Florida Mouse Biological Status Review Report

March 31, 2011

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
620 South Meridian Street
Tallahassee, Florida 32399-1600

Biological Status Review Report
for the
Florida Mouse
(*Podomys floridanus*)
March 31, 2011

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of November 8, 2010 that had not undergone a status review in the past decade. Public information on the status of the Florida mouse was sought from September 17, 2010 to November 1, 2010. The three-members of the Biological Review Group (BRG) met on November 3, 2010. Group members were Terry J. Doonan, Ph.D. (FWC lead), James D. Austin, Ph.D. (University of Florida), and I. Jack Stout, Ph.D. (University of Central Florida) (Appendix 1). In accordance with rule 68A-27.0012, Florida Administrative Code (F.A.C), the Florida mouse BRG was charged with evaluating the biological status of the Florida mouse using criteria included in definitions in 68A-27.001, F.A.C., and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels Version 3.0 (2003)* and *Guidelines for Using the IUCN Red List Categories and Criteria, Version 8.1 (2010)*. Please visit http://myfwc.com/wildlifehabitats/imperiled/listing-action-petitions/ to view the listing process rule and the criteria found in the definitions.

In late 2010, staff developed the initial draft of this report which included BRG findings and a preliminary listing recommendation from staff. The draft was sent out for peer review and the reviewers' input has been incorporated to create this final report. The draft report, peer reviews, and information received from the public are available as supplemental materials at http://myfwc.com/wildlifehabitats/imperiled/biological-status/.

The Florida mouse BRG concluded from the biological assessment that the Florida mouse does not meet any listing criteria. Staff reviewed the assessment and recommended that the Florida mouse not be listed as a Threatened species and that it be removed from the Species of Special Concern list.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida. FWC staff gratefully acknowledges the assistance of the biological review group members and peer reviewers. Staff would also like to thank Karen Nutt who served as a data compiler on the species and drafted much of this report.

BIOLOGICAL INFORMATION

Taxonomic Classification - This biological status report is for the Florida mouse (*Podomys floridanus*). There has been much contention as to whether the Florida mouse should be placed within the genus *Peromyscus* or should maintain its own generic rank (as reviewed in Hafner et al. 1998). According to molecular evidence, *Podomys* shares what appear to be derived chromosomal inversions with other members of the genus *Peromyscus* (Greenbaum and Baker

1978) and recent phylogenetic analyses embedded *Podomys* within the putative genus *Peromyscus* (Bradley et al. 2007; Miller and Engstrom 2008). Miller and Engstrom (2008) anticipated, however, that further data could lead to the conclusion that this concept of *Peromyscus* is inflated, and that division of *Peromyscus* into multiple genera (including *Podomys*) might prove to be the most viable option.

Life History and Habitat Requirements –

Appearance – Summarized in Layne (1990), Layne (1992), and Jones and Layne (1993). The Florida mouse has relatively large pinnae, eyes, and hind feet. *Podomys* is characterized by the presence of only five plantar tubercles on the hind feet. Juvenile pelage is gray, while adults have distinct orange-buff colored patches on the cheeks, shoulders and lower sides. Adults also have a relatively large body size, weighing between 20.3 and 49.0g.

Reproduction and survivorship – Summarized in Jones (1990), Layne (1990), and Jones and Layne (1993). Reproduction occurs throughout the year, but peaks in fall and in winter. The number of young in litters is typically between two and four. Offspring are weaned at 3 to 4 weeks of age. Mean survival time for adults (during trapping) was reported as being longer in sandhill habitat (4.2 months) than in scrub habitat (2.0 months). However, survivorship of more than 360 days was reported in 8.6% of 1 population.

Habitat use and home range size – Summarized in Layne and Jackson (1964), Jones (1990), Layne (1990), Lips (1991), Layne (1992), and Jones and Layne (1993). Florida mouse populations are largely restricted to fire-maintained, xeric, upland habitats with deep, well-drained sandy soils. The two primary habitats occupied by the Florida mouse are scrub and sandhill, though the species has been recorded in a number of other habitats as well. Ground cover may be sparse, especially in scrub, but numbers of Florida mice in a habitat may be correlated with ground cover diversity, especially in sandhill habitat.

Local populations of *P. floridanus* are isolated and scattered because the distribution of sandhill vegetation and sand-pine scrub in Florida is discontinuous. The distribution of this species is becoming increasingly fragmented due to habitat loss.

Florida mice excavate burrows that they use as daytime refuges and as sites where they make their nests. They typically begin their burrows inside the burrows of other species, often the gopher tortoise (*Gopherus polyphemus*). However, they will also use burrows of other species such as the nine-banded armadillo (*Dasypus novemcinctus*) and old-field mouse (*Peromyscus polionotus*), or opportunistically use stump holes or other holes for that purpose, especially in scrub.

Home ranges tend to be smaller in scrub habitat than in sandhill habitat (Layne 1990), which may be a function of greater resource abundance in scrub. Scrub habitat generally supports higher numbers of Florida mice than sandhill habitat. In occupied habitats, reported population density estimates have ranged from 1.6/ha to 28/ha and average around 5-10/ha depending on the location and habitat type. In sandhill habitats, females have been reported to

have a home range size of 2,601 m^2, while males had an average home range of 4,042m^2 (Jones 1990).

Where suitable habitat is distributed patchily across the landscape, some research has indicated that Florida mice are more likely to occupy habitat patches that are either relatively close to other patches of suitable habitat or of greater size (Mushinsky and McCoy 1996). But, in another study conducted across 16 patches of scrub habitat on the Lake Wales Ridge where most of those scrub islands were located less than 1km apart, Mushinsky and McCoy (1995) recorded Florida mice on 14 of 16 scrub islands, including all 9 islands of < 10 ha. And they found no clear correlation between estimated Florida mouse density and either patch size or distance to the closest adjacent patch of scrub.

Diet – Summarized in Fertig and Layne (1963), Jones (1990), Layne (1990), Layne (1992), Jones (1993), and Jones and Layne (1993). Florida mice consume a wide range of food items including acorns, insects, seeds, nuts, fungi, and other plant material. There is typically a greater abundance of *Podomys floridanus* in scrub and scrubby flatwoods compared to sandhill habitats, a finding that correlates with a higher and more consistent annual production of acorns in the former habitat.

The weight-relative normal water consumption of *Podomys floridanus* and the ability of the Florida mouse to stabilize its weight at low water intake are similar to that of *Peromyscus* species inhabiting xeric habitats. Physiological adaptations are thought to be less important than behavioral ones, however, in permitting the Florida mouse to inhabit drier environments.

Geographic Range and Distribution – *Podomys floridanus* occurs only in a narrow range of dry habitats in the northern two-thirds of peninsular Florida (Fertig and Layne 1963). Peripheral peninsular counties are St. Johns, Clay, Putnam, Alachua, Suwannee, and Taylor counties in the north, south to Sarasota County on the west coast (although not documented in Sarasota County in recent years), south to Highlands County in central Florida, and, at least formerly, south to Dade County on the east coast (now south to near Boynton Beach; Layne 1992; Jones and Layne 1993; Pergams *et al*. 2008). *Podomys floridanus* occurs on Merritt Island, Brevard County (Stout 1979; I. Jack Stout, UCF, pers. comm.). Historically, at least, an isolated Florida mouse population occurred near Carabelle, Florida in Franklin County (Layne 1992; Jones and Layne 1993). A cursory survey for this Carabelle population carried out by Florida Natural Areas Inventory (FNAI) in 2001 proved unsuccessful (Dan Hipes, FNAI, pers. comm.). Although the species probably no longer occurs on the Pinellas coast, a single specimen was captured in 1984 near Clearwater (Layne 1992). *Podomys floridanus* is apparently most continuously distributed in north-central peninsular Florida. In the southern peninsula, the Florida mouse is confined mainly to the Lake Wales Ridge in the central region and to a very narrow strip along the east coast (Layne 1992).

Cox and Kautz (2000) reported that an estimated 339,100 ha (837,600 ac) of potential habitat existed, of which approximately 41.5% occurred on managed lands. Endries et al. (2009) reported that >278,000 ha (686,953 ac) of potential habitat existed, of which 53% occurred on managed lands. Comparing data from these two sources indicates an overall decline in potential

habitat of 18% over that period while the percentage of potential habitat on managed lands increased by 5%.

Population Status and Trend – No estimate of the total population size of the Florida mouse is available. It is known though that there has been a long-term trend of decline in sandhill and scrub habitats occupied by the Florida mouse. (Myers1990, Debra Childs Woithe Inc. and PBS&J 2010, Frost 2006). While the Florida mouse continues to occupy much of its former range, habitat loss has undoubtedly caused the current population level to be well below the pre-settlement level in both population size and area of occupancy (Layne 1992, Jones and Layne 1993, Pergams et al. 2008).

Because the Florida mouse has a short generation time (<2 yr; see above), it is important to consider trends in numbers over a ten year time period (IUCN 2010). Pergams et al. (2008), stated that *P. floridanus* experienced population declines of at least 30% over the last ten years, although it is unclear how this estimate was calculated. Alternatively, two separate GIS analyses of potential habitat for the Florida mouse have been carried out, one by Cox and Kautz (2000) and one by Endries et al. (2009). The difference in potential habitat estimated between these two studies suggests that potential habitat for the Florida mouse may have only declined 18% between 2000 and 2009 (Cox and Kautz 2000, Endries et al. 2009). Although these two GIS analyses used different methodologies and different landsat models, a comparison between them provides the best estimate currently available of habitat loss and, hence, population reduction over the last 10 years.

Projections of continuing habitat degradation and loss (FWC 2008, Zwick and Carr 2006) support an expectation of continued declines in distribution and population size for the Florida mouse (Layne 1992, Jones and Layne 1993). One projection based on data from Endries et al. (2009) and Zwick and Carr (2006) suggests declines of potential habitat for the Florida mouse of no more than about 7% by 2020 and 13.5% by 2040 (Mark Endries, FWC, unpublished data).

Quantitative Analyses – A population viability analysis carried out on the Florida mouse gave only a 1% probability of extinction in the next 1,000 months but exhibited large probabilities of decline (Endries et al. 2009). There were a 70% probability of a 50% decline in abundance when all potential habitat was considered and a 74% probability of a 50% decline when only managed habitat was used in analyses. The model had a baseline growth rate of 1.003 and was most sensitive to changes in adult and juvenile survival rates. The high sensitivity of the model to adult and juvenile survival is worrisome because there is not a reliable, published measure of survival for this species. Thus, given that this parameter strongly influences small mammal populations, the PVA results is considered to add limited or weak support to the overall assessment.

BIOLOGICAL STATUS ASSESSMENT

Threats – The Florida mouse exhibits narrow preferences for fire-maintained, xeric upland habitats occurring on deep, well-drained soils, especially scrub and sandhill habitats (Jones and Layne 1993). Because of this narrow habitat specificity, the major threat to the Florida mouse is loss and degradation of habitat caused by conversion to other uses (e.g.,

development and agricultural use) and insufficient management (e.g., fire suppression) (Layne 1990, 1992). In Highlands County, 64% of the species' habitat was destroyed between 1940 and 1980, with an additional 10% considered disturbed or degraded (Layne 1992).

Also, the distributions of sandhill and sand-pine scrub habitats in Florida are discontinuous and becomingly increasingly fragmented (Layne 1992), causing populations of *P. floridanus* to become more isolated, with reduced movement of individuals among populations (Layne 1992).

Further, dependence by Florida mice on gopher tortoise burrows as sites for excavation of their burrows (Jones and Layne 1993) leaves this species vulnerable to loss or declines of gopher tortoises in some habitats. It has been estimated that gopher tortoise populations in Florida have declined 50-60% over the past 60-93 years (Enge et al. 2006). The IUCN (Pergams et al. 2008) stated that "*Podomys floridanus* is moderately dependent on gopher tortoise (*Gopherus polyphemus*) burrows, and gopher tortoises in Florida are well documented to be in decline, as much as 80% by some estimates due to habitat destruction as well as Upper Respiratory Tract Disease [URTD]." However, most estimated gopher tortoise declines associated with habitat loss occurred prior to the last 10 years (Cox and Kautz 2000, Enge et al. 2006, Endries et al. 2009). Further, Berish et al. (2010) reported that while URTD may be chronic in many gopher tortoise populations, mortality is typically low and rarely results in local extinctions that would have a negative effect on Florida mouse populations.

The Florida mouse also can be threatened by insufficient or inappropriate habitat management. This species shows a preference for early successional habitats, maintained or created by frequent fire cycles. The availability of these habitats declines as natural and prescribed fires are suppressed (Hafner et al. 1998). This could be problematic on private lands, where prescribed fire return intervals may be longer than is recommended by land managers to maintain the habitat quality necessary for robust Florida mouse populations. However, for managed conservation lands across regions of the state occupied by the Florida mouse, Debra Childs Woithe Inc. and PBS&J (2010) recently estimated that only 37-61% of sandhill habitats and 15-50% of scrub habitats currently meet management targets for fire return intervals. The manner in which this criterion is used may be of further concern because fire return intervals are at best indices to habitat quality and targets are not set consistently. Setting management criteria more directly linked to high-quality habitat for the Florida mouse could be imperative to better ensure there will not be unrecognized degradation of the available habitat. This could be done by establishing management targets based on habitat structure and, perhaps more importantly, vegetative composition.

Red imported fire ants (*Solenopsis invicta*) may be a potential predatory threat to *P. floridanus* (Wetterer and Moore 2005). Florida mice are also preyed upon by a range of other species including several snakes, foxes, raccoons, and bobcats (Layne 1992, Jones and Layne 1993). Some of these predator species benefit from close association with people, which may increase the threat of predation to Florida mice as habitats become fragmented and natural areas are increasingly interspersed with developed areas.

Population Assessment – Findings from the BRG are included below in the Biological Status Review Information Findings table. The BRG concluded from the biological assessment that the Florida mouse does not meet any listing criteria. Please see additional notes at the end of the table for further explanation and clarifications.

LISTING RECOMMENDATION

Staff reviewed the assessment and recommended the Florida mouse not be listed as a Threatened species and that it be removed from the Species of Special Concern list.

SUMMARY OF THE INDEPENDENT REVIEW

Comments were received from 7 reviewers: Dr. Brad Bergstrom (Valdosta State University), Dr. Robert McCleery (University of Florida), Dr. I. Jack Stout (University of Central Florida), Ms. Ginger Morgan (Department of Environmental Protection), Dr. J. Steve Godley (Cardno ENTRIX), Dr. Stephen Castleberry (University of Georgia), and Mr. Dan Hipes (Florida Natural Areas Inventory). Appropriate editorial changes recommended by the reviewers were made to the report. Six reviewers concurred with the staff recommendation. One reviewer, Mr. Hipes, questioned the recommendation because he did not believe that a comparison between the two GIS analyses of potential habitat by Cox and Kautz (2000) and Endries et al. (2009) provided a reliable estimate of habitat loss. Mr. Hipes believed that if a proper analysis of habitat loss and habitat degradation were to be carried out, then the estimated reduction in population size over the last 10 years might be >30%. Dr. Stout was also of the opinion that the GIS estimate of suitable habitat for the Florida mouse was overly optimistic. Dr. Castleberry thought the results of Endries et al. (2009) appeared sound, but said he would have more confidence in them if they were published in peer reviewed literature. The BRG agrees that there may be difficulties associated with comparing two GIS analyses that used different methodologies. However, the approach that was taken makes use of the best available data at this time, while acknowledging its potential shortcomings. The BRG believes the GIS analyses provided sufficient resolution at a statewide scale over the 10 year time period of the assessment to warrant their use as the basis for inferences on area of occupancy and population declines.

Dr. McCleery said he had no confidence in the results of the population viability analysis (PVA) of Endries et al. (2009) and felt that should not be a determining factor for the recommendation. The BRG agrees the available PVA reported by Endries et al. (2009) has limited value and provides little support for the overall results in this assessment. Dr. Bergstrom questioned why the last 6 measures under the "Population Size and Trend" criterion in the Findings table were left blank. Those measures were not assessed because they are dependent on the first measure of that criterion being met and that was not the case. Dr. Castleberry stated that there are no data available to support the key assumption made throughout the BSR that loss of habitat results in population declines. The BRG agrees that there are few data available on population trends. However, the BRG has followed standardized protocols of the IUCN by inferring population declines in this way. Dr. Bergstrom stressed that a viable management plan needed to be developed and implemented, while Ms. Morgan and Mr. Hipes argued for the proper management and preservation of sandhill and scrub habitat. A management plan for the Florida mouse is currently being developed by the FWC that will be based on measurable

objectives and include recommendations for habitat management. Peer reviews are available at MyFWC.com.

LITERATURE CITED

Berish, J. E. D., L. D. Wendland, R. A. Kiltie, E. P. Garrison, and Cyndi A. Gates. 2010. Effects of mycoplasmal upper respiratory tract disease on morbidity and mortality of gopher tortoises in northern and central Florida. Journal of Wildlife Diseases. 46(3):695-705.

Bradley, R.D., N.D. Durish, D.S. Rogers, J.R. Miller, M.D. Engstrom, and C.W. Kilpatrick. 2007. Toward a molecular phylogeny for *Peromyscus*: evidence from mitochondrial cytochrome-b sequences. Journal of Mammalogy 88(5):1146-1159.

Cox, J.A., and R.S. Kautz. 2000. Habitat conservation needs of rare and imperiled wildlife in Florida. Office of Environmental Services, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida. 156 pp.

Debra Childs Woithe Inc. and PBS&J 2010. Florida's Wildlife Legacy Initiative Statewide Habitat Reporting System: 2010 Report. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida, USA. 129pp.

Endries, M, B. Stys, G. Mohr, G. Kratimenos, S. Langley, K. Root, and R. Kautz. 2009. Wildlife Habitat Conservation Needs in Florida. Fish and Wildlife Research Institute Technical Report TR-15. x + 178pp.

Enge, K. M., J. E. Berish, R. Bolt, A. Dziergowski, and H. R. Mushinsky. 2006. Biological Status Report – Gopher tortoise. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida. 60 pp.

Fertig, D.S. and J.N. Layne. 1963. Water relationships in the Florida mouse. Journal of Mammalogy 44(3):322-334.

FWC. 2008. Wildlife 2060: What's at stake for Florida. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida. 28 pp.

Frank, P.A. and J.N. Layne. 1992. Nests and daytime refugia of cotton mice (*Peromyscus gossypinus*) and golden mice (*Ochrotomys nuttalli*) in south-central Florida. American Midland Naturalist 127(1):21-30.

Frost, C. 2006. History and future of the longleaf pine ecosystem. Pages 9-42 *in* Shibu, J., E. J. Jokela, and D. L. Miller, editors. The longleaf pine ecosystem: Ecology, silviculture, and restoration. Springer, New York, New York.

Greenbaum, I.F. and R.J. Baker. 1978. Determination of the primitive karyotype for *Peromyscus*. Journal of Mammalogy 59(4):820-834.

Hafner, D.J., E. Yensen, and G.L. Gordon, Jr. (compilers and editors). 1998. North American Rodents. Status Survey and Conservation Action Plan. IUCN/SSC Rodent Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. X + 171pp.

Hooper, E.T. 1968. Classification. Pp. 27-74, in Biology of *Peromyscus* (Rodentia). J.A. King, ed. Special Publications, American Society of Mammalogists 2:ii + 1-593.

IUCN Standards and Petitions Subcommittee. 2010. Guidelines for Using the IUCN Red List Categories and Criteria. Version 8.1. Prepared by the Standards and Petitions Subcommittee in March 2010. Downloadable from http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf

Jones, C.A. 1990. Microhabitat use by *Podomys floridanus* in the high pine lands of Putnam County, Florida. Ph.D. dissertation. The University of Florida, Gainesville, 158pp.

Jones, C.A. 1993. Observations regarding the diet of Florida mice, *Podomys floridanus* (Rodentia: Muridae). Brimleyana 18:131-140.

Jones, C.A. and J.N. Layne. 1993. *Podomys floridanus*. Mammalian Species 427:1-5.

Layne, J.N. 1990. The Florida mouse. Pp.1-21 in Proceedings of the eighth annual meeting gopher tortoise council: Burrow associates of the gopher tortoise (C.K. Dodd, Jr., R.E. Ashton, Jr., R. Franz, and E. Wester, eds.). Florida Museum of Natural History, Gainesville, 134 pp.

Layne, J.N. 1992. Florida mouse *Podomys floridanus*. Pp. 250-264 in Rare and endangered biota of Florida. Volume I. Mammals (S.R. Humphrey, ed.). University Presses of Florida, Gainesville, 386 pp.

Layne, J.N. and R.J. Jackson. 1994. Burrow use by the Florida mouse (*Podomys floridanus*) in south-central Florida. American Midland Naturalist 131(1):17-23.

Lips, K.R. 1991. Vertebrates associated with tortoise (*Gopherus polyphemus*) burrows in four habitats in south-central Florida. Journal of Herpetology 25(4):477-481.

Miller, J.R. and M.D. Engstrom. 2008. The relationships of major lineages within Peromyscine rodents: a molecular phylogenetic hypothesis and systematic reappraisal. Journal of Mammalogy 89(5):1279-1295.

Mushinsky, H. R. and E. D. McCoy. 1995. Vertebrate species composition of selected scrub islands on the Lake Wales Ridge of Central Florida. Florida Game and Freshwater Fish Commission, Final Report, Nongame Wildlife Program Project GFC-87-149. 325pp.

Mushinsky, H. R. and E. D. McCoy. 1996. Habitat factors influencing the distribution of small vertebrates on unmined and phosphate-mined uplands in Central Florida. FIPR Publication No. 03-100-129. 97 pp.

Myers, R. L. 1990. Scrub and high pine. Pages 150-193 *in* Myers, R. L. and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, Florida.

Pergams, O., G. Hammerson, and D.R. Jackson. 2008. Podomys floridanus. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. www.iucnredlist.org. Downloaded on 05 October 2010.

Stout, I. J. 1979. Terrestrial Community Analysis. Final report to NASA/KSC, A Continuation of Base-line Studies for Environmentally Monitoring Space Transportation Systems (STS) at John F. Kennedy Space Center. Contract No. NAS 10-8986. 628 pp.

Wetterer, J.K. and J.A. Moore. 2005. Red imported fire ants (Hymenoptera: Formicidae) at gopher tortoise (Testudines: Testudinidae) burrows. Florida Entomologist 88:349-3

Zwick, P.D. and M.H. Carr. 2006. Florida 2060: A population distribution scenario for the State of Florida. A research project prepared for 1000 Friends of Florida. Geoplan Center at the University of Florida, Gainesville, Florida, USA. 25pp. Downloadable from http://www.1000friendsofflorida.org/PUBS/2060/Florida-2060-Report-Final.pdf

Biological Status Review Information
Findings

Species/taxon: Podomys floridanus
Date: 11/03/10
Assessors: Terry Doonan, I. Jack Stout, Jim Austin

Generation length: <3 years

Criterion/Listing Measure	Data/Information	Data Type*	Sub-Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Sub-Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	There is an inferred, approximate, 18% loss of potentially suitable habitat over the last 10 years. There are no other data to suggest a decline in Podomys numbers >50% during that time (see notes).	I	N	Layne, 1992; Jones & Layne 1993;Endries et al, 2009; Cox & Kautz 2000
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	There is an inferred, approximate, 18% loss of potentially suitable habitat over the last 10 years. Although Pergrams et al. (2008) state there has been >30% decline, there is no information as to how they arrived at this figure and there are no other data to suggest a decline in Podomys numbers >30% during that time (see notes).	I	N	Layne, 1992; Jones & Layne 1993;Endries et al, 2009; Cox & Kautz 2000
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	Only 7% loss of potentially suitable habitat is projected over the next 10 years (see notes).	P	N	Layne, 1992; Jones & Layne 1993;Endries et al, 2009; Cox & Kautz 2000; Zwick and Carr 2006
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	There is an inferred, approximate, 18% loss of potentially suitable habitat over the last 10 years with only 7% loss of habitat projected over the next 10 years. Although Pergrams et al. (2008) state there has been >30% decline, there is no information as to how they arrived at this figure and there are no other data to suggest a decline in Podomys numbers >30% during that time.	I,P	N	Layne, 1992; Jones & Layne 1993;Endries et al, 2009; Cox & Kautz, 2000; Zwick and Carr 2006
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	>7,722 mi^2; EOO (see notes)	E	N	Layne 1992; Jones & Layne 1993; Endries et al. 2009

(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	~ 1076 mi^2 of potentially suitable habitat. Of that area, it is suspected that no more than 50-70% of that area is occupied by Florida mice (see notes).	S	Y	Endries et al. 2009
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Habitat patch size that supports a viable Florida mouse population inferred to be approximately 40 ha (200 mature individuals at an average density of 5/ha). The majority of scrub and sandhill sites are > 40 ha and many sites are greater than 1 km^2. The Florida mouse population is distributed across more than 10 locations.	E	N	Layne 1992; Endries et al. 2009; Debra Childs Woithe Inc. and PBS&J 2010;
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	It is expected that the area of potentially suitable habitat (area of occupancy) will continue to decline by about 7% over next 10 years.	P	Y (b(ii)), (b(iii))	Endries et al. 2009
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	Fluctuations within years occur because reproduction tends to be seasonal. Fluctuation across multiple years occur, especially in sandhill habitats, probably associated with annual fluctuations in habitat suitability, but fluctuations across years are not synchronous among subpopulations. Fluctuations that occur are suspected to be less than an order of magnitude.	I, S	N	Layne 1992; Jones & Layne 1993
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	It is inferred that the total number of mature individuals in the Florida mouse population is >10,000. If it was assumed that Florida mice only occur on potentially suitable habitat that occurs on managed conservation lands (=53% of total =147,340 ha), and if it was assumed that Florida mice only occupy 25% (note from above it is suspected that occupancy is 50-70%), then area of occupied potentially suitable habitat would be 36,835 ha (=147,340 ha x 25%). As a conservative estimate of population size, if it were further assumed that Florida mice only occur at extremely low densities equivalent to the estimated home range size of 2.5 ha (1 mature individual mouse per 2.5 ha) then the estimated population size would be 14,734 mature individual mice (=36,835 ha/2.5).	I	N	Layne 1992; Jones and Layne 1993; Endries et al. 2009
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR				

(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:				
a. Population structure in the form of EITHER				
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation				
b. Extreme fluctuations in number of mature individuals				
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	See C above for information that inferred population size is >1,000 mature individuals.	I	N	Layne 1992; Jones and Layne 1993; Endries et al. 2009
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	See (b)2.a above for information that the area of occupancy is inferred to be >500 mi^2 (>1,300 km^2) and the number of locations is estimated to be >10.	E,I	N	Layne 1992; Endries et al. 2009
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	A population viability analysis carried out on the Florida mouse gave only a 1% probability of extinction in the next 1,000 months (Endries et al. 2009).	I	N	Endries et al. 2009

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria/sub-criteria are met)
Does not meet any of the criteria	

Is species/taxon endemic to Florida? (Y/N)	Yes

If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.

Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria/sub-criteria are met)
Does not meet any of the criteria	

Additional Notes, Biological Status Review Findings

Population size reduction: Assumption is that 10 years is longer than 3 generations
• The extent of decline for the Florida mouse in the last 10 years is not known with certainty.
• Pergams et al. (2008), stated that *P. floridanus* experienced population declines of at least 30% over the last ten years. In making that statement, Pergams et al. (2008) cited declines of gopher tortoises as the basis of the threat, but we do not agree with that. Most estimated gopher tortoise declines associated with habitat loss occurred prior to the last 10 years in potentially suitable habitat (Cox and Kautz 2000, Enge et al. 2006, Endries et al. 2009). Further, Berish et al. (2010) reported that while URTD may be chronic in many gopher tortoise populations, mortality is typically low and rarely results in local extinctions that would have a negative effect on Florida mouse populations. Pergrams et al. (2008) also cited habitat loss as a major threat but did not provide information as to how they quantified it.
• Potential habitat for the Florida mouse may have only declined 18% between 2000 and 2009 (Cox and Kautz 2000, Endries et al. 2009).
• Projections of continuing habitat degradation and loss (FWC 2008; Zwick and Carr 2006) support an expectation of continued declines in distribution and population size for the Florida mouse (Layne 1992, Jones and Layne 1993).
• One projection based on data from Endries et al. (2009) and Zwick and Carr (2006) suggests declines of potential habitat for the Florida mouse of no more than about 7% by 2020 and 13.5% by 2040 (Mark Endries, FWC, unpublished data).

Extent of Occurrence (EOO):
• > 7,722 mi^2
• If estimated as a minimum convex polygon, the EOO extends across the majority of, or entirely encompasses, Highlands (1,106 mi^2), Polk (2,010 mi^2), Hardee (638 mi^2), Manatee (893 mi^2), Hillsborough (1,266 mi^2), Pasco (868 mi^2), Hernando (589 mi^2), Citrus (774 mi^2), Gilchrist (356 mi^2), Alachua (969 mi^2), Lake (1,156 mi^2), Marion (1,663 mi^2), Putnam (827 mi^2), Clay (644 mi^2), Martin (753 mi^2), St. Lucie (726 mi^2), Indian River (617 mi^2), Brevard (1,557 mi^2), Osceola (1,507 mi^2), and Orange (1,005 mi^2) counties.

Area of Occupancy:
• < 772 mi^2 – The total potential suitable habitat available was estimated to be 1,076 mi^2 (= 278,862 ha) by Endries et al. (2009). It is suspected that the occupancy rate for Florida mice is no more than 50-70% of the total potential suitable habitat available. Although Mushinsky and McCoy (1995) reported high (94%) rates of patch occupancy for scrub habitat patches on the Lake Wales Ridge, they reported low population densities in those patches, which were consistent with low, to very low, occupancy rates. In another study, Mushinsky and McCoy (1996) found that where patches of suitable habitat were widely dispersed even the patch occupancy rate was low (40%).

APPENDIX 1: Brief biographies of the Florida mouse Biological Review Group members

Terry Doonan has a Ph.D. in Biology from the University of Kansas. He has worked for FWC as a Regional Species Conservation Biologist since 1994. Dr. Doonan has over 20 years experience studying the ecology of vertebrate populations, with an emphasis on small mammal species. He has studied small mammal populations and communities in multiple ecosystems, with emphasis on the Florida mouse in north Florida.

James Austin has a Ph.D. in Biology from Queen's University, Kingston Ontario. He has worked as an assistant professor for the University of Florida since 2006. Dr. Austin has 6 years experience in small mammal research including species in Florida (Santa Rosa beach mice, and Florida mice) and elsewhere (e.g., Arizona). His research emphases the use of molecular ecology approaches (e.g., mating systems, landscape genetics) to study wildlife populations.

Jack Stout has a Ph.D. from Washington State University. He is currently a Professor Emeritus at the University of Central Florida. Dr. Stout has worked over 30 years on the ecology and conservation of wildlife habitats and species in Florida, including Florida mice and beach mice.

APPENDIX 2. **Summary of letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010.**

No information was received during the solicitation of information period for the Biological Status Reviews that closed 1 November 2010.