Supplemental Information for the Homosassa Shrew

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. Robert McCleery

From: McCleery,Robert Alan
To: Imperiled
Subject: Homosassa Shrew Review
Date: Wednesday, January 05, 2011 6:16:46 PM

This descion would easily switch from a reecommandation to list to a reccomadnation not to list if the Cox and Kautz (2000) distribution were used, istead the assessment used the Jones et al (1991) distribution. However, I did not find that the Jones et al. (1991) examination of morphometrics was very convincing. Firstly, the type of morphometric analysis used in this study is no longer consider to be an effective means of determing phlyogenetic or cladistic relationships. Second there was a very small sample size from florida and high amounts of variartion from the samples within the state. Third, any variation in the shrews from peninsular Florida in this study could have clearly been explained by geographic separation form the next nearest subpopulations. This should have been tested with a mantels test. Nonetheless, there still appears to be more evidence to contend that the speices doesn't have a highly restricted distribution than to suggest it does. Due to this fact I would concur with the this finding and conclude that listing was not warranted.

Again let me know if you would like anythig else.

Best,

Bob

Peer review #2 from Robert Rose

From: Rose, Robert
To: Imperiled
Subject: RE: sending my peer reviews of BSR reports
Date: Thursday, January 20, 2011 8:24:28 PM
Attachments: Homosassa shrew Final Draft BSR 11-21-10.docx
Sherman"s short-tailed shrew Final Draft BSR 11-18-10.docx

Hi, Elsa,

Attached are my reviews of the two shrew reports I agreed to assess. In general, they are good, but I have recommended some changes in each to improve clarity and usefulness.

I think that methods used by investigators in the past need to be addressed because early studies mostly used snap traps but we now know that pitfall traps are most useful for catching shrews. The value of pitfall traps should be emphasized when surveys are recommended or undertaken. In my opinion, unless pitfall traps are used to survey/sample SE shrews, don't bother. Pitfall traps don't have to be placed in labor-intensive arrays with drift fences to be effective in catching the smallest mammals.

Another general comment is to use metric units (km rather than miles). It's OK to use both but metric should be in there somewhere.

In the Blarina report, the authors need to make clear why they have chosen to retain the name B. c. shermani rather than to call it Blarina shermani. If otherwise, I have missed something.

I have made my comments in the enclosed files using Track Changes, which I hope will suffice for your needs. I will discard the hard copies with my remarks/comments unless you wish for me to send those to you. Let me know in a few days if you wish to receive the hard copies I have marked.

Cheers.

BOB ROSE, Professor Emeritus
Department of Biological Sciences
Old Dominion University
Norfolk, VA 23529-0266

Biological Status Review
for the
Homosassa shrew
(*Sorex longirostris eionis*)

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 Homosassa shrew was sought from September 17 to November 1, 2010. The members of the biological review group (BRG) met on November 3-4, 2010. Group members were Melissa Tucker (FWC lead), David Shindle, and Dan Pearson. In accordance with rule 68A-27.0012 Florida Administrative Code (F.A.C.), the BRG was charged with evaluating the biological status of the Homosassa shrew 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)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. Please visit http://myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Homosassa shrew Biological Review Group concluded from the biological assessment that the Homosassa shrew does not meet criteria for listing. No information was received from the public during our information request period. Based on the literature review, and the biological review findings, staff recommends ~~nd~~ removing the species from the FWC list of species of special concern.

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

BIOLOGICAL INFORMATION

Taxonomic Classification – This report is for the Homosassa shrew, a subspecies of the southeastern shrew, in Florida. The Homosassa shrew has been designated as ~~to~~ the subspecies *Sorex longirostris eionis* (Davis 1957 as cited in Jones *et al*. 1991).

Life History – The Homosassa shrew has been captured in palmetto thickets, longleaf pine sandhills, cypress swamps, bay swamps, slash pine and longleaf pine flatwoods, hydric hammocks, xeric hammocks, sand pine scrub, and clear-cuttings (as ~~outlined~~summarized in Jones *et al*. 1991).

Little is known about the life history, behavior, and biology of the Homosassa shrew. Summary information is provided for the species as a whole, *Sorex longirostris*.

Population densities of *Sorex longirostris* have been calculated at 30 shrews/ha and 44 shrews/ha, although French indicated that the 44 shrews/ha may over estimate density due to plot

design and location. Few authors have captured ten or more shrews in one locality (French 1980a; see summary in French 1980b). The average density recorded for all *Sorex* sp. is 14 shrews per hectare (Smallwood and Smith 2001).

Pregnant females have been found from March through October and litter sizes ranged between one and six offspring (French 1980a). Based on French (1980b) most individuals don't breed during the first summer, and only survive one winter. Average generation time is estimated at approximately nine months.

Geographic Range and Distribution – The Homosassa shrew was originally described as being ~~endemic~~ restricted to ~~only~~ the type locality, in the wet associated with Homosassa Springs, in Citrus County, Florida (Hall 1981 ~~as cited in Jones et al. 1991~~and Davis 1957, as cited in Jones *et al*. 1991). A morphometric analysis of *Sorex longirostris* in Florida, however, has revealed that the Homosassa shrew has a much larger distribution and that it occurs in the northern two-thirds of peninsular Florida (Jones *et al*. 1991). Additional sampling of the Homosassa shrew throughout its range is necessary, though, to provide a~~n~~ more exact estimate of its distribution and to more accurately delimit the zone of intergradation with *S. l. longirostris* (which occurs in the Florida panhandle; Jones *et al*. 1991).

Population Status and Trend – No range wide surveys have been conducted. No site-specific survey information within the assessment time frame has been provided. Herp array trapping data from K. Enge (pers comm.) provides single year data on shrew species as incidental non-target trap species. During seasonal drift fence/pitfall trapping in 1989, two sites within the range of the Homosassa shrew yielded two *S. longirostris* (and only two *Blarina* sp). During 1990, similar trapping across five watersheds in west central Florida yielded 41 *S. longirostris* captures, with similar numbers caught in each watershed (compared to 221 *Blarina* captures). Wolfe and Esher (1981) conclude that differences in relative abundance of *Sorex* and *Blarina* are due to trapping methods, and that actual abundance is roughly equal. However, *S. longirostris eionis* densities appear to be low across ~~the~~its range.

According to Florida's Wildlife Legacy Initiative (FWC 2005), the Homosassa shrew can be found in the following types of habitat: hardwood swamp/mixed wetland forest, industrial/commercial pineland, and mixed hardwood-pine forest (all habitats that are ~~in good condition~~ abundant but declining), natural pineland (which is ~~in poor condition and~~ declining), and disturbed/transitional habitat (~~the condition of which is uknown~~ variable and in flux). No estimates of habitat loss within the assessment period have been made.

It is projected that the Homosassa shrew's native habitat will continue to be lost and degraded as the human population in Florida continues to grow and expand (FWC 2008; Zwick and Carr 2006). Although Cox and Kautz (2000) report that 62% of the Homosassa shrew's potential habitat is on managed lands, their study used a restricted geographic range for *S. l. eionis* that included only Citrus and Hernando Counties. A more comprehensive analysis that included the entire distribution of the Homosassa shrew revealed that only 30% of potential habitat was on conservation lands (M. Endries/FWC, unpublished data), the other 70% was vulnerable to degradation or conversion to other uses. (But this area is hugely larger than parts of two counties!!) ~~In the next ten years b~~Between 2010 and 2020, it is predicted that 2,164 mi^2

(metric) of land in Florida (4% of Florida's total land area) will undergo urban development and that 39.4% (40%, precision??) of the converted land will be native habitat (Zwick and Carr 2006). GIS analysis by FWRI staff, using FWC 2003 data layers combined with projected future development from Zwick and Carr indicate a 6% decline in available habitat by 2020, 13% loss by 2040, and 20.55% loss by 2060. These percentages may overestimate the total loss due to differences in the pixel sizes of the two data sets (M. Endries/FWC unpublished data, Zwick and Carr 2006).

Quantitative Analyses – A population viability analysis for the Homosassa shrew has not been published.

BIOLOGICAL STATUS ASSESSMENT

Threats – The threats to Homosassa shrews are believed to be similar to those for Sherman's short-tailed shrew and include habitat loss and habitat degradation due to increased urbanization and agricultural practices (Layne 1992). Development that leads to a reduction of cover, particularly in a loss of coarse woody debris or a drying of soils, would be detrimental to local shrew populations (Davis *et al*. 2010; Layne 1992). Furthermore, since cats frequently prey on shrews, an increase in free-ranging cats in more developed areas would result in high shrew mortality rates (Layne 1992). (This argument [also in other shrew report) is not great because most shrews live in leaf litter or are subterranean, so predation by feral cats likely is minimal. Predators such as cats go for the biggest prey they can take, further placing tiny shrews way down the list.

Statewide Population Assessment – Findings from the Biological Review Group are included in a Biological Status Review information table.

LISTING RECOMMENDATION – Staff recommends removing the Homosassa shrew (*Sorex longirostris eionis*) from Florida's species of special concern list because the species does not meet 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.

LITERATURE CITED

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.

Davis, J.A., Jr. 1957. A new shrew (*Sorex*) from Florida. American Museum Novitates 1844:1-9.

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Hall, E.R. 1981. The ~~em~~M

ammals of North America. Second ed. John Wiley & Sons, New York 1:1-600 + *90*.

Jones, C.A., S.R. Humphrey, T.M. Padgett, R.K. Rose, and J.F. Pagels. 1991. Geographic variation and taxonomy of the southeastern shrew (*Sorex longirostris*). Journal of Mammalogy 72(2):263-272.

Layne, J.N. 1992. Sherman's short-tailed shrew *Blarina carolinensis shermani*. Pages 328-334 in S.R. Humphrey (ed.), Rare and ~~e~~Endangered ~~b~~Biota of Florida. Vol. I. Mammals. University Press of Florida. Gainesville, Florida.

Smallwood, K.S. and T.R. Smith. 2001. Study design and interpretation of shrew (*Sorex*) density estimates. Ann. Zool. Fennici 38:149-161.

Wolfe, J. L. and R. T. Esher. 1981. Relative abundance of the southeastern shrew. Journal of Mammal~~ol~~ogy. 62(3): 649-650. OUCH!

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.

Use metric in report and in tables

Biological Status Review Information
Findings

Species/taxon: Homosassa Shrew (Sorex longirostris eionis)
Date: 11/03/10
Assessors: Melissa Tucker, David Shindle, Dan Pearson

Generation length: 9 months (use 10 year window for assessment)

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]	Does not apply - habitat loss has not ceased, and no estimated population size.		N	
(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]	No data on population size or potential reduction. Insufficient data on habitat loss in last 10 years.		N	
(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]	The 6% estimate (FWRI data & Zwick and Carr) does not meet criteria.	I, P	N	Zwick & 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]	No data on population size or potential reduction. Insufficient data on habitat loss in last 10 years or in the future.		N	
[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	Range estimate based on range size in Jones is 8,044 sq miles - minimum size, but exceeds criteria. Estimate from range provided by FWRI is 35,246 km2 - also over criteria. See Notes sheet (#1) for explanation of range.	E	N	Jones et al 1991

(b)2. Area of occupancy $< 2{,}000\ km^2$ ($772\ mi^2$)	Not enough data on habitat use and locations to determine AOO. Based on calculations by FWRI, maximum AOO is 9616 sq miles. No ability to determine if estimates are off by order of magnitude.	I	?	Endries, M/FWC unpublished data
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	No data available.	S	N	
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	Projected decline of approximately 6% of the maximum area of occupancy based on FWRI data layers and Zwick and Carr	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
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	No data available.	S	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	No density estimates for shrews exist from Florida. Based on minimum densities in published literature at other sites, and the maximum area of occupancy, the population is likely to be over 10,000 individuals. See notes sheet (#2) for density estimate information.	I, P	N	Smallwood and Smith 2001
(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	FWRI and Zwick and Carr - the projected habitat decline is only 6%, which is likely an overestimate based on data layers.	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	Projected decline of approximately 6% of the maximum area of occupancy based on FWRI data layers and Zwick and Carr	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
a. Population structure in the form of EITHER	No data available.	S	N	
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	No data available.	S	N	
b. Extreme fluctuations in number of mature individuals	No data available.	S	N	
(D) Population Very Small or Restricted, EITHER				

(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	No density estimates for shrews exist from Florida. Based on minimum densities in published literature at other sites, and the maximum area of occupancy, the population is likely to be over 10,000 individuals.	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
(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	Range estimate based on range size in Jones is 8,044 sq miles - minimum size, but exceeds criteria. Estimate from range provided by FWRI is 35,246 km2 - also over criteria. Not enough data on habitat use and locations to determine AOO. Based on calculations by FWRI, maximum AOO is 9616 sq miles. No ability to determine if estimates are off by order of magnitude. No data available on number of locations, but believed to be more than 5.	E, I	N	Jones et al 1991, Zwick and Carr 2006; Endries, M/FWC unpublished data
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	No PVA conducted.		N	

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)	N (but close)

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 criteria	

1	Species/taxon:	Homosassa Shrew (Sorex longirostris eionis)
2	Biological Status Review Information Regional Assessment Date:	11/3-4/10
3	Assessors:	Melissa Tucker, David Shindle, Dan Pearson
4		
5		
6		
7		
8	Initial finding	Supporting Information
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	N
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	N
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the Florida population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	
22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	Does not meet criteria

Additional notes –

Assumptions:

1. Concurred that the expanded range as presented by Jones et al. 1991 was more accurate than the range presented by Cox and Kautz 2000. Jones et al. 1991 used seven cranial characteristics to analyze specimens from across the range of *S. longirostris*. They concluded that *S.l. eionis* was a valid subspecies, but that the range included most of peninsular Florida (as opposed to the restricted locality in Citrus and Hernando Counties).

2. Density estimates: as reported in cited literature, density estimates range from 14 to 44 shrews/hectare. No Florida specific density estimates have been provided, and the group consensus~~concensus~~ was that the reported densities were higher than actual densities. However, with no data available, we used the lowest reported estimate (14/ha) and applied this to area of occupancy, which led to a population greater than 10,000.

Appendix 1. Biological Review Group Members Biographies

Melissa Tucker has an ~~a~~M. S. in Ecology from the University of Georgia. She has worked as the Mammal Taxa Coordinator in FWC's Species Conservation Planning Section since 2007. Ms. Tucker has worked over 5 years on wildlife conservation issues, including planning and implementing conservation actions for mammals statewide, with an emphasis on small mammal species.

David Shindle has an ~~a~~M.S. in Wildlife Science from Texas A & M University. He has worked as a wildlife biologist for the Conservancy of Southwest Florida since 2005. Mr. Shindle has over 15 years experience in research and conservation of wildlife, with emphasis on the mammals of south Florida.

Daniel Pearson has an ~~a~~M.S. Wildlife Ecology and Conservation from University of Florida, Gainesville. Dan has worked as a biologist with the Florida Park Service for >20 years and has conducted surveys for several wildlife species including the Homosassa Shrew.

Peer review #3 from Dr. Jack Stout

From: Jack Stout
To: Imperiled
Subject: review of Homosassa shrew report
Date: Wednesday, January 19, 2011 11:23:58 AM

I have read the report and generally agree with the findings. The GIS-derived AOO figures trouble me in that we have no sense of actual occupied habitat types. Nonetheless, the more recent claims of this subspecies in many more counties than originally known gives support for the decision to delist. I would suggest that the claim of no data on density of shrews in Florida be altered to accommodate Herb Kale's paper on shrews near Vero Beach: Kale, H. W. II. 1972. A high concentration of *Cryptotis parva* in a forest in Florida. J. of Mammalogy 53(1):216-218. He did provide density estimates.

Jack Stout

Peer review #4 from Dr. Steven Castleberry

From: Steven Castleberry
To: Imperiled
Subject: Re: Homosassa shrew Draft BSR Report
Date: Friday, January 14, 2011 9:56:55 AM
Attachments: Homosassa Shrew Review_Castleberry.docx

Dr. Haubold,

I have attached my comments on the Biological Status Review for the Homosassa Shrew. I apologize for not getting it to you by the 11th. I was unable to get to the office most of this week because of the snow.

Feel free to contact me if you have any questions.

Steven

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

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

January 14, 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:

In the following pages you will find my review of the draft Biological Status Review (BSR) for the Homosassa Shrew. At your request I assessed the biological data available on the species and the assumptions made by the review team. As you and the review team know, there are very little biological data available regarding this subspecies of *Sorex longirostris*. Practically, all of the data were collected in other parts of the species' range. It is impossible to know how or even if, those data apply to *S. l. eionis*. However, in general I think the review team did an admirable job given how little data they had to work with.

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
Warnell School of Forestry and Natural Resources
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BIOLOGICAL INFORMATION

Taxonomic Classification

Subspecific designation within *S. longirostris* is based a single paper that examined cranial morphometrics (i.e., Jones et al. 1991). For the time period in which the study was conducted, the methods and statistics used were appropriate. Because it is the only research available on geographic variation in the species, I have no problem with recognizing *S. longirostris* in peninsular Florida as a distinct subspecies based on that publication. However, the work was conducted 20 years ago, since which a wealth of new techniques, particularly molecular genetic techniques, and analytical methods have been developed that would provide much greater resolution in an examination of geographic variation. Given these advances it would be greatly advantageous to assess geographic variation, and subsequently taxonomic status, using appropriate molecular methods.

Life History

As stated in the review, there is little literature specific to *S. l. eionis*. Thus, it is reasonable that most of the BSR is based on literature from other parts of the distribution. However, the one document cited in French (1980) that appears most relevant is not cited in the BSR:

> Florida Game and Fresh Water Fish Commission. 1976. Cross Florida Barge Canal Restudy Report-Wildlife Study. Prepared for Dept. of the Army, Jacksonville District, Corps of Engineers, Jacksonville, Fla. Vol. 4, Appendix D - Mammal Study, 137 pp.

I have not read this document and thus do not know how relevant it is, but it appears to be one of the few, if not the only, document specific to Florida.

Geographic Range and Distribution

There seems to be an arbitrary geographical boundary separating *S. l. eionis* and *S. l. longirostris*. As I stated above in the Taxonomic Classification section, more sampling is needed to investigate subspecies designations. Distribution and subspecies designations are integrally linked. In the Jones et al. (1991) paper there was a fairly small representation of samples from within the putative range of *S. l. eionis*. I realize that the range described in the BSR is based on the best available data, but I question the reliability of using such a small data set for drawing the distributional boundary.

Population Status and Trend

The unpublished data from K. Enge cannot be evaluated because there is too little information given about the sampling protocol. A more detailed explanation (specific locations of the surveys, array configuration and number, number of trap nights, etc.) of the methods would make these statements more useful.

How the habitat associations in the FWC's Florida's Comprehensive Wildlife Conservation Strategy were determined is not described in the BSR. The Comprehensive Wildlife Conservation Strategy (State Wildlife Action Plan) states that they were determined by the "best available professional opinion." It is my role to evaluate the science which I cannot do in this case. I understand that this is the best you have, but it is a concern that the habitat associations in this section rely entirely on information that is not in the published literature and thus cannot be objectively evaluated.

LISTING RECOMMENDATION

I suggest referencing the "Biological Status Review Information" table here. I was looking for an explanation of why the criteria were not met and it took me a while to realize that the rationales are in the table.

Based on the available data, I agree with the review team that the listing criteria are not met. However, as everyone involved knows, there are serious data deficiencies. With adequate data, perhaps the criteria still would not be met but the decision not to list would be based on data rather than a lack of data. Clearly, more studies are needed to make a more informed recommendation regarding listing.

ASSUMPTIONS

Assumption 1: My statements above regarding the need for an examination of geographic variation using more modern methods are relevant to this assumption. However, given the data currently available I think the assumption is valid.

Assumption 2: Again, given the lack of region-specific data, data on the same species from other areas in the range are the next best thing. I think this assumption is the best the review team can do, but it is impossible to know the accuracy of the density estimates used to make the assumption.

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; Tucker, Melissa
Cc: Dana_Hartley@fws.gov
Subject: Re: Homosassa shrew
Date: Tuesday, November 02, 2010 1:59:37 PM
Attachments: 19890328 phone call Humphrey with Service.pdf
Importance: High

Hi Melissa,

From a quick search, it appears that we do not have much information on this species. However, I found this old telephone conversation record in our electronic files.

Thanks,

-Paula
(See attached file: 19890328 phone call Humphrey with Service.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

March 28, 1989 telephone conversation with Dr. Steve Humphrey,
Florida Museum of Natural History

We discussed four species:

1. Steve has been working on the taxonomy of the Homossassa shrew, and believes that it represents a distinct species, with a range extending from Leon County (Tallahassee) to Polk County (Tiger Creek). It appears, therefore, to be a fairly wide-ranging species found in riparian areas and extending into hydric hammocks.

2. Pat Jodice is working with Steve on the Big Cypress fox squirrel. The animal is now very rare in the Big Cypress Preserve, with only a few animals having been seen in about a month and a half of looking. There are more animals around some of the golf course areas outside the Preserve. No one is sure why they have declined so much in the Preserve; poaching has been suggested as a cause but this has not been proven.

3. Sherman's fox squirrel - Steve says that forestry statistics show that longleaf pine stands have declined 90 percent from 1936 to 1986. Since this was the primary habitat of Sherman's fox sql1irrel, he feels that the species may soon need to be listed as threatened or endangered at the State (and presumably Federal) level.

4. Anastasia Island beach mouse - Steve has been working with Phil Frank on this subspecies on a State Nongame grant for several months. At the State Park, they have not found as many house mice as they expected (though populations may increase in the warmer months) but they have found large numbers of feral cats. This suggests that predation may be a more severe problem for beach mice at the State Park than competition from house mice. Cats and house mice are uncommomn at Fort Matanzas National Monument, which has more beach mouse habitat and a much denser beach mouse population.

Michael M. Bentzien
March 29, 1989

Copy of the Homosassa shrew BSR draft report that was sent out for peer review

Biological Status Review for the Homosassa shrew (*Sorex longirostris eionis*)

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 Homosassa shrew was sought from September 17 to November 1, 2010. The members of the biological review group (BRG) met on November 3-4, 2010. Group members were Melissa Tucker (FWC lead), David Shindle, and Dan Pearson. In accordance with rule 68A-27.0012 Florida Administrative Code (F.A.C.), the BRG was charged with evaluating the biological status of the Homosassa shrew 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)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. Please visit http://myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Homosassa shrew Biological Review Group concluded from the biological assessment that the Homosassa shrew does not meet criteria for listing. No information was received from the public during our information request period. Based on the literature review, and the biological review findings, staff recommend removing the species from the FWC list of species of special concern.

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

BIOLOGICAL INFORMATION

Taxonomic Classification – This report is for the Homosassa shrew, a subspecies of the southeastern shrew, in Florida. The Homosassa shrew has been designated to the subspecies *Sorex longirostris eionis* (Davis 1957 as cited in Jones *et al*. 1991).

Life History – The Homosassa shrew has been captured in palmetto thickets, longleaf pine sandhills, cypress swamps, bay swamps, slash pine and longleaf pine flatwoods, hydric hammocks, xeric hammocks, sand pine scrub, and clear-cuttings (as outlined in Jones *et al*. 1991).

Little is known about the life history, behavior, and biology of the Homosassa shrew. Summary information is provided for the species as a whole, *Sorex longirostris*.

Population densities of *Sorex longirostris* have been calculated at 30 shrews/ha and 44 shrews/ha, although French indicated that the 44 shrews/ha may over estimate density due to plot design and location. Few authors have captured ten or more shrews in one locality (French 1980a; see summary in French 1980b). The average density recorded for all *Sorex* sp. is 14 shrews per hectare (Smallwood and Smith 2001).

Pregnant females have been found from March through October and litter sizes ranged between one and six offspring (French 1980a). Based on French (1980b) most individuals don't breed during the first summer, and only survive one winter. Average generation time is estimated at approximately nine months.

Geographic Range and Distribution – The Homosassa shrew was originally described as being endemic to only the type locality, Homosassa Springs, Citrus County, Florida (Hall 1981 as cited in Jones *et al*. 1991; Davis 1957 as cited in Jones *et al*. 1991). A morphometric analysis of *Sorex longirostris* in Florida, however, has revealed that the Homosassa shrew has a much larger distribution and that it occurs in the northern two-thirds of peninsular Florida (Jones *et al*. 1991). Additional sampling of the Homosassa shrew throughout its range is necessary, though, to provide an exact estimate of its distribution and to accurately delimit the zone of intergradation with *S. l. longirostris* (which occurs in the Florida panhandle; Jones *et al*. 1991).

Population Status and Trend – No range wide surveys have been conducted. No site specific survey information within the assessment time frame has been provided. Herp array trapping data from K. Enge (pers comm.) provides single year data on shrew species as incidental non-target trap species. During seasonal drift fence/pitfall trapping in 1989, two sites within the range of the Homosassa shrew yielded two *S. longirostris* (and only two *Blarina* sp). During 1990, similar trapping across five watersheds in west central Florida yielded 41 *S. longirostris* captures, with similar numbers caught in each watershed (compared to 221 *Blarina* captures). Wolfe and Esher (1981) conclude that differences in relative abundance of *Sorex* and *Blarina* are due to trapping methods, and that actual abundance is roughly equal. However, *S. longirostris eionis* densities appear to be low across the range.

According to Florida's Wildlife Legacy Initiative (FWC 2005), the Homosassa shrew can be found in the following types of habitat: hardwood swamp/mixed wetland forest, industrial/commercial pineland, and mixed hardwood-pine forest (all habitats that are in good condition but declining), natural pineland (which is in poor condition and declining), and disturbed/transitional habitat (the condition of which is unknown). No estimates of habitat loss within the assessment period have been made.

It is projected that the Homosassa shrew's native habitat will continue to be lost and degraded as the human population in Florida continues to grow and expand (FWC 2008; Zwick and Carr 2006). Although Cox and Kautz (2000) report that 62% of the Homosassa shrew's potential habitat is on managed lands, their study used a restricted geographic range for *S. l. eionis* that included only Citrus and Hernando Counties. A more comprehensive analysis that included the entire distribution of the Homosassa shrew revealed that only 30% of potential habitat was on conservation lands (M. Endries/FWC, unpublished data), the other 70% was

vulnerable to degradation or conversion to other uses. In the next ten years, between 2010 and 2020, it is predicted that 2,164 mi^2 of land in Florida (4% of Florida's total land area) will undergo urban development and that 39.4% of the converted land will be native habitat (Zwick and Carr 2006). GIS analysis by FWRI staff, using FWC 2003 data layers combined with projected future development from Zwick and Carr indicate a 6% decline in available habitat by 2020, 13% loss by 2040, and 20.55% loss by 2060. These percentages may overestimate the total loss due to differences in the pixel sizes of the two data sets (M. Endries/FWC unpublished data, Zwick and Carr 2006).

Quantitative Analyses – A population viability analysis for the Homosassa shrew has not been published.

BIOLOGICAL STATUS ASSESSMENT

Threats – The threats to Homosassa shrews are believed to be similar to those for Sherman's short-tailed shrew and include habitat loss and habitat degradation due to increased urbanization and agricultural practices (Layne 1992). Development that leads to a reduction of cover, particularly in a loss of coarse woody debris, or a drying of soils would be detrimental to local shrew populations (Davis *et al*. 2010; Layne 1992). Furthermore, since cats frequently prey on shrews, an increase in free-ranging cats in more developed areas would result in high shrew mortality rates (Layne 1992).

Statewide Population Assessment – Findings from the Biological Review Group are included in a Biological Status Review information table.

LISTING RECOMMENDATION – Staff recommends removing the Homosassa shrew (*Sorex longirostris eionis*) from Florida's species of special concern list because the species does not meet 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.

LITERATURE CITED

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Biological Status Review Information
Findings

Species/taxon: Homosassa Shrew (Sorex longirostris eionis)
Date: 11/03/10
Assessors: Melissa Tucker, David Shindle, Dan Pearson

Generation length: 9 months (use 10 year window for assessment)

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]	Does not apply - habitat loss has not ceased, and no estimated population size.		N	
(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]	No data on population size or potential reduction. Insufficient data on habitat loss in last 10 years.		N	
(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]	The 6% estimate (FWRI data & Zwick and Carr) does not meet criteria.	I, P	N	Zwick & 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]	No data on population size or potential reduction. Insufficient data on habitat loss in last 10 years or in the future.		N	
[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	Range estimate based on range size in Jones is 8,044 sq miles - minimum size, but exceeds criteria. Estimate from range provided by FWRI is 35,246 km2 - also over criteria. See Notes sheet (#1) for explanation of range.	E	N	Jones et al 1991

(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Not enough data on habitat use and locations to determine AOO. Based on calculations by FWRI, maximum AOO is 9616 sq miles. No ability to determine if estimates are off by order of magnitude.	I	?	Endries, M/FWC unpublished data
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	No data available.	S	N	
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	Projected decline of approximately 6% of the maximum area of occupancy based on FWRI data layers and Zwick and Carr	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
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	No data available.	S	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	No density estimates for shrews exist from Florida. Based on minimum densities in published literature at other sites, and the maximum area of occupancy, the population is likely to be over 10,000 individuals. See notes sheet (#2) for density estimate information.	I, P	N	Smallwood and Smith 2001
(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	FWRI and Zwick and Carr - the projected habitat decline is only 6%, which is likely an overestimate based on data layers.	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	Projected decline of approximately 6% of the maximum area of occupancy based on FWRI data layers and Zwick and Carr	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
a. Population structure in the form of EITHER	No data available.	S	N	
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	No data available.	S	N	
b. Extreme fluctuations in number of mature individuals	No data available.	S	N	
(D) Population Very Small or Restricted, EITHER				

(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	No density estimates for shrews exist from Florida. Based on minimum densities in published literature at other sites, and the maximum area of occupancy, the population is likely to be over 10,000 individuals.	I, P	N	Zwick and Carr 2006, Endries, M/FWC unpublished data
(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	Range estimate based on range size in Jones is 8,044 sq miles - minimum size, but exceeds criteria. Estimate from range provided by FWRI is 35,246 km2 - also over criteria. Not enough data on habitat use and locations to determine AOO. Based on calculations by FWRI, maximum AOO is 9616 sq miles. No ability to determine if estimates are off by order of magnitude. No data available on number of locations, but believed to be more than 5.	E, I	N	Jones et al 1991, Zwick and Carr 2006; Endries, M/FWC unpublished data
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	No PVA conducted.		N	

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)	N (but close)
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 criteria	

1	Biological Status Review Information Regional Assessment	Species/taxon:	Homosassa Shrew (Sorex longirostris eionis)

2	Date:	11/3-4/10
3	Assessors:	Melissa Tucker, David Shindle, Dan Pearson
4		
5		
6		
7		
8	Initial finding	Supporting Information
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	N
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	N
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the Florida population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	
22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	Does not meet criteria

Additional notes –

Assumptions:

1. Concurred that the expanded range as presented by Jones et al. 1991 was more accurate than the range presented by Cox and Kautz 2000. Jones et al. 1991 used seven cranial characteristics to analyze specimens from across the range of *S. longirostris*. They concluded that *S.l. eionis* was a valid subspecies, but that the range included most of peninsular Florida (as opposed to the restricted locality in Citrus and Hernando Counties).

2. Density estimates: as reported in cited literature, density estimates range from 14 to 44 shrews/hectare. No Florida specific density estimates have been provided, and the group concensus was that the reported densities were higher than actual densities. However, with no data available, we used the lowest reported estimate (14/ha) and applied this to area of occupancy, which led to a population greater than 10,000.

Appendix 1. Biological Review Group Members Biographies

Melissa Tucker has a M. S. in Ecology from the University of Georgia. She has worked as the Mammal Taxa Coordinator in FWC's Species Conservation Planning Section since 2007. Ms. Tucker has worked over 5 years on wildlife conservation issues, including planning and implementing conservation actions for mammals statewide, with an emphasis on small mammal species.

David Shindle has a M.S. in Wildlife Science from Texas A & M University. He has worked as a wildlife biologist for the Conservancy of Southwest Florida since 2005. Mr. Shindle has over 15 years experience in research and conservation of wildlife, with emphasis on the mammals of south Florida.

Daniel Pearson has a M.S. Wildlife Ecology and Conservation from University of Florida, Gainesville. Dan has worked as a biologist with the Florida Park Service for >20 years and has conducted surveys for several wildlife species including the Homosassa Shrew.

Appendix 2. Summary of letters and emails received during the solicitation of information from the public.

No information about this species was received during the public information request period.

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