Supplemental Information for the Florida Mouse

Biological Status Review Report

The following pages contain peer reviews received from selected peer reviewers, comments received during the public comment period, and the draft report that was reviewed before the final report was completed

March 31, 2011

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Peer review #1 from Dr. Brad Bergstrom

From: Bradley J. Bergstrom
To: Imperiled
Subject: RE: Deadline reminder for peer reviews of BSR reports
Date: Friday, January 28, 2011 11:48:12 AM
Attachments: Peer review of Florida Mouse BSR.docx
Peer review of BigCypress Fox Squirrel BSR.docx
Peer review of Sherman"s Fox Squirrel.docx

Please find attached three separate Word files, which are my peer reviews of the BSRs for:

1) Florida mouse
2) Big Cypress fox squirrel
3) Sherman's fox squirrel

_____
Brad Bergstrom, Ph.D., Professor
Department of Biology
Valdosta State University
Valdosta, GA 31698-0015 USA

Peer review of "Biological Status Review for the Florida mouse (*Podomys floridanus*)"
Reviewer: Dr. Brad Bergstrom, Biology Dept., Valdosta State University, Valdosta, GA

Date of Review: 26 January 2011

Note: the BSR does not indicate the current state status of this species; however, the 2008-09 FWC Endangered and Threatened Species Management and Conservation Plan indicates that *Podomys floridanus* is a Species of Special Concern (SSC).

Podomys floridanus is the only full species of mammal that is endemic to Florida. The Florida mouse is mostly restricted to sandhill, scrub, and fire-managed, early-succesional upland forested habitats in the northern 2/3 of the peninsula. It has an area of occupancy (AOO) that may be as little as 500 mi^2, and it is projected that its AOO will decline by an additional 7% in the next ten years, presumably due to outright loss of unmanaged habitat to developed uses and to loss of other habitat to succession (fire suppression). In view of these facts, it is important that the de-listing decision be very carefully considered.

Given that a population viability analysis indicates very low probability of extinction and that the species occurs on many sites that are of sufficient minimum size, at least half of which are under management to promote early successional stages, I am in qualified agreement that the Florida mouse can be de-listed as long as a viable management plan is developed and implemented. I am wondering, however, why the last 6 measures or submeasures under the "Population Size and Trend" criterion are blank. Do we know, for instance, that some subpopulations do exist that number more than 1,000 individuals? I would feel more comfortable in my conclusion if I knew these answers were No. I would not assume that lack of an answer necessarily equates to a No.

Peer review #2 from Dr. Robert McCleery

From: McCleery,Robert Alan
To: Imperiled
Subject: Florida mouse
Date: Tuesday, January 04, 2011 8:41:48 PM

Based on the IUCN criteria and the lack of information available I would not have been able to conclude that the Florida Mouse warranted listed. However, I have reservation especially in light of the IUCN claim that the population has decreased > 30% in 10 years. This claim was contradicted by the authors of this decision based on a lack of data and a PVA. I agree that there was a clear lack of data to show a decline of 30% in 10 years, but I had major concerns about the use of the PVA to support any conservation based decision. I did not have access to the data used to make the Endreis et al. PVA; however, they did note in their description of the model that they did not validate this model and that the model was highly sensitive to adult and juvenile survival. This is worrisome because it is survival that drives small mammal populations and there is not a current or reliable measure of survival for this species. I would put little or no faith in this PVA. The utility of the PVA is to show a real need to collect precise and rigorous estimates of survival. So, I would solely base my decision on the fact there was no information to show the population was decreasing at a rate of > 30% a decade . I concur with all of the BSR's distribution and habitat loss findings and support the final conclusions.

Please let me know if you need additional information

Best,

Bob

Peer review #3 from Dr. Steve Castleberry

From: Steven Castleberry
To: Imperiled
Subject: Florida Mouse review
Date: Tuesday, February 08, 2011 9:58:45 AM
Attachments: Florida Mouse Review_Castleberry.docx

Dear Dr. Haubold:

I have attached my comments of the Florida Mouse Biological Status Reveiw. I apologize for my tardiness in getting to you. Please let me know if you have any questions.

Steven Castleberry

Steven B. Castleberry, Professor of Wildlife Ecology and Management
Warnell School of Forestry and Natural Resources
University of Georgia
Athens, Georgia 30602

The University of Georgia

Daniel B. Warnell School of Forestry and Natural Resources
Forestry, Wildlife, Water and Soil Resources, Fisheries and Aquaculture, Natural Resource Recreation and Tourism

February 8, 2011

Elsa M. Haubold, Ph.D., Section Leader
Species Conservation Planning Section
Florida Fish & Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, Florida 32399

Dear Dr. Haubold:

Below you will find my review of the draft Biological Status Review (BSR) for the Florida Mouse. At your request I assessed the biological data available on the species and the assumptions made by the review team. In general, there are little data available on the current distribution and population abundance of the species. A key assumption throughout the review is that loss of habitat results in population declines. While this is a very plausible assumption, it is not supported by data. Nonetheless, I think the conclusion reached by review team that the criteria for listing are not met is appropriate given the data available.

My comments are presented in the heading format of the BSR. Although I examined each section carefully, I did not have comments on some of the sections. I only included sections for which I had comments in my review.

Do not hesitate to contact me if you have questions.

Best regards,

Steven Castleberry, Professor of Wildlife Ecology and Management
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BIOLOGICAL INFORMATION

Taxonomic Classification

The review team stated that recent work by Bradley et al. (2007) and Miller and Engstrom (2008) suggest that *Podomys* should be embedded within the genus *Peromyscus*. I agree with this conclusion. However, I am confused by the last sentence, "Miller and Engstrom (2008) did anticipate that further data could support division of *Peromyscus* into multiple genera (including *Podomys*)." The currently taxonomic arrangement is that *Peromyscus* is divided into multiple genera, including *Podomys*. Do you mean that further data may support the current arrangement? If so, I did not have the same interpretation of Miller and Engstrom's conclusions.

Population Status and Trend

While I have no doubt that the population is below pre-settlement levels, I do not find this statement well-supported by the literature cited in the review. I cannot find anything regarding population status in Jones and Layne (1993). Layne (1992) actually states that there are no population estimates available. Pergams et al. (2008) merely cite Layne (1992). It seems that everyone assumes that because habitat has been lost that the population has declined, which is certainly likely, but there apparently are no data available to support the assumption.

Quantitative Analyses

I read the description of the PVA conducted by Endries et al. (2009) and the methodologies and assumptions appear sound. However, the credibility of the results would be increased if they were in the peer-refereed literature rather than in an internal technical report.

BIOLOGICAL STATUS ASSESSMENT

Threats

I commend the review teams' objectivity in reviewing the literature, specifically as related to the statements by Pergams et al. (2008) regarding gopher tortoise population declines. Pergams et al. (2008) contained claims that were not fully supported by facts. The review team provided correct information regarding those claims.

LISTING RECOMMENDATION

Based on the available data, I agree with the review team that the listing criteria are not met. However, there really are no data available on population status or population trends over the past 20-30 years. The assumption that populations have declined and will continue to decline is based on past and projected habitat loss. Extensive surveys and monitoring are needed to document that habitat loss leads to population declines.

Peer review #4 from Ginger Morgan

From: Morgan, Ginger
To: Imperiled
Cc: Green, Sherry
Subject: RE: Deadline reminder for peer reviews of BSR reports FLORIDA MOUSE
Date: Tuesday, January 11, 2011 7:13:20 AM

I have read the "Biological Status Review For The Florida Mouse (*Podomys floridanus*)" (BSR) and find it to be an accurate assessment of the biology, behavior, and current population trend of the species.

Although previous protocol afforded the Florida mouse protection under a "Species of Special Concern" listing; the species does not meet criteria to be listed under current FAC or IUCN category/guidelines. The Group's conclusion that the Florida mouse does not meet any criteria for listing is a correct decision.

The BSR discussed several threats to Florida mouse survival. Habitat loss, whether via development, fragmentation, mismanagement, or fire suppression, is detrimental to much of Florida's fauna and flora. Proper upland (sandhill and scrub) management and land preservation protects ecosystem health; therefore, will protect residing listed and non-listed species.

The Florida mouse relies extensively on the burrows of the gopher tortoise, especially in the sandhills. The amount of sandhill lost historically in Florida and the Southeastern United States is alarming. Management targeted to protect the sandhills, and namely the tortoise, will indirectly benefit the Florida mouse as well as other gopher tortoise burrow commensals. Ultimately, the outcome of agency protection of the gopher tortoise and its concern for the preservation of sandhill and scrub ecosystems will be the best tool in maintaining most of Florida's upland species, including the endemic Florida mouse.

Thank you for the opportunity to review.
Ginger Morgan
Park Biologist
Ichetucknee Springs State Park
Troy Spring State Park
12087 SW US Hwy 27
Fort White, Florida 32038

Peer review #5 from Dr. Steve Godley

From: Steve Godley
To: Imperiled
Subject: Florida Mouse BSR Peer Review
Date: Thursday, January 06, 2011 2:02:30 PM
Florida Mouse BSR Peer Review

I concur with the finding of the Biological Review Group that the Florida mouse (*Podomys floridanus*) does not meet any of the FWC criteria for listing included in the definitions in Rule 68A-27.001(3).

I have two suggestions for improving the Biological Status Review:
1. Include in the text and/or the BSR table and notes under Area of Occupancy the findings of Mushinsky and McCoy (1991), and Mushinsky and McCoy (1996). On the Lake Wales Ridge, Mushinsky and McCoy (1991) detected Florida mice on 15 of 16 (94%) scrub islands including 9 that were 10 ha or less in size; almost all of these 16 sites had other scrub islands within 1 km. In contrast, in the Bone Valley phosphate region where xeric islands are widely dispersed, Mushinsky and McCoy (1996) found *Podomys* on only 12 of 30 (40%) islands of scrub, sandhill or scrubby flatwoods, and their distribution was strongly tied to larger xeric islands (10/12 islands >25 ha, 2/18 islands < 25 ha; 28/30 of these islands supported gopher tortoises). Over the past two decades my colleagues and I have trapped in excess of 150 other xeric habitat islands in Central Florida, and this biogeographic pattern of distance, island size and population density (fewer mice in sandhill as you reported) rings remarkably true.

2. Cite the work of Schmutz (1997), who showed that Florida mice can be successfully translocated to reclaimed scrubs, as this may be important component of the management plan that will ultimately follow. Our subsequent work for Mosaic has confirmed the successful re-establishment of Florida mice on 4 other reclaimed sites with population persistence of up to 14 years.

Literature Cited
Mushinsky, H. R. and E. D. McCoy. 1991. Vertebrate species composition of selected scrub islands on the Lake Wales Ridge of Central Florida. FGFWFC Final Report NG87-149. 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.

Schmutz, D. D. 1997. Translocation and microhabitat distribution of *Podomys floridanus* on native uplands and reclaimed mine sites. M. S. Thesis, Univ. South Florida. 160 pp.

Thank you for the opportunity to serve. If you need an electronic copy of Schmutz (1997), let me know.

J. Steve Godley
Director Emeritus / Senior Principal
Cardno ENTRIX
3905 Crescent Park Drive, Riverview, FL 33578

Peer review #6 from Dan Hipes

From: Dan Hipes [mailto:DHipes@fnai.org]
Sent: Thursday, January 06, 2011 2:22 PM
To: Doonan, Terry
Subject: Florida Mouse Draft BSR

Terry: I've attached my review of the FL mouse BSR. There are comments in the text and at the end. I hope this was adequate and helpful. Let me know if you have any questions or if I misinterpreted something. I'm sorry I couldn't be at the original meeting.

Dan Hipes, Chief Scientist
Florida Natural Areas Inventory
1018 Thomasville Rd. Suite 200-C
Tallahassee, Fl 32303

Biological Status Review
For the
Florida Mouse
(*Podomys floridanus)*

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 September 1, 2010. 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). 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(3) 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/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Florida mouse BRG concluded from the biological assessment that the Florida mouse does not meet any of the criteria for listing.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

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) did anticipate that further data could support division of *Peromyscus* into multiple genera (including *Podomys*).

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 one 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 4,042$m^{2)}$ (Jones 1990).

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* is also apparently on Merritt Island, Brevard County and in an isolated population near Carabelle, Florida in Franklin County although the current status of the latter population is unknown (Layne 1992; Jones and Layne 1993). 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).

Comment [Dlh1]: This may be better described as a historic population. I can't find the record, but I think it is based on an old museum specimen. FNAI conducted a cursory survey (ca 200 traps out for one night) for DOF in 2001 at the presumed location in apparently suitable habitat without success. I'm not aware of any other than the initial collection.

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 (112,551 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. However, potential habitat for the Florida mouse may have only declined 18% between 2000 and 2009 (Cox and Kautz 2000, Endries et al. 2009).

Comment [Dlh2]: There is no documentation for this number on the IUCN site. It might be worth stating that it is unclear how this number was determined/calculated

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).

Comment [Dlh3]: Since the group determined that criterion Aa2 was not met there should be additional explanation and support for a decline of less than 30%. As presented, it looks like another unrelated statistic describing the decline, when it is really presenting a contracting or alternative interpretation of information. This is very important since it directly applies to the criteria for listing.

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.

Comment [Dlh4]: There is very little emphasis on habitat degradation in this review. It should be made clear that the habitat requires management; Without it the habitat becomes unsuitable despite the fact that it remains as potential habitat. This is important because even if there is no change in potential habitat over some span of years, there is certainly a decrease in population because of habitat degradation.

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 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 low.

Comment [Dlh5]: Perhaps this should say "typically low". Local mortality can be very high. The sentence could go on to say "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). According to Debra Childs Woithe Inc. and PBS&J (2010), on managed conservation lands, about of 80% of sandhill habitats and 51% of scrub habitats currently meet or exceed management targets for fire return intervals statewide.

Comment [Dlh6]: This sentence should be followed by some statement about the lack of prescribed fire on private lands.

Comment [Dlh7]: This is very misleading. The numbers were based on questionnaires presented to managers who are not likely to give themselves a bad grade; and the management targets (fire return interval) may not be adequate to maintain suitable habitat. A huge proportion of sandhill habitat included in this stat is on Eglin AFB which is not within the range of Florida mouse. Ocala National forest may not have targets for its scrub because they don't burn most of it, and therefore that unburned habitat would not be included in this stat. If you still want to use numbers from this report you should calculate those for the range of FL mouse from the tables in the Technical Notes (page 6-17)

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.

Statewide Population Assessment – Findings from the BRG are included below in the Biological Status Review Information–Findings table.

LISTING RECOMMENDATION

The BRG concluded from the biological assessment that the Florida mouse does not meet any of the criteria for listing. Staff reviewed the assessment and recommend that the Florida mouse be removed from the list as it does not meet any of the criteria for listing as described in 68A-27.001(3) F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

This will be completed after the peer review.

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Biological Status Review Information
Findings

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

Generation length: <3 years

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). 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 >30% 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. 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. 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

Comment [Dlh9]: This should be Y based on Pergams et al. cited in the Biological Status Assessment. If the group suspects that this number is incorrect it should state so and provide documentation. Endries et al. does not specifically apply to population numbers and relies on imprecise landcover data for inferences; the camparison analysis between Endries et al data and the Cox and Kautz data is flawed because tiny patches (backyards) within developed habitat are still included in potential habitat. There could be much greater than 18% loss of habitat. I inserted a map of potential habitat from Endries et al 2009 at the end of this document to illustrate this. If you add other degraded habitat to that, the number might exceed 30% and the inferred population decline as well. The answer is not as clear as presented in this report.

Comment [Dlh8]: This should start with "Although Pergams et al. state that there has be a >30 percent decline…"

(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%). 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				

Comment [Dlh10]: This is very conservative and probably should be described as such.

(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).		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 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 are met)
Does not meet any of the criteria	

Comment [DIh11]: Further clarification of available info or summary of inferences?

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. However, Pergams et al. (2008) cited declines of gopher tortoises as a threat and habitat loss as a major threat.
• 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).
• Berish et al. (2010) reported that while URTD may be chronic in many gopher tortoise populations, mortality is low.

Comment [Dlh12]: It is not clear how this relates to the previous sentence

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 mi2), Polk (2,010 mi2), Hardee (638 mi2), Manatee (893 mi2), Hillsborough (1,266 mi2), Pasco (868 mi2), Hernando (589 mi2), Citrus (774 mi2), Gilchrist (356 mi2), Alachua (969 mi2), Lake (1,156 mi2), Marion (1,663 mi2), Putnam (827 mi2), Clay (644 mi2), Martin (753 mi2), St. Lucie (726 mi2), Indian River (617 mi2), Brevard (1,557 mi2), Osceola (1,507 mi2), and Orange (1,005 mi2) counties.

Area of Occupancy:
• < 772 mi^2 – It is suspected that the occupancy rate for Florida mice is no more than 50-70% of the total potential suitable habitat available; the total was estimated to be 1,076 mi^2 (= 278,862 ha) by Endries et al. (2009).

Peer review #7 from Dr. Jack Stout

From: Jack Stout
To: Imperiled
Subject: review
Date: Tuesday, January 11, 2011 11:42:00 AM
Attachments: Florida mouse Final Draft BSR 11-17-10.docx

I believe the ultimate recommendation is biologically sound with respect to the Florida mouse. I do believe the estimate of suitable habitat is overly optimistic because remote sensing of habitat may be flawed in predicting the extent of the plant communities and does not reveal anything about the quality of habitat.

Jack Stout

Biological Status Review
For the
Florida Mouse
(*Podomys floridanus)*

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 September 1, 2010. 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). 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(3) 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/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Florida mouse BRG concluded from the biological assessment that the Florida mouse does not meet any of the criteria for listing.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

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) did anticipate that further data could support division of *Peromyscus* into multiple genera (including *Podomys*).

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 one 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 4,042$m^{2)}$ (Jones 1990).

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* is also apparently on Merritt Island, Brevard County and in an isolated population near Carabelle, Florida in Franklin County although the current status of the latter population is unknown (Layne 1992; Jones and Layne 1993). 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).

Comment [S13]: I have trapped them on Merritt Island since 1976 and as recently as the spring of 2008. A NASA tech. publ. could be cited if necessary.

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 (112,551 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. However, 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).

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.

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 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 low.

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). According to Debra Childs Woithe Inc. and PBS&J (2010), on managed conservation lands, about of 80% of sandhill habitats and 51% of scrub habitats currently meet or exceed management targets for fire return intervals statewide.

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.

Statewide Population Assessment – Findings from the BRG are included below in the Biological Status Review Information–Findings table.

LISTING RECOMMENDATION

The BRG concluded from the biological assessment that the Florida mouse does not meet any of the criteria for listing. Staff reviewed the assessment and recommend that the Florida mouse be removed from the list as it does not meet any of the criteria for listing as described in 68A-27.001(3) F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

This will be completed after the peer review.

Letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010

Email from Paula Halupa

From: Paula_Halupa@fws.gov
To: Imperiled; Doonan, Terry
Cc: Dana_Hartley@fws.gov
Subject: Re: Florida mouse
Date: Tuesday, November 02, 2010 1:42:32 PM
Attachments: Bard and Stout 1992 Florida mouse.pdf
Importance: High

Hi Terry,
I did not see much in our electronic files on the Florida mouse, but came across this.

Thanks,

-Paula
(See attached file: Bard and Stout 1992 Florida mouse.pdf)
^^
Paula J. Halupa
Fish and Wildlife Biologist
Listing, Candidate Conservation, and Recovery
U.S. Fish and Wildlife Service
South Florida Ecological Services Office
1339 20th Street
Vero Beach, FL 32960-3559

military discipline called Operations Research are applied to the problem of Manatees and high speed boats. Sweep rate, lethality, collision avoidance and exchange rates are considered. It is concluded that real recovery of the Manatee population -ill require marked reduction in kill rate. The influence of several factors on this is shown.

10:30 am, BFUGlK

10:45 am, REB-7A Microhabitat differences in space use by Podomvs floridanus in xeric pinelands. A.M. BARD (1) AND I.J. STOUT (2), (1) DNR, 12549 State **Prrrk** Drive, Clennont, FL 34711, (2) Department of Biology, University of Central Florida. Orlando, FL 32816. We examined the association between microhabitat features and capture frequency of the Florida mouse, Podomvs floridanus in 3 phases of xeric pineland: a) sand pine scrub, b) xeric oak scrub, and c) xeric longleaf pine-wire grass. Each study site was isolated from the others by more than 500m. Over the 11-months of study, 36 individual Podovrns were captured on the sand pine scrub site; 2 individuals were captured in the xeric oak scrub. Posomvs was never captured on the longleaf pine site. Capture locations were classified as: a) near a gopher tortoise burrow, or b) distant from a tortoise burrow. Numerous burrows were present on each site. The working hypothesis was that captures of both sexes in each season would be equal among the trap stations regardless of microhabitat differences. Based on 165 captures over 4 seasons (11 months), the hypothesis could not be rejected ($p > 0.05$). Regardless, more captures (n=94) were at burrows than in their absence (n=71). There was a strong tendency for female Podornys to be captured at burrow locations in summer (17 or 23) and fall (12 of 16). Fluorescent pigment was employed to track individual mice to post-release escape burrows. Escape sites were inconspicuous mouse-sized burrows near tortoise burrows, most of which had been abandoned for years. Vegetation structure rather than availability of home sites appeared to explain the local distribution of Podomvs.

11:OO am, REB-8A Activity and Diet of an Urban Population of Big Cypress Fox Squirrel. PATRICK G.R. JODICE (1) AND STEPHEN R. HUMPHREY (2). (1) Florida Game and Fresh Water Fish Commission, W e City, FL 32055, (2) Florida Museum of Natural History, University of Florida, Gainesville, FL 32611. Activity and diet of Big Cypress fox squirrels (Sciurus niger avicennia) were studied for 1 year on **1** golf courses in Naples, Florida. Percentage of time spent foraging and inactive varied seasonally. Diets also varied among seasons. Seasonal changes in foraging and inactivity were not correlated with changes in diet and weather, and the seasonal dietary shifts that did occur did not alter the time spent foraging. Mating behavior and young rearing may have the strongest effect on seasonal activity patterns. The value of golf courses may be maximized by leaving native trees in place and planting exotic trees with long reproductive seasons.

11:15 am, REB-9A Status and Distribution of the Long-tailed Weasel in Florida. J.A. HOVIS, Florida Game and Fresh Water Commission, Nongame Wildlife Program, Ocala, FL 32674. A status survey of the long-tailed weasel (Mustela frenata) in Florida was conducted between April 1990 and March 1991. No weasels were captured during 4 9 3 trap nights of effort, but 182 occurrence records were obtained from the literature, state and private collections, and reported

sightings. These data revealed that long-tailed weasels occur throughout Florida, excluding the southeastern portion of the state, and are most

Copy of the Florida mouse BSR draft report that was sent out for peer review

Biological Status Review
For the
Florida Mouse
(*Podomys floridanus)*

EXECUTIVE SUMMARY

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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) did anticipate that further data could support division of *Peromyscus* into multiple genera (including *Podomys*).

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 one 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 4,042$m^{2)}$ (Jones 1990).

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* is also apparently on Merritt Island, Brevard County and in an isolated population near Carabelle, Florida in Franklin County although the current status of the latter population is unknown (Layne 1992; Jones and Layne 1993). 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 (112,551 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. However, 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).

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.

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 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 low.

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). According to Debra Childs Woithe Inc. and PBS&J (2010), on managed conservation lands, about of 80% of sandhill habitats and 51% of scrub habitats currently meet or exceed management targets for fire return intervals statewide.

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.

Statewide Population Assessment – Findings from the BRG are included below in the Biological Status Review Information–Findings table.

LISTING RECOMMENDATION

The BRG concluded from the biological assessment that the Florida mouse does not meet any of the criteria for listing. Staff reviewed the assessment and recommend that the Florida mouse be removed from the list as it does not meet any of the criteria for listing as described in 68A-27.001(3) F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

This will be completed after the peer review.

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Biological Status Review Information
Findings

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

Generation length: <3 years

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). 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 >30% 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. 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. 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%). 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).		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 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 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. However, Pergams et al. (2008) cited declines of gopher tortoises as a threat and habitat loss as a major threat.
• 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).
• Berish et al. (2010) reported that while URTD may be chronic in many gopher tortoise populations, mortality is low.

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 mi2), Polk (2,010 mi2), Hardee (638 mi2), Manatee (893 mi2), Hillsborough (1,266 mi2), Pasco (868 mi2), Hernando (589 mi2), Citrus (774 mi2), Gilchrist (356 mi2), Alachua (969 mi2), Lake (1,156 mi2), Marion (1,663 mi2), Putnam (827 mi2), Clay (644 mi2), Martin (753 mi2), St. Lucie (726 mi2), Indian River (617 mi2), Brevard (1,557 mi2), Osceola (1,507 mi2), and Orange (1,005 mi2) counties.

Area of Occupancy:
• < 772 mi^2 – It is suspected that the occupancy rate for Florida mice is no more than 50-70% of the total potential suitable habitat available; the total was estimated to be 1,076 mi^2 (= 278,862 ha) by Endries et al. (2009).

Appendix 1. Biological Review Group Members Biographies

Terry Doonan has a Ph.D. in Biology from the University of Kansas. He has worked for FWC as a Regional Species Conservation Planning 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.

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

Appendix 3. Information and comments received from the independent reviewers.