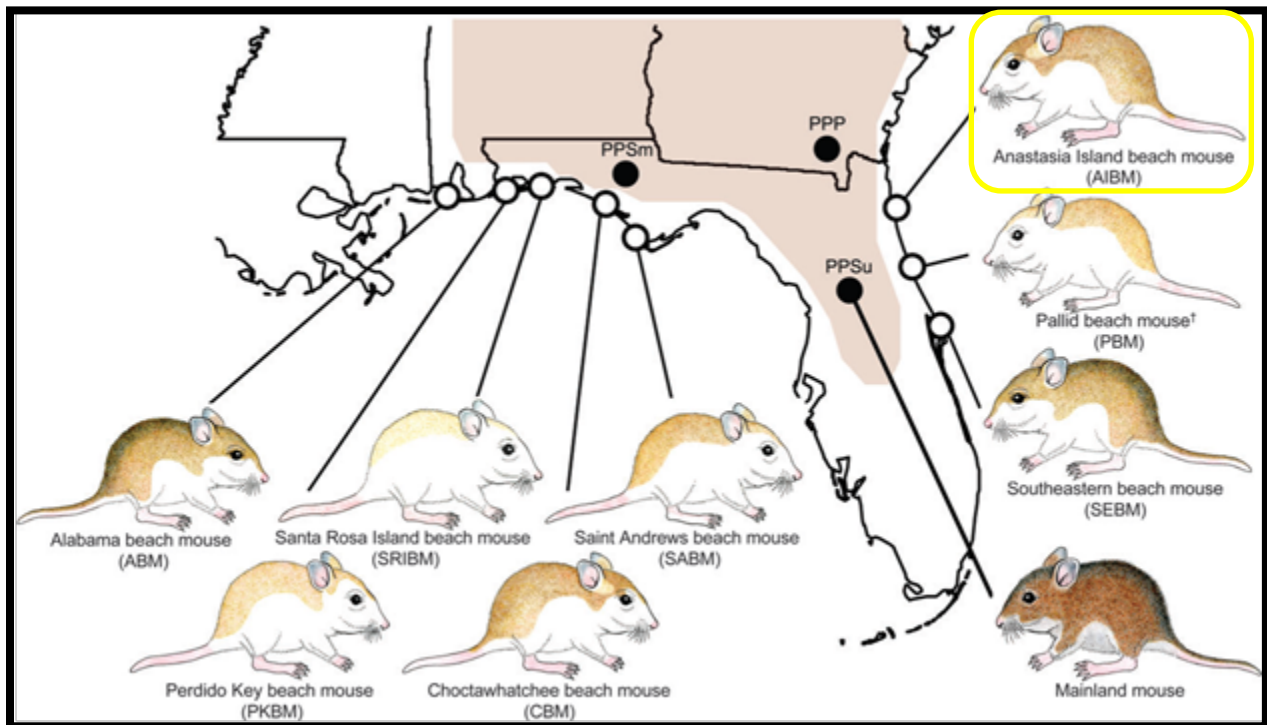


Anastasia Island Beach Mouse
(Peromyscus polionotus phasma)

**5-Year Review:
Summary and Evaluation
June 24, 2019**

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



Steiner et al. 2009

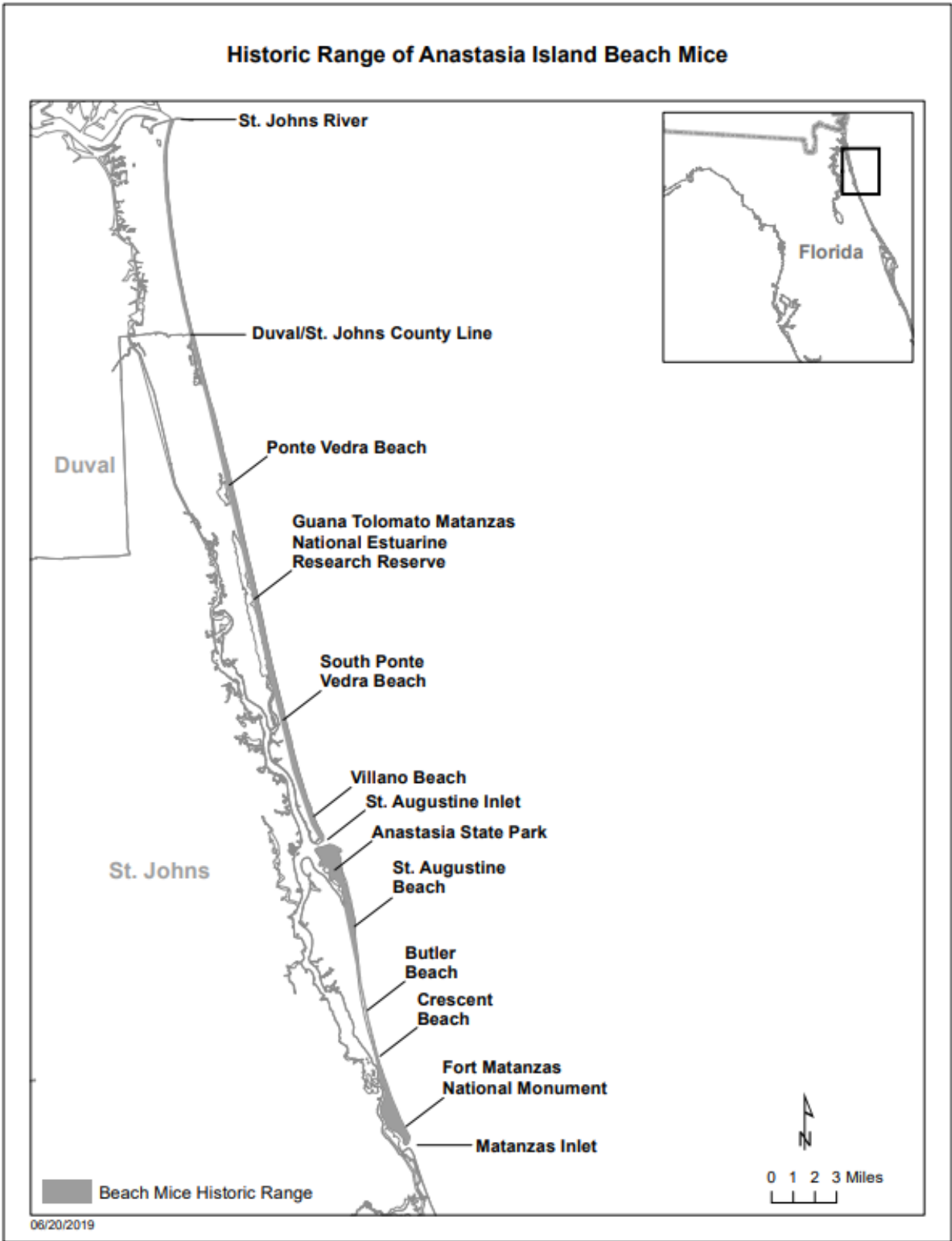


Figure 1. Historic range of the Anastasia Island Beach Mouse (*Peromyscus polionotus phasma*) (USFWS 1989).

5-YEAR REVIEW

Anastasia Island Beach Mouse/*Peromyscus polionotus phasma*

I. GENERAL INFORMATION

A. Methodology used to complete the review:

This review was completed by the Service's lead recovery biologist for the Anastasia Island beach mouse (AIBM) who is located at the North Florida Ecological Services Field Office. Information sources include peer-reviewed scientific publications, unpublished reports, ongoing field survey results and information from qualified Service, State and other professional biologists, the 1989 Final Rule listing the AIBM as endangered, the 1993 Recovery Plan for the Anastasia Island Beach Mouse and Southeastern Beach Mouse, the 5-Year Status Reviews for the AIBM (2007), Southeastern Beach Mouse (2008) and Perdido Key Beach Mouse (2014). All literature and documents used in this review are on file at the North Florida Field Office in Jacksonville, Florida. All recommendations resulting from this review are the result of thoroughly reviewing the available information on the AIBM. No part of the review was contracted to an outside party. The public notice for this review was published on March 25, 2014, with a 60-day public comment period (79 FR 16366). We received one public comment. The completed draft review was sent to cooperating Service Field Offices and five peer reviewers for review. Comments were incorporated into this final document as appropriate.

B. Reviewers:

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

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B. Background

1. **Federal Register Notice citation announcing initiation of this review:** 79 FR 16366; March 25, 2014.
2. **Species status:** Stable. At the time of listing in 1989, AIBM were distributed along the length of Anastasia Island, from the northern end at St. Augustine Inlet, Anastasia State Park (ASP), to the southern end at Matanzas Inlet, Fort Matanzas National Monument (FMNM). AIBM distribution in the coastal dunes and swales along the entire length of Anastasia Island continues today. Since the 2007 Review, there has been a decline in captures during trapping of the primary dunes at the northern section of ASP near the St. Augustine Inlet (FDEP 2016). This decline generally has corresponded to a net loss of primary dune habitat along the northern third of ASP. A 2011 track tube survey confirmed AIBM presence in the restored primary dune habitat at the south end of ASP, an area previously prone to overwash (Kropp and Dupree 2015). This is consistent with the observed habitat restoration and stability gained within the central and southern sections of the park since 2007. These ASP habitat conditions appear to be a function of one or more of the local, coastal navigation/shoreline/dune stabilization projects over the past twenty years, which include maintenance dredging of St. Augustine Inlet, dredging the inlet's ebb tidal shoal, and beach renourishment and dune stabilization efforts south of St. Augustine Inlet. Track tube and trapping surveys in 2011 confirmed that St. Augustine Beach, Butler Beach, and Crescent Beach dune habitats south of ASP and north of FMNM continue to be occupied (Kropp and Dupree 2015; Doonan, pers. comm.). These track tube surveys also indicated that FMNM continues to be occupied. Post Hurricane Mathew (2016) and Irma (2017) track tube monitoring indicate AIBM continue to occupy the coastal dunes along the entire length of Anastasia Island (FWC 2019). We do not know the current status of the reintroduced population north of St. Augustine Inlet at the Guana-Tolomato-Matanzas National Estuarine Research Reserve (GTMNERR) which has over 4 miles of primary and secondary dunes and coastal scrub habitat located beyond this steep dune system. In 1992, 55 AIBM from ASP and FMNM were released in the coastal dunes of GTMNERR and appeared to flourish. In 2000 an additional 33 AIBM from ASP were released at GTMNERR. We reported in 2007 that this population was in decline and there had not been any captures since the summer of 2006. With no additional captures after 6 years, monitoring was discontinued in 2012 (Marcum, pers. comm.) due the probability that AIBM were extirpated from the GTMNERR. The effort to reintroduce mice into the historic range north of St. Augustine Inlet may have been unsuccessful. Due to the dynamic nature of small mammal populations, beach mice could have gone undetected and we consider the status of this small population as unknown but likely extirpated.

In October 2016, Hurricane Matthew moved north along the Atlantic coast of Florida causing a substantial storm surge, erosion and destruction along Anastasia Island's dune habitats. Hurricane Irma, which made landfall and traversed along Florida's Gulf Coast in September 2017, also caused a storm surge event and additional damage to Anastasia Island's coastal habitats. A multi-agency monitoring effort to

better understand impacts from the hurricanes and improve recovery efforts was initiated in January 2018 and completed in March 2019 (FWC 2019) and is summarized as follows. Track tube stations were installed along the length of Anastasia Island; 131 track tubes were placed at ASP, FMNM and at 4 St. Johns County (SJC) properties in between. Live-trapping was conducted along transects in suitable habitats at ASP (4 transects) and FMNM (3 transects) in June, September, and December 2018 to confirm species identification; opportunist trapping was done on the SJC properties. Initial track tube detection rates for AIBM were 32% at ASP and 36% at FMNM. Detection rates reached highs of 91% at ASP and 68% at FMNM in March, then declined through the fall before increasing again in December. Trapping data confirmed that AIBM was the only rodent species present in dune habitats at all sites. Results and observations indicate that AIBM and the coastal dune habitats they depend upon have been recovering from Hurricanes Mathew and Irma and that AIBM continue to occupy the coastal dunes along the entire length of Anastasia Island. As there was extensive loss and damage to fore dune habitats, a restoration strategy that is site-specific for ASP and FMNM has been developed and these strategies can be applied on county and private properties along the central section of Anastasia Island (Miller 2019).

The AIBM distribution along Anastasia Island remains stable and the reintroduced population at GTMNERR is unknown and we believe they are likely extirpated.

3. Recovery achieved: 2 (25-50% recovery objectives achieved)

4. Listing history:

Original Listing FR notice: 54 FR 20598

Date listed: May 12, 1989

Entity listed: Subspecies

Classification: Endangered

5. Associated rulemakings: None

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

Final Recovery Plan – 1993

The 2007 5-year review was noticed September 27, 2006 (71 FR 56545) and was completed September 6, 2007. In this review, we recommended that no change was required to the endangered classification for the AIBM.

Each year the Service reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we did a recovery data call that included showing status recommendations like “Stable” for this mouse. We continue to show that species status recommendation in 5-year reviews. The most recent evaluation for *P. p. phasma* was completed in 2018.

7. Species’ Recovery Priority Number at start of review (48 FR 43098): 6C. The number “6C” reflects a subspecies with a high degree of threat and low degree of recovery potential and some degree of conflict between the species’ recovery efforts and economic development.

8. Recovery Plan:

Name of plan: Recovery Plan for the Anastasia Island Beach Mouse (*Peromyscus polionotus phasma*) and Southeastern Beach Mouse (*Peromyscus polionotus niveiventris*)

Date issued: September 23, 1993

II. REVIEW ANALYSIS

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

1. **Is the species under review a vertebrate?** Yes
2. **Is the species under review listed as a DPS?** No.
3. **Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?** No. Kalkvick et al. (2016) reconfirms the current listing as a subspecies.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes, reclassification criteria but no delisting criteria.
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. Even though the basic biology has not changed, it is not up-to-date in regards to the status, habitat changes, range, genetics, and threats. The recovery criteria can provide a basis on what is needed to change the status of this subspecies. However, based on the extent of suitable habitat and other factors addressed in this review, it may be difficult to meet the recovery criteria.
 - 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. Factor A (present or threatened destruction, modification or curtailment of its habitat or range) was identified as the primary

factor affecting the species at the time of listing, and is only partially addressed in the recovery criteria. Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not addressed but is not relevant to the subspecies. Factor C (disease and predation) is discussed in the recovery plan as a threat, but is not addressed in the recovery criteria. Factor D (inadequacy of existing regulatory mechanisms) is not addressed as it is not relevant to this subspecies. Factor E (other natural or manmade factors affecting its continued existence) should be included in the recovery criteria since hurricanes or other storm events, storm frequency and sea level rise could have serious impacts on the remaining populations of AIBM.

- 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.** Reclassification from Endangered to Threatened criteria: The Anastasia Island beach mouse can be considered for reclassification from endangered to threatened status if five viable, self-sustaining populations can be established. Because the majority of this subspecies' historical range has been permanently destroyed, it is not likely that it can be fully recovered or delisted (USFWS 1989, Executive Summary). Delisting criteria were not developed for AIBM.

It may not be possible to support five viable, self-sustaining populations to meet the recovery criteria for reclassification to threatened status due to the lack of suitable habitat throughout the historic range of the AIBM.

At the time of listing in 1989, AIBM were known to occur along the 14.5 miles of Anastasia Island in St. Johns County, Florida within ASP and FMNM and in the dunes and swales in between. ASP continues to provide 3.5 miles of suitable habitat and undeveloped coastline to support AIBM at the north end of Anastasia Island (FDEP 2016). AIBM continue to occupy the narrow coastal dune habitat area between ASP and FMNM on private lands as well as several St. Johns County Parks (10 miles) (FWC, 2019; Miller 2019; Kropp and Dupree 2015; and Doonan pers. comm.). The width of this occupied habitat varies; Frank and Humphrey (1992) described an idealized cross section of dune topography for Anastasia Island which was approximately 500 feet wide, but most of the dune and swale habitat along the central section of Anastasia Island is much narrower due to the residential development of St. Augustine Beach, Butler Beach and Crescent Beach. AIBM continues to occupy the one mile of undeveloped coastal dune and swale habitat along the ocean and inlet shorelines at FMNM (FWC, 2019; Kropp and Dupree 2015). Habitat at FMNM is similar to ASP; however, beyond the primary dunes the habitat becomes woody, contains dense swales, and is bordered by oak forest to the west (Frank and Humphrey 1992; NPS 2012). Due to the interconnected habitat, Anastasia Island appears to support one population

AIBM were reintroduced into historical habitat at GTMNERR in 1992-1993. Fifty-five mice (27 females and 28 males) were trapped at ASP (37) and FMNM (18) and placed in soft-release enclosures at GTMNERR (Frank 1995). This population was

augmented again in 2000 (21 males and 12 females) trapped at ASP (33 total) (Bard pers. comm.). The last beach mouse was captured in 2006 and trapping ended in 2012 after 6 years with no captures (Marcum, pers. comm.) due to the probability of extirpation. There has not been any monitoring at this location since 2012 until a 2018 camera trap survey was conducted but it did not detect AIBM (USFWS 2018). It is possible AIBM have gone undetected due to the dynamic nature of small mammal populations and we currently consider the status of this population as unknown but likely extirpated. The 4.2 miles of undeveloped coastal habitat at GTMNERR provides a very narrow dune system for AIBM to use, as does the dune habitat north of GTMNERR along the remainder of the residential beaches to Mickler's Landing and very little dune and swale habitat south of the GTMNERR to St. Augustine Inlet.

C. Updated Information and Current Species Status

1. Biology and Habitat

- a. **Abundance, population trends, demographic features, or demographic trends:** Long-term trapping data have shown that beach mouse densities are dynamic and can fluctuate 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 1966; Hill 1989; Rave and Holler 1992b; Frank and Humphrey 1992; Swilling et al. 1998; Swilling 2000; Sneckenberger 2001). Without suitable habitat sufficient in size to support the dynamic nature of beach mouse populations, subspecies are at risk from local extirpation, and may not maintain the densities necessary to persist through storm events and seasonal fluctuations of resources. Frank and Humphrey (1996) suggest that the amount and quality of AIBM habitat, plus the fact that large numbers of beach mice inhabit ASP and FMNM, these populations may have long-term viability. Also, the distribution of AIBM mice along the length of the island decreases the probability of extinction in the event of a catastrophic event such as a major hurricane (Frank and Humphrey 1996).

Population trend.

Unlike species that have annually-based life cycles, beach mice lifespans range from months to a year or two. They can breed year-round (overlapping and asynchronous among individuals) and several times within a lifetime. To calculate demographic and population growth rates for beach mouse populations, precision depends upon the frequency of trapping, for example monthly or bi-monthly would allow for fine scale monitoring. Long-term monitoring at this scale can allow for trends in annual and seasonal population fluctuations common to small mammals to be determined. Currently, the only available data from which to evaluate trends in AIBM populations are limited to two transects trapped quarterly by season at ASP from 2001-2018 (FDEP 2019). Consequently,

population trends for AIBM are limited simple comparisons of captures during recent trapping sessions in this section of the occupied range. Other recent surveys have been used to determine presence/occupancy and to confirm identification (FWC 2019).

Abundance and population trends.

Frank and Humphrey (1992) documented AIBM populations on Anastasia Island are highly variable between seasons and years, with densities ranging from 2 to 90 mice per hectare. In 2007, we reported quarterly trapping at ASP each year has not shown a substantial increase or decrease. Annual capture totals at the two long-term monitoring transects from 1995-2018 (FDEP 2019) show the dynamic nature of small mammal populations, see Figure 2. Trapping surveys suggest that the beach mice at ASP are declining along the fore dunes of ASP (FDEP 2019) this is related to significant erosion and loss of habitat due to management of the inlet and recent hurricanes. The beach renourishment and reconstruction of the dune system along the southern section of the park in the early 2000s, which had suffered from severe erosion and had several wash-over areas, now provides suitable habitat that is occupied. Overall, the long-term presence of AIBM at the north end of Anastasia Island (ASP) has been documented in the historic literature and through monitoring surveys since listing the subspecies in 1989. The coastal dune, interdunal swale and coastal grassland habitat at ASP supports a viable population.

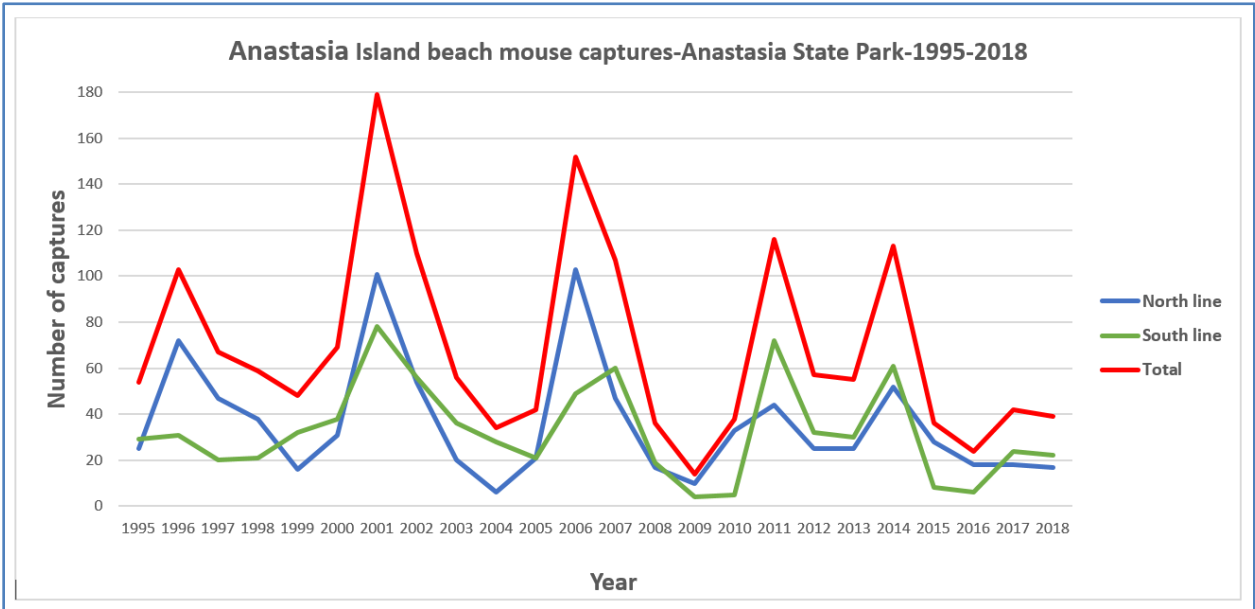


Figure 2. Anastasia Island beach mouse captures at Anastasia State Park 1995-2018 (FDEP 2019). Annual number of captures from quarterly trapping (winter, spring, summer and fall) at two long term primary dune transects at the north and central section of ASP and also pooled/totalled for both transects.

In 2007, we reported that the private and county lands located between ASP and FMNM (10 miles) only provide small fragmented habitats. A 2011 and 2018 track tube and trapping surveys documented that the narrow coastal dune system is fairly intact (~200 acres), fairly continuous from ASP to FMNM and with confirmed presence of AIBM south of ASP and north of FMNM (FWC 2019; Miller 2019; Kropp and Dupree 2015). Whether this narrow area of dune habitat supports a stable, increasing, or declining segment of the population is unknown. This central section of Anastasia Island has supported AIBM since listing in 1989.

AIBM are present at FMNM, but their abundance is unknown. A trapping survey in 2006 documented the continued presence of beach mice (Doonan, pers. comm.). The 2011 survey (Kropp and Dupree 2015), FMNM staff observations (Foote, pers. comm.), and recent track tube and trapping surveys (FWC 2019) indicate that AIBM continue to occupy the habitat available at FMNM.

Establishing additional viable populations within the historic range would significantly reduce the probability of extinction of AIBM from hurricanes (Frank and Humphrey 1992). AIBM were introduced at GTMNERR in 1992-1993 with mice from both ASP and FMNM and augmented in 1999-2000 with mice from ASP. Post release trapping was initiated in January 1993 and ended in 2012 after six years with no captures of AIBM since 2006, see Figure 3. This may be a result of habitat conditions, loss or alteration from storms, factors associated with small populations such as genetic depression or other environmental/population factors. A 2018 camera trap survey did not detect the presence of beach mice (USFWS 2019). The status of the AIBM is unknown at the GTMNERR. We believe they are extirpated, but it is possible they remain in very low numbers and have gone undetected or occur in adjacent habitats.

In summary, since the 2007 Review, monitoring continues to show AIBM occupy ASP. The 2011 and 2018 surveys and other observations continue to show AIBM occupy FMNM and occupy the 10 miles of coastal dunes in front of the residential developments between ASP and FMNM. The status of reintroduced population at the GTMNERR is unknown and it is possible that a small population remains or that they have been extirpated.

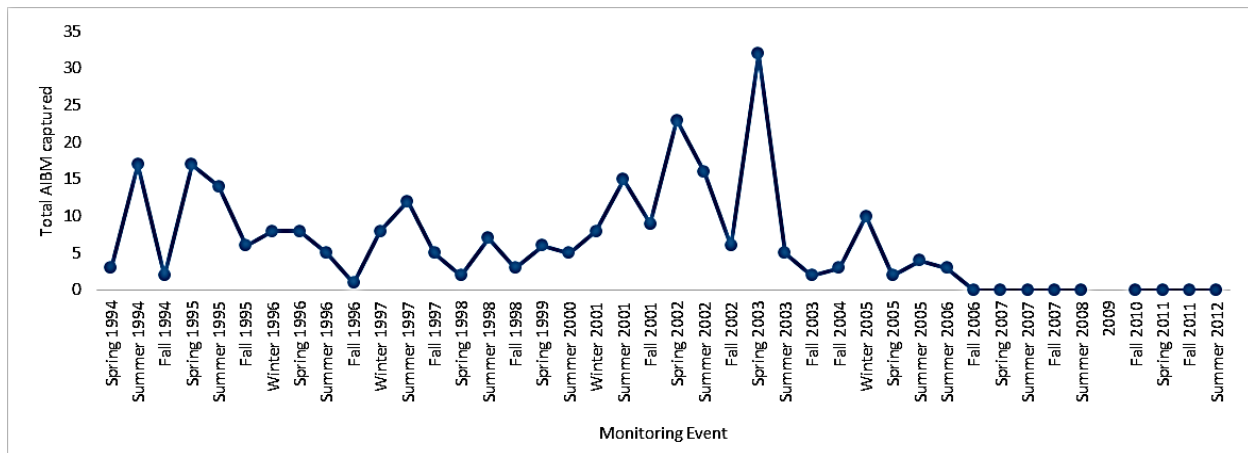


Figure 3. Anastasia Island beach mouse captures at Guana-Tolomoto-Matanzas National Estuarine Research Reserve, 1994-2012 (FDEP 2016). Quarterly (winter, spring, summer and fall) number of captures from trapping at all transects pooled/totalled.

Life history.

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. 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). Frank and Humphrey (1992) found reproductive activity in AIBM was low in January and April and increased in July and decreased in October. Bard (pers. comm. and Moyers et al. 1999) found AIBM breed year-round and lactating females were observed in all seasons.

Frank and Humphrey (1995) found the mean longevity of AIBM was 80 days (range 20–593 days). Bard (pers. comm.) found many recaptures of AIBM over 12 months apart and had one recapture 758 days after the initial capture of the mouse as a subadult. Survival rate estimates of beach mice along the Gulf Coasts of Florida and Alabama have demonstrated that their average life span is about nine months (Swilling 2000). Beach mice held in captivity have lived three years or more (Blair 1951; Holler 1995).

- b. Genetics, genetic variation, or trends in genetic variation:** Selander et al. (1971) conducted a study using allozyme markers on 30 populations of *Peromyscus polionotus*. He 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, which likely reflects the smaller, isolated

nature of island populations. Island populations of vertebrates typically have reduced genetic variation and should not be discounted as a potential factor contributing to greater population extinction rates (Frankham 1997; and Speilman et al. 2004). An already low level of genetic variation is an important factor when planning for translocations and founding of captive colonies for reintroductions and using sources from different areas may help to improve diversity.

Beach mouse populations naturally persist through local extirpations due to storm events or the stochastic/dynamic nature of coastal ecosystems. Historically, these areas would be recolonized as adjacent population densities increased and dispersal into the unoccupied habitat occurred. From a genetic perspective, beach mice can recover from a population perspective (Wooten 1994), given sufficient habitat and genetic heterogeneity is available for population expansion after the bottleneck occurs.

As part of a larger project to investigate the evolutionary history of Atlantic coast beach mice, genetic samples were collected from four locations on Anastasia Island by the University of Central Florida, including ASP and FMNM (Kalkvik et al. 2016). They found AIBM, and other Atlantic beach mice subspecies, are comprised of unique haplotypes and that they originate from a single haplotype found in central Florida. Kalkvik et al. (2016) also found the AIBM lineage is, relatively, quite distinct from the Southeastern beach mouse with low genetic diversity in both mitochondrial and nuclear markers as compared to the founder population.

- c. **Taxonomic classification or changes in nomenclature:** Since the listing of the AIBM, further research concerning the taxonomic validity of the subspecific classification of beach mice has been conducted. According to Mullen et. al. (2009), studies support the separation of beach mice from inland forms and the current taxonomy (Bowen 1968) that each beach mouse group represents a unique and isolated subspecies. These studies were based on genetic differences and phenotype classification. As noted above in b. Genetics, genetic variation, or trends in genetic variation, Kalkvik et al. (2016) also supports that the Atlantic beach mice subspecies originated from a single mainland source and represent different lineages, supporting the hypothesis that these subspecies constitute unique taxonomic units.
- d. **Spatial distribution, trends in spatial distribution, or historic range:** The historic range of AIBM is from the St. Johns River in Duval County to Matanzas Inlet in St. Johns County, Florida, approximately 50 miles of coast (Figure 1). AIBM in the 1940-50s were known from the vicinity of the Duval-St. Johns County line (Mickler's Landing) southward to Matanzas Inlet (Frank and Humphrey 1992); approximately 37.5 miles of coast. At the time of listing AIBM were known to occur at the north and south ends of Anastasia Island at ASP and FMNM and the dune and swales in between. The population north of St. Augustine Inlet was thought to be extirpated between 1949 and 1986 because of

either habitat modification (e.g., storms) or exotic animal predation and competition (e.g., free-ranging cats and house mice) (NERR 2009). Frank (1995) stated that the extirpation could have resulted when severe hurricanes such as Donna in 1964 and David in 1979 passed through the area and impacted much of the coastal dune habitat. Beach mice were reintroduced north of St. Augustine Inlet at the GTMNERR in 1992 and were augmented in 2000 and last documented in 2006.

Currently AIBM populations are found along the entire 14.5 miles of Anastasia Island: 3.5 miles of undeveloped barrier island at ASP, 10 miles of primary and secondary coastal dune and swale habitat along St. Augustine Beach, Butler Beach and Crescent Beach and one mile of undeveloped barrier island of FMNM. Anastasia Island is separated from the mainland of Florida to the west by extensive salt marshes and the Matanzas River, to the north by the St. Augustine Inlet, and to the south by the Matanzas Inlet. This has restricted the range of AIBM to the length of Anastasia Island. Currently, the distribution along the 4.2 miles of the GTMNERR where AIBM were reintroduced in 1992 is unknown and it is likely they have been extirpated again. While the last capture occurred in 2006, it is possible that this population has gone undetected. Or, as previously mentioned, without suitable habitat they are at risk from local extirpation, and thus did not attain the densities and genetic heterogeneity necessary to persist through storm events and fluctuations of resources and habitat.

ASP is composed of 3.5 miles of continuous primary and secondary dunes, including the scrub vegetation. Most of the suitable habitat for AIBM occurs on a narrow peninsula known as Conch Island within ASP (Frank and Humphrey 1992). The northwestern corner of Conch Island is a remnant of the land mass which occurred north of St. Augustine Inlet prior to the relocation of the inlet channel to the north by the U.S. Army Corps of Engineers in 1940. Subsequent placement of spoil from dredging activities in St. Augustine Inlet as well as from the mouth of Salt Run resulted in a different topography from the rest of Anastasia Island. Anastasia Island a naturally occurring barrier island that was created through natural coastal processes and accretion of sand in recent geologic time. AIBM have been documented throughout Conch Island; even in areas with wax myrtle (*Myrica cerifera*). ASP has been roller chopped to reduce the dense woody vegetation in interior swales (FDEP 2016). This management project reduced the height of the wax myrtles and with prescribed burning in recent years this area still appears to provide good travel corridors for AIBM across Conch Island (Bard, pers. comm.).

Since the 2007 Review, the northern section of ASP shoreline has experienced significant erosion and retreat of the ocean front dune system by as much as 300-500 feet (Bard pers. comm.). Additional erosion from Hurricanes Mathew and Irma in 2016 and 2017 has occurred. The central section of ASP has also had a landward retreat of the ocean front dune but to a lesser extent. Beach renourishment and restoration of the primary dune system along the southern

section of ASP, which had historically suffered severe erosion and dune washover, has stabilized, and in recent years has become well vegetated, and now provides additional suitable habitat that is occupied (Kropp and Dupree 2015). There is a very narrow corridor of habitat to the south of ASP, due to coastal development between Pope Road and 12 Lane. This area was severely eroded by Hurricanes Mathew and Irma and a recent renourishment project will help to re-establish a travel corridor between ASP and the dunes and swales along the developed beaches of Anastasia Island to the south of ASP, but this section of shoreline needs additional management and restoration to ensure it does provide a corridor.

Past actions in St. Augustine Beach, south of ASP, have resulted in the Service consulting on AIBM issues. These consultations resulted in coastal developments minimizing impacts to AIBM by avoiding the primary dunes, e.g. the Sea Colony development in St. Augustine Beach. Surveys in 2006 documented AIBM at St. Johns County parks Frank B. Butler Park East and Crescent Beach Park (Doonan, pers. comm.). A more extensive survey of Anastasia Island in 2011 and 2018 confirmed AIBM occupy the coastal dune habitat along the 10-mile long section of beachfront communities, St. Augustine Beach, Butler Beach and Crescent Beach (FWC 2019; Kropp and Dupree 2015). It should be noted that there are very few undeveloped properties left along the central section of Anastasia Island. Efforts should be made to acquire parcels that retain or would have historically supported coastal dune or scrub vegetation where possible.

From 2008-2016 much of the St. Johns County managed beaches between ASP and FMNM developed and retained additional dune features seaward of the primary dune and were utilized by AIBM (Golubovich, pers. comm.). This habitat feature is likely related to the renourishment projects and the lack of tropical storm impacts during that time period. Hurricanes Mathew and Irma significantly impacted these features but some recovery has been observed.

FMNM provides AIBM with one mile of continuous primary and secondary dunes and scrub habitat. This habitat is similar to ASP; however, beyond the primary dunes the habitat becomes woody, contains densely vegetated swales, and is bordered by oak forest to the west (Frank and Humphrey 1992). Most of the suitable habitat is within foredune habitat along the Atlantic Ocean side of the park. Past accretion along the beachfront provided additional habitat for AIBM to use for foraging and burrowing, however, this area has also experienced erosion near Matanzas Inlet during 2014-16 (Foote, pers. comm.) and additional erosion from Hurricanes Mathew and Irma with some recovery observed. Habitats west of A1A support AIBM (Doonan, pers. comm.) and should be managed, maintained, or restored as appropriate to maximize their quality for AIBM. AIBM are restricted from moving southward because of the presence of Matanzas Inlet. Movement northward is dependent on maintaining a corridor of suitable habitat north of FMNM and seaward of the coastal development described above,

but this area also experienced erosion and retreat of the foredune system from Hurricanes Mathew and Irma.

GTMNERR provides 4.2 miles of primary and secondary dunes and has scrub habitat located beyond this steep dune system that could provide habitat for AIBM. These areas have been burned in the past and further restoration such as clearing ground cover and opening the canopy could provide additional habitat for AIBM at GTMNERR. Other subspecies of beach mice, such as the Southeastern beach mouse (*Peromyscus polionotus niveiventris*), have been known to move inland and occupy transitional areas within scrub habitats.

- e. **Habitat or ecosystem conditions:** Beach mice occupy both foredunes (primary and secondary) and scrub dunes on a permanent basis and studies have found no detectable differences between scrub and frontal dunes in beach mouse body mass, home range size, dispersal, reproduction, survival, food quality, and burrow site availability (Swilling et al. 1998; Swilling 2000; Sneckenberger 2001). While seasonally abundant, the availability of food resources in the primary and secondary dunes fluctuates (Sneckenberger 2001). In contrast, the scrub habitat provides a more stable level of food resources, which becomes crucial when food is scarce or nonexistent in the primary and secondary dunes. Furthermore, the scrub dunes appear to serve as refuge for beach mice during and after a storm event (Holliman 1983, Swilling et al. 1998), from which recolonization of the frontal dunes takes place (Swilling et al. 1998, Sneckenberger 2001).

Anastasia Island is a typical barrier island on the Atlantic Coast. Vegetation on the foredunes is generally sparse, consisting of salt-tolerant species adapted to harsh conditions. The most important of these species are the sea oats (*Uniola paniculata*), railroad vine (*Ipomoea pes-caprae*), beach morning glory (*I. stolonifera*), and beach elder (*Iva imbricata*), which are important in dune formation, trapping windblown sand, and stabilizing the dune (Frank and Humphrey 1992).

At ASP, a majority of the beach dune community is located in the northern part of the park on Conch Island. This area supports the largest numbers of the AIBM. Approximately 30 percent of the beach dune community on Conch Island has been invaded by wax myrtle and elderberry (*Sambucus* spp.) as part of the succession of inter-dune swales into maritime hammock (FDEP 2016). Most of Conch Island is less than 60 years old. It contains a well-developed dune field with a series of inter-dune swales, some hundreds of feet wide. ASP began a program to maintain these swales in a very early, grass/sedge dominated habitat in 1999. In 2002, chosen swales were mowed and mulched to ground level (Bard, pers. comm.); roller chopping as a tool to reduce woody vegetation continued into 2007. Prescribed burning on a 3 to 4-year rotation was begun in 2009; one of the objectives of the prescribed burning program at the park is to maintain an open, herbaceous-dominated character on Conch Island (Bard, pers. comm.). ASP has

been able to successfully burn Conch Island in 2009, 2013, and 2016. If burning objectives cannot be met, then additional mowing/mulching may be warranted.

The beach dune community at the northern section of ASP has experienced significant erosion and retreat of the ocean front dune system in recent years due to inlet management and recent hurricanes. The central and south sections of ASP are susceptible to erosion and multiple beach nourishment projects have occurred there, particularly along the southern section (FDEP 2016). When the dune community at the southern end of ASP historically suffered from erosion and associated overwash, and suitable beach mouse habitat was lost or was in poor condition, it was likely that movements of AIBM across that area were greatly restricted or blocked entirely. A beach nourishment and restoration project which constructed a berm and primary dune on the southern two miles of the park, was completed in 2003 (FDEP 2016). Sea oats and bitter panic grass (*Panicum amarum*) were planted on the dune, and slope to the berm, along the entire park project. This restoration has created suitable habitat for AIBM and the 2011 survey documented that it was occupied (Kropp and Dupree 2015). These habitat losses and habitat gains cannot be decoupled from St. Augustine Inlet management, ebb shoal dredging and beach renourishment projects during the past decade and recent hurricanes

The central section of Anastasia Island encompasses 10 miles of primary and secondary coastal dune and swale habitat seaward of the single family homes, condominiums, and commercial developments of St. Augustine Beach, Butler Beach and Crescent Beach. This narrow strip of dune vegetation is mostly continuous from ASP to FMNM with beach access paths, dune walkovers and eight beach driving access points. The width of the coastal dune along this portion of Anastasia Island varies from 10s of feet to close to 500 feet and has been accreting and growing seaward in some sections of shoreline like Butler Beach.

Habitat at FMNM is similar to ASP; however, beyond the primary dunes the habitat becomes woody, contains dense swales, and is bordered by oak forest to the west, which may prevent movement of beach mice into this area (Frank and Humphrey 1992). The Matanzas Inlet beaches at FMNM had been experiencing accretion of sand along the dunes creating more suitable habitat for AIBM up into 2014 but erosion has been predominant since 2014 (Foote, pers. comm.). Additional erosional changes have occurred due to Hurricanes Mathew (2016) and Irma (2018). Surveys in 2011 detected AIBM at a majority of track tubes installed and indicated that they occupy most of the existing suitable habitat and had utilized the created dunes to forage on vegetation such as sea oats (Kropp and Dupree 2015) and post hurricane track tube surveys also show continued occupancy and use of dune and swale habitats (FWC 2019).

There are 4.2 miles of undeveloped Atlantic Ocean oceanfront located at GTMNERR. The basic profile of this beach is a low 2 to 4-foot foredune with a

narrow trough between this and the secondary dune which reaches elevations of 20-35+ feet. This area has some of the highest dunes in Florida. The dunes have provided a storm barrier since they are high and stabilized by vegetation. In 1964, Hurricane Dora affected this area creating gaps in the dunes. Since then nor'easters and tropical storms have continued to cause erosion to the primary dunes; this has limited the amount of suitable habitat for AIBM (NERR 2009). Dense vegetation these narrow coastal dunes could be limiting the movement along the beach. Coastal grassland and scrub vegetation found inland of the dunes could provide additional habitat for AIBM if the habitat is managed with roller chopping and prescribed burning to create more open and less vegetated sandy habitat. Further research in the management of this habitat with fire is needed to understand the response of AIBM to applied management activities.

- f. **Other natural factors (tropical storms and hurricanes):** Hurricanes, tropical and other storm events affect beach mouse population densities in the coastal dune and scrub habitats. Possible 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.

Tropical storms and hurricanes affect AIBM habitat in the following ways

- 1) Tidal surge and wave action over washes dune habitat leaving flat sand surface denuded of vegetation;
- 2) Sand deposition completely or partially covers vegetation;
- 3) The ocean ward portion of the dune habitat is sheared (erosion-damage to landward areas varies in severity);
- 4) Vegetation is denuded, killed by salt spray and/or prolonged inundation; and
- 5) Islands may be breached entirely and channels from the Atlantic to the estuary may be created.

Although storm events especially hurricanes can significantly alter AIBM habitat and population densities in certain habitats, some physical effects may benefit the subspecies. Storm events are responsible for maintaining coastal dune habitat upon which beach mice depend through repeated cycles of destruction, alteration, and recovery of dune habitat. Storms could function to break up population subgroups and force population mixing (USFWS 2014). The resultant breeding between members of disparate subgroups increases genetic heterogeneity and could moderate effects of genetic drift and bottlenecks.

2. Five-Factor Analysis

- a. **Present or threatened destruction, modification, or curtailment of its habitat or range:** Habitat destruction caused by coastal development, beach driving, and public use has continued along Anastasia Island since the time of listing but there are few undeveloped oceanfront lots left. The Service has consulted on several

coastal development projects along St. Augustine Beach where there have been minimal impacts to the primary dunes by requiring dune crossovers. The State of Florida also requires coastal setbacks for coastal development to protect primary dunes. This has also reduced impacts to primary dunes occupied by AIBM. Most of the coastal development has already occurred and few undeveloped private lands exist where AIBM occur. The areas with the largest populations of AIBM (ASP and FMNM) are in State or Federal ownership. They have management plans that include the protection of suitable habitat for AIBM.

The habitat losses near St. Augustine Inlet at the north end of ASP and habitat stabilization projects along Anastasia Island cannot be decoupled from St. Augustine Inlet management, ebb shoal dredging and beach renourishment projects. The Service has and will continue to work and consult with the U.S. Army Corps of Engineers (ACOE) on St. Augustine Inlet maintenance, dredging, and beach renourishment projects in regards to conservation and minimizing impacts to AIBM.

Beach driving has occurred on Anastasia Island for several decades. In 2000, beach driving was no longer allowed at ASP (FDEP 2016) which has greatly reduced the effect visitors have on the dunes. ASP now has designated crossovers to access the beach. Although ASP still receives a large number of visitors, they have to access the beach on foot or by bicycle.

The beach driving that occurs on Anastasia Island between ASP and FMNM could still result in impacts to dune habitat. The coastal dune habitat left due to coastal development setback in St. Augustine Beach, Butler Beach and Crescent Beach continues to be occupied by AIBM. Primary dunes are still intact and education/enforcement efforts are underway and needed to keep cars and visitors out of the dunes. Habitat degradation of the dunes is likely to continue if pedestrians do not use the designated crossovers in these areas. In August 2006, St. Johns County received approval from the Service for a 20-year Incidental Take Permit (ITP) and Habitat Conservation Plan (HCP) to minimize these possible effects to both sea turtles and AIBM and to address the issues listed above. We recognize and commend St. Johns County in their stewardship and implementation of their HCP along the County's beaches and coastal habitats important to sea turtles, beach mice and shorebirds.

Much like ASP, beach driving occurred on FMNM beaches for many years. In January 2010, beach driving was no longer allowed at FMNM (NPS 2014) greatly reducing the effect visitors have on the dunes. FMNM has designated crossovers to access the beach. Although this area still receives a large number of visitors, they have to access the beach on foot or by bicycle.

GTMNERR has increased the amount of public parking and crossovers to try to reduce human impacts on the dune system which has reduced impacts from pedestrians using unmarked paths through the dunes to access the beach. Such

pathways can result in the loss of stabilizing vegetation and exposure of the sediments to erosion by wind in those areas (NERR 2009).

- 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 or ear 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 (*Pantherophis guttatus*), pygmy rattlesnake (*Sistrurus miliarius*), eastern diamondback rattlesnake (*Crotalus adamanteus*), Eastern screech owl (*Megascops asio*), 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). Coyote (*Canus latrans*) have been documented on Anastasia Island. Predation in beach mouse populations that have sufficient recruitment and habitat availability is natural and not a concern.

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 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). The pallid beach mouse once occupied the coastal dunes, swales and coastal grasslands south of the AIBM's range from Matanzas Inlet through Ormond and Daytona Beaches to Ponce Inlet. Predation of beach mice by feral cats has been documented (Van Zant and Wooten 2003). Cat tracks have been observed in areas of low trapping success for beach mice (Moyers et al. 1999 and Gore and Schaefer 1993) found beach mouse tracks were inversely correlated with the presence of cat tracks.

Predation by free-roaming and feral cats continues to be a threat to AIBM. Feral cats can affect AIBM population dynamics and depress densities. Feral and free-ranging cats were observed in large numbers throughout the dunes at ASP in the late 1980s. Since that time ASP has removed cats from the park. After cats were removed at ASP, there was an increase in AIBM numbers and mean survivorship (Frank and Humphrey 1992). There have been sightings of free-ranging cats from adjacent residences along Anastasia Island's developed beaches (Kropp and Dupree, 2015), FMNM and GTMNERR. It is unknown if these cats have had any effect on AIBM. Feral and free-ranging cats have been documented at St. Johns County parks and along the residential beaches of Anastasia Island where AIBM are known to occur by St. Johns County staff. There are no formal control programs being implemented along St. Johns County beaches. Although AIBM

persist in these areas, we do not know if populations are depressed or declining as a result of cat predation.

At FMNM, an increase in the frequency of predation of least terns, Wilson's plover, and sea turtle eggs and young by red fox and coyotes has been documented (Foote, 2016. NPS, pers. comm.). As noted above, they are a threat to AIBM at FMNM.

At GTMNERR, quarterly (winter-spring-summer-fall) trapping found that the number of cotton mice (*Peromyscus gossypinus*) and cotton rats (*Sigmodon hispidus*) increased while the number of AIBM declined (Love, pers. comm. 2016). The reason for this change in species dynamics is uncertain; however, it may be due to the change in suitable habitat conditions (i.e., erosion of the primary dunes). The 2018 camera trap survey documented (USFWS 2019) the presence of cotton mice (*Peromyscus gossypinus*), cotton rats (*Sigmodon hispidus*) and black rats (*Rattus rattus*).

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

- d. Inadequacy of existing regulatory mechanisms:** The AIBM is Florida listed, which allows the state to protect beach mice under Florida Administrative Code (F.A.C) 68A-27 along with the FDEP. Several state and federal properties (ASP, FMNM, and GTMNERR) have protection measures for AIBM included in their management plans. The Service addresses the impacts to AIBM using several existing regulatory mechanisms (e.g. Section 7 and 10 of the Endangered Species Act, as amended) that are working to benefit this subspecies. The ACOE confers/consults with the Service in regards to dredging of inlets and navigable waterways, sediment bypass projects and for beach renourishment projects or permit applications within St. Johns County as to their affects to AIBM and related habitat needs. St. Johns County provides protection and conservation to sea turtles, beach mice and the coastal dune habitat through an incidental take permit from the Service to address impacts from beach driving on county managed beaches.

The F.A.C 253.03 and 259.03, Chapter 18-2, requires a State Land Management Plan for all state parks. ASP does have an approved management plan (FDEP 2016) that addresses the protection and monitoring of AIBM.

In 1999, Guana River State Park was designated a National Estuarine Research Reserve (NERR) to be administered by the National Oceanic and Atmospheric Administration (NOAA) and became GTMNERR. FDEP's Florida Coastal Office then took over managing the park in 2004. Management authority was then conveyed to FDEP. NOAA requires the preparation of a management plan under the NERR regulations (Coastal Zone Management Act section 315, and 15 Code of Federal Regulations (CFR) Part 921) for the conservation of resources.

As mentioned earlier, GTMNERR has an approved management plan (FDEP 2009) in place that protects AIBM and associated habitat.

All parks in the National Park System (NPS) are required to develop a general management plan (GMP). The FMNM GMP was recently updated (NPS 2014). It describes the general path the NPS intends to follow in managing Fort Matanzas National Monument for the next 15- 20 years. The GMP addresses the protection and monitoring of AIBM and habitat needs.

Service management guidelines and conservation measures are available to minimize impacts to beach mice and their habitats. These guidelines were developed for the Gulf coast subspecies of beach mice and offer recommendations aimed to minimize impacts pre-construction, during construction, and in operation and management following construction. Such measures include providing controlled access to the beach, top down construction for construction or replacement of dune walk-overs, use of predator-proof refuse containers, and use of wildlife-friendly lighting.

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

Tropical storms, hurricanes and other storms

Per the Recovery Plan, one of the greatest threats to AIBM is the potential for a catastrophic loss of the entire population because of a severe hurricane. The establishment of additional populations within the historic range would reduce the possibility of extinction. The last direct strike of a hurricane in St. Johns County was Hurricane Dora (Category 2) in 1964 and there have been no records of a Category 3-5 landfalls since 1880 (NOAA at <http://www.aoml.noaa.gov/hrd/tcfaq/E24.html>). During this same time period southeast Florida has had sixteen major hurricanes, southwest Florida eleven, and northwest Florida twelve. Hurricanes Mathew (2016) and Irma (2017) both had close passes by Anastasia Island where hurricane force winds and significant storm surge events occurred and impacted the coastal habitats.

Storm events affect beach mouse population densities in various habitats. Effects include direct mortality of individuals, relocation/dispersal of individuals out of natural habitat, and subsequent long-term effects of habitat alterations (i.e., impact on food resource availability and dune structure) (USFWS 2014). Habitat impacts can be widespread, encompassing the range of the subspecies, although storm events can significantly alter AIBM habitat and population densities in certain habitats, some physical effects may have modest benefits to the subspecies (see section II.C.1.f.). Although it is likely that any potential benefits to AIBM caused by tropical storm events are outweighed by the adverse impacts.

In March 2007, the Service held a Captive Management Feasibility Workshop to explore the feasibility of and options for developing a captive management

program for beach mouse subspecies. The final report describes both the pros and cons of short and long-term captive programs. The report provides valuable information for us to determine what needs to be done to protect the remaining populations of AIBM in case of a catastrophic event such as a hurricane (Traylor-Holzer and Lacy 2007). An emergency action plan has been developed for ASP, which provides a protocol for the live trapping and removal of mice from the park in case of a hurricane (FDEP 2016). The Recovery Plan (USFWS 1993) and future iterations will include recovery actions regarding captive management and emergency response plans.

Sea level rise

Sea level rise is a long-term threat to AIBM and all coastal dependent species based on numerous prediction models. According to the Third National Climate Assessment, release May 2014, sea level rise and increasing storm surge events are occurring and are impacting coastal species and ecosystems (Melillo et al. 2014 and Wolf 2014). It is expected that low-lying coastal habitat will be affected most severely by sea level rise. Models such as the Sea Level Rise Affecting Marshes Model (SLAMM) can be used to project different levels of rise such as a 6-foot rise would remove significant amounts of habitat within ASP and FMNM. The varying and dynamic elements of climate science are inherently long term, complex, and interrelated. At present, the science is not exact enough to precisely predict when and where climate impacts will occur. Although we may know the direction of change, it may not be possible to predict its precise timing or magnitude. Future planning will include guidance and use scenario planning to develop management strategies that account for potential environmental changes, given the future uncertainties in climatic conditions.

D. Synthesis

When this subspecies was first documented by Bangs in 1898, the AIBM's range was described as occurring on Anastasia Island and later documented north of St. Augustine Inlet to the Duval and St. Johns County border (Ivey 1949) in Florida. The historic range extended north to the St. Johns River (USFWS 1989). When listed in 1989, the AIBM's distribution had been significantly reduced and they were only known to occur in the southern portion of the historic range at the north and south ends of Anastasia Island and within the dunes and swales in between. Surveys since the 2007 review show AIBM continue to occupy of the entire length of Anastasia Island. Thus, the current range continues to include the 3.5 miles of ASP undeveloped coastal dunes, swales and coastal grassland habitat, the narrow coastal dune system that fronts the 10 miles of developed coastline of St. Augustine Beach, Butler Beach and Crescent Beach, and the 1 mile of undeveloped coastal habitat at FMNM. AIBM distribution may still include 4.2 miles of coastal dune and swale habitat at the GTMNERR and adjacent habitats per a 1992 reintroduction, however, we believe they are likely extirpated.

ASP has been regularly surveyed since 1995 and the capture trends fluctuate in what appear to be a multi-year cycle. We believe this population is stable even though there has been significant loss of suitable habitat at the north section. There have also been some gains at the south section of ASP and AIBM occupy all suitable habitats within the park. The distribution of AIBM has been confirmed to occupy the dunes along the developed shoreline of Anastasia Island and FMNM. The reintroduction that occurred at GTMNERR in 1992-1993 with an augmentation in 2000 had shown some success; however, the population saw a decline and the last documented capture of AIBM was in 2006. It is possible that this population has been extirpated. Due to the dynamic nature of beach mouse populations, AIBM could still occupy this area given the presence of potential suitable habitat. We recommend that a camera trap survey be conducted before we can determine if this population has been extirpated or if present that habitat management and additional augmentations might be warranted. The coastal dune habitat at GTMNERR could provide additional habitat needed to support AIBM recovery and reduce risk due to an additional population and a wider occupied range if a population could be established. ASP, FMNM and GTMNERR all have management plans that address management of the habitat (FDEP 2016; NPS 2014; and NERR 2009). As the historic range extended north to the St. Johns River, we also suggest that City of Jacksonville's Hanna Park and the beachfront of Mayport Naval Station be evaluated for the suitability for a reintroduction.

There are still several threats that are affecting AIBM throughout its range. Habitat loss was considered the major threat when this subspecies was first listed. Habitat loss continues to occur throughout the range but mainly due to erosion caused by nor'easters, tropical storms, hurricanes and sea level rise. The recent habitat losses at the north end of ASP cannot be decoupled from St. Augustine Inlet management, ebb shoal dredging and beach renourishment projects and recent hurricanes. The Service has and will continue to work and consult with U.S. Army Corps of Engineers and FDEP on St. Augustine Inlet maintenance dredging and beach renourishment projects in regards to conservation of AIBM. Coastal development has already affected most of Anastasia Island and the beaches north of St. Augustine Inlet with little habitat left to be developed or acquired for conservation of the AIBM. Efforts should be made to acquire or purchase conservation easements on the remaining lands to further recovery of the AIBM. Habitat loss has also occurred due to physical damage caused by beach driving and foot traffic through the dunes. ASP, FMNM, and GTMNERR have built crossovers that allow visitors to access the beach, and this has alleviated some of the impacts to the dunes. ASP and FMNM no longer allow beach driving, which has greatly reduced impacts to the dunes. Beach driving still occurs along the 10 miles of developed shoreline of Anastasia Island, approximately 70 percent of Anastasia Island's shoreline, but St. Johns County developed a Habitat Conservation Plan in 2006 and has an Incidental Take Permit for beach driving which allows them to implement conservation for the protection of sea turtles, AIBM and the dune habitats on which they depend. ASP continues to restore the interdunal swale habitat in the interior of Conch Island through prescribed burning to create openings and travel corridors for AIBM.

Predation by feral and free-ranging cats is a threat to AIBM. When the AIBM was first listed in 1989, feral cats were documented on ASP. Since that time, ASP has conducted an extensive feral cat removal program at the park. Still, work is needed to determine whether feral cats remain a significant predator of AIBM at FMNM and St. Johns County parks since these sites serve as refugia for this subspecies. Thus, predator control strategies, with recommended actions should be an ongoing management and incorporated into future recovery planning for AIBM (USFWS 1993; FDEP 2009; FDEP 2016). FMNM is currently participating in a multi-park Predator Management Plan-Programmatic Environmental Assessment to explore options for mitigating the negative effects of predators on species of management concern.

Hurricanes are the most catastrophic threat to the entire AIBM population and recent impacts from Mathew and Irma have allowed for the study and monitoring of recovery from those impacts. If Anastasia Island receives a direct hit from a strong storm, waves could completely overwash the island and severely impact AIBM and their habitat. This is why it is important to establish additional populations within the historic range.

Storm frequency and sea level rise are additional threats to AIBM and all other coastal dependent species based on numerous prediction models that will need to be considered. We will evaluate and address the impacts of climate change in our planning and decision making, as appropriate and according to Service policy. Also, other State and Federal initiatives will provide information that informs beach mouse recovery through landscape-level conservation strategies to restore, manage, and conserve the biodiversity of the region in the face of both environmental change and development pressures. Ongoing and forthcoming efforts at State, County, and other local levels related to climate change adaptation also are likely to inform how we revise and implement the recovery plan for the AIBM. Future updates to the recovery plan will consider and include emerging information such as on-going and projected change in climate, sea level and related effects on the AIBM habitat and would help to guide future recovery efforts.

The above-mentioned threats continue for AIBM and could result in a major impact to AIBM populations. For this reason, we are recommending that the status of AIBM remain the same, Endangered. The recovery criteria for downlisting AIBM have not been met. The recovery criteria state that AIBM could be considered for reclassification from endangered to threatened status if five viable, self-sustaining populations can be established. However, AIBM on Anastasia Island may function as one population and it is unclear whether the historic range north of St. Augustine Inlet will support AIBM. It may not be possible to support five populations. The recovery plan and recovery criteria for downlisting were developed in 1993. Much has been learned about beach mice since and the recovery plan and criteria are due for an update to reflect our current knowledge base.

III. RESULTS

A. **Recommended Classification:** No change; remain Endangered.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

The following suggested recommendations are in order of priority. Please note that these actions are not necessarily specific to AIBM. 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. Revise the current recovery plan to define objective measurable criteria (both reclassification and delisting criteria), better address the five factors, and update ecological information for the AIBM. Currently, the recovery plan includes both the AIBM and the Southeastern beach mouse. Individual plans should be developed for these two subspecies to address the specific recovery actions and recovery criteria relating to each subspecies.
- B. Continue fostering a working partnership with partners and stakeholders: Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection's Anastasia State Park and Division of Beaches and Shores, U.S. Army Corps of Engineers, Fort Matanzas National Monument, Guana-Tolomoto-Matanzas National Estuarine Research Reserve, and St. Johns County and beach front communities of South Ponte Vedra, Vilano Beach, St. Augustine Beach, Butler Beach and Crescent Beach for recovery of Anastasia Island beach mouse and all beach mice subspecies.
- C. Develop an emergency response plan to outline and update actions to be taken in case of severe threats to the persistence of AIBM (i.e., forecasted category 5 hurricane, feral cat population increase, population crash) (Traylor-Holzer and Lacy 2007). An emergency action plan has been developed for ASP, which provides a protocol for the live trapping and removal of mice from the park in case of a hurricane (FDEP 2016).
- D. Improve the management of AIBM habitat at ASP, FMNM, GTMNERR and St. Johns County Parks to expand and or improve the available habitat and travel corridors for AIBM. Enforce the use of crossovers in areas with suitable beach mouse habitat to reduce impacts to the dunes. Restore and manage habitats with native plant species that are also food sources for AIBM. Continue to educate the public at the public parks about the importance of the dune habitat.
- E. Develop and implement a monitoring program for AIBM, including a survey to determine presence/absence of the reintroduced population at GTMNERR. This plan should include some goals and objectives such as habitat mapping; obtaining demographic, landscape, or dispersal data; estimating future population trends or the likelihood of extinction; assessing management options; 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.
- F. 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).

- G.** Continue genetic sampling and conduct a taxonomic assessment of the species and its subspecies. A priority is to determine genetic diversity across Anastasia Island and set goals for improving. Sampling can also tell us if inbreeding depression is occurring. This information will help the Service determine what constitutes a stable population for AIBM recovery.
- H.** Perform a population viability analysis to estimate the probability of survival of beach mice populations of differing effective breeding size.
- I.** Remove feral cats from areas of suitable AIBM habitat. Develop an outreach/education program focused on the threats feral and free-ranging cats pose to wildlife.
- J.** Use top down construction techniques for new, repair or replacement of dune walkovers.

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5-YEAR REVIEW
Anastasia Island Beach Mouse
(*Peromyscus polionotus phasma*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

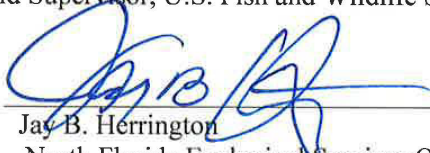
 X No change is needed

Review conducted by: William B. Brooks
North Florida Ecological Services Office
US Fish and Wildlife Service
Jacksonville, Florida

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve



Jay B. Herrington
North Florida Ecological Services Office
US Fish and Wildlife Service
Jacksonville, Florida

Date

6/24/2019

Appendix A. Summary of peer review for the 5-year review of Anastasia Island Beach Mouse (*Peromyscus polionotus phasma*)

A. Peer Review Method: Peer review was requested from four knowledgeable individuals outside the Service (Alice Bard, Florida State Parks FDEP; Pamela Marcum, FDEP GTM National Estuarine Research Preserve; Terry Doonan, Florida Fish and Wildlife Conservation Commission; and Kurt Foote, NPS Fort Matanzas National Monument; Jan Brewer, St. Johns County.

We also requested review from Vivian Negron-Ortiz and Kristi Yanchis, Panama City Ecological Services Field Office; Sandra Sneckenberger, South Florida Ecological Services Field Office; Jim Valade, Annie Dziergowski, and Todd Mecklenborg, North Florida Ecological Services Field Office; Kelly Bibb, Regional Office Ecological Services.

We also received one outside review comment letter from the Center for Biological Diversity and addressed sea level rise, storm intensity and climate change in the five factor analysis and synthesis sections of this review.

B. Peer Review Charge: External peer review comments were received from Alice Bard, Terry Doonan, Kurt Foote and Jan Brewer.

C. Summary of Peer Review Comments: Comments received, reviewed and were incorporated in to review. No substantive comments were received from the peer review.

D. Response to Peer Review: No response needed.