps” and how they affect beach mouse breeding, foraging and movement behavior and home range.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF THE
PERDIDO KEY BEACH MOUSE, (*Peromyscus polionotus trissyllepsis*)**

Current Classification _____
Recommendation resulting from the 5-Year Review

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Appropriate Listing/Reclassification Priority Number, if applicable _____

Review Conducted By Sandra Sneckenberger, Panama City Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve *Sandra A. Carmody* Date 8/17/07

The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.

REGIONAL OFFICE APPROVAL:

The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.

Lead Regional Director, Fish and Wildlife Service

Approve *Noreen E Walsh* Date 9/4/07

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other regions is required.

APPENDIX A: Summary of peer review for the 5-year review of the Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*)

A. Peer Review Method:

The draft 5-year review was provided to beach mouse experts on May 30, 2006. Reviewers responded in writing by July 16, 2007.

B. Peer Review Charge:

The following instructions and guidance was provided to the peer reviewers:

“We are interested in all comments you may have about the document, but we especially seek your appraisal of our overall assessment of the status of the Choctawhatchee and Perdido Key beach mice. Do the data summarized, or any other pertinent data of which you are aware, suggest that these species should remain listed as endangered (in danger of extinction throughout all or a significant portion of its range), downlisted to threatened (likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range), or delisted?”

Peer reviewers were provided with the 5-year review draft, and Peer Review in Endangered Species Act Activities, the July 1, 1994, *Federal Register* notice establishing a peer review process for all listing and recovery actions taken under the authorities of the Endangered Species Act.

C. Summary of Peer Review Comments/Report

Dr. Jeff Gore agreed that PKBM should remain listed as endangered. His suggestions also included clarifications regarding historical accounts of habitat use by beach mice and how populations were assessed and classified as self-sustaining. Dr. Gore suggested language to explain the status of PKBM at GSP. He agreed that revising the recovery plan should be a priority and suggested that the revised plan have measurable population goals. Concerning future actions, Dr. Gore addressed the need for a monitoring program, a comprehensive translocation plan, as well as alternatives to land acquisition (i.e., public-private partnerships and easements).

Comments made by Dr. Ron Loggins focused on recommendations for future actions. He suggested conducting a habitat use and food habit study to elucidate the effects of revegetation and habitat modification following storm events, evaluating the corridor use and size requirements for functional corridors, improving local government cooperation in conservation efforts and regulation enforcement, developing a statewide beach mouse trapping protocol, and establishing a full time position to coordinate research, monitoring, and recovery actions of all beach mouse subspecies. Dr. Loggins also agrees that revision of the recovery plan is warranted and suggest it be a high priority. He also suggested Gulf State Park as a recipient site for translocation project. Dr. Loggins also suggested that habitat restoration and fertilization projects should be implemented and should be a high priority recovery action.

Comments made by Mr. Harold Mitchell included clarifications regarding the PKBM conservation strategy, particularly he suggested further discussion of actions taken when minimization will no longer allow for the persistence of PKBM. Mr. Mitchell recommended changes to improve clarity of the text, and suggested language to improve guidance provided to land managers. Mr. Mitchell also had concerns regarding the recovery criteria which will be revisited when the PKBM recovery plan is revised.

Suggestions made by Dr. Jeff Van Zant included clarifications regarding how populations were assessed prior to and following the tropical storms. Dr. Van Zant also asked for clarification on the social structure of beach mouse populations. He also included changes to improve the clarity of discussions regarding genetic analyses and interpretation of genetic research.

D. Response to Peer Review

The Service agreed to all comments and suggestions provided by the peer reviewers. The draft five-year review was modified in accordance with the reviewers' suggestions.