Homosassa Shrew Biological Status Review Report

October 27, 2017

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

Biological Status Review
for the
Homosassa shrew
(*Sorex longirostris eionis*)
October 27, 2017

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of November 8, 2010 that had not undergone a status review in the past decade. The 2011 evaluation found that the Homosassa shrew did not meet any listing criteria. After considering reviewers' comments about insufficient data, staff reviewed the BRG findings and recommended that the Homosassa shrew be maintained as a Species of Special Concern until additional data could be collected. A Species Action Plan for the Homosassa shrew was developed in 2013 and the species was included in the Imperiled Species Management Plan, finalized in 2016. The ISMP identifies the need to re-assess all remaining Species of Special Concern by 2017. In 2017, FWC initiated the request to re-evaluate the Homosassa shrew.

Public information on the status of the Homosassa shrew was sought from May 10 to June 26, 2017. No information was received from the public during our information request period. The members of the Biological Review Group (BRG) met on August 15, 2017. Group members were Chris Winchester (FWC lead), John Kilgo (US Forest Service), and Dan Pearson (Florida Park Service, Department of Environmental Protection) (Appendix 1). 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, F.A.C., and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 4.0)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 13).* Please visit http://myfwc.com/wildlifehabitats/imperiled/listing-process/ to view the listing process rule and the criteria found in the definitions.

The Homosassa shrew BRG concluded from the biological assessment that the Homosassa shrew does not meet any listing criteria. Staff recommends that the Homosassa shrew be removed as a Species of Special Concern from Rule 68A-27.005, F.A.C.

FWC staff gratefully acknowledges the assistance of the biological review group members and peer reviewers. Staff would also like to thank Claire Sunquist Blunden and Emily Evans for providing guidance with IUCN criteria and assistance in documenting the meeting.

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 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 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 (1980a 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 restricted to only the type locality, in the mesic habitats associated with Homosassa Springs, Citrus County, Florida (Hall 1981; 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). Recent surveys found *Sorex longirostris* within its presumed range in Marion, Clay, Putnam, Gilchrist, Lafayette, and Hamilton counties (Teets and Doonan 2015; Smith et al. 2015). However, additional sampling of the Homosassa shrew throughout its range is necessary 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 –Recent surveys (2011-2015) occurred in a portion of the presumed range and captured *S. longirostris* in most areas surveyed, although capture rates were low (Teets and Doonan 2015; Smith et al. 2015). Teets and Doonan (2015) detected *S. longirostris* at 3 of 5 (60%) survey locations within the presumed range, but only captured 6 individuals. Captures occurred in Columbia, Clay and Putnam counties over 1 year survey period (Teets and Doonan 2015). Smith et al. (2015) captured *S. longirostris* at all 3 survey locations in Marion County, with only 18 individuals captured during the 3 year survey period. Results of recent surveys confirm the presence of *S. longirostris* within the presumed range, but

do not provide data on population size or trends. No range-wide surveys were conducted.

Results of multiple other survey efforts suggest that *S. longirostris eionis* densities are low across the range and less than either *Cryptotis* or *Blarina*. Seasonal drift fence/pitfall trapping in 1990, across five watersheds in west central Florida yielded 41 *S. longirostris* captures, compared to 221 *Blarina* captures (K. Enge, FWC, unpublished data). Wolfe and Esher (1981) concluded that reported differences in relative abundance of *Sorex* and *Blarina* are due to trapping methods, and that actual abundance is roughly equal. In a multi-year study, Kale (1972) found that the densities of *Cryptotis parva* were 32/ha and *Blarina carolinensis* were 11/ha, but captured no *S. longirostris*. Catano and Stout (2015) used drift fence arrays with pitfall traps to sample from June 2011 to January 2012, but caught only 3 *B. carolinensis* and 0 *S. longirostris*.

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 (Jones et al. 1991). Teets and Doonan (2015) captured *S. longirostris* in upland mixed woodland, sandhill, dome swamp and mesic flatwoods. Smith et al. (2015) collected *S. longirostris* in mixed pine-hardwood forest, mixed wetland forest and pine flatwoods. Densities across these habitats are not known, so a conservative estimate of density as 1 per square kilometer has been used when projecting population trends based on habitat loss.

No direct estimates of habitat loss within the assessment period have been made, however projections from GIS data were possible. 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 (Barrett 2017, 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 approximately 35% of potential habitat was on conservation lands (Barrett 2017). While this is a smaller percentage of habitat on conservation lands than estimated by Cox and Kautz (2000), the total land area in conservation lands still exceeds the original range that was limited to Citrus and Hernando counties. A GIS analysis by FWC staff, using the Cooperative Land Cover (CLC) data layers, version 3.2 updated in 2016, combined with projected future development data from Zwick and Carr (2006) indicate a 5.1% decline in available habitat by 2020, 7.2% loss by 2040, and 8.0% loss by 2060 (Barrett 2017). These percentages may overestimate the total loss due to differences in the pixel sizes used in the two data sets (Barrett 2017).

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

BIOLOGICAL STATUS ASSESSMENT

Threats – The threats to Homosassa shrews have not been described in literature, but are believed to be similar to those cited by Layne (1992) for Sherman's short-tailed shrew and

include habitat loss and habitat degradation due to increased urbanization and agricultural practices. Activities that lead 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). The impacts of cat predation on the Homosassa shrew are unknown, however cat predation on small mammals numbers in the billions annually (Loss et al 2013) and Layne (1992) suggested that since cats frequently prey on shrews, an increase in free-ranging cats in more developed areas would result in high shrew mortality rates. Anecdotal observations suggest that human-influenced incidental mortalities may also occur from swimming pools and lawn-maintenance activities. However, more data are needed to accurately assess these potential impacts (FWC 2013).

Population Assessment – Findings from the BRG are included in a Biological Status Review Information table below. The BRG found that the Homosassa shrew (*Sorex longirostris eionis*) did not meet the criteria to be listed as a Threatened species as evaluated in the findings table.

LISTING RECOMMENDATION

After considering the BRG findings from the 2010 and 2017 assessments, staff recommends that the Homosassa shrew not be listed as a Threatened species and that it be removed from the Species of Special Concern list.

SUMMARY OF THE INDEPENDENT REVIEW

Independent scientific review of the biological assessment was sought and received from 5 scientists. All 5 agreed that the Homosassa shrew did not meet the criteria for listing as a Threatened species. One reviewer recommended maintaining the species as a Species of Special Concern (SSC). However, when changes to Rule 68A-27, F.A.C. were adopted in 2010 to revise the state's listing process, the SSC category was only temporarily retained for the 5 SSC that were deemed data deficient during the 2010 review, with direction from the Commission that when there was sufficient data, a decision on whether or not listing as Threatened was warranted would be made. After re-evaluation of these 5 species (including the Homosassa shrew), the SSC category would be abolished. One reviewer pointed out that additional data is needed to help inform conservation of the species. Staff concur that more data on habitat use and other demographic factors is needed and this will be addressed in the revised Species Action Plan (SAP) for the Homosassa shrew, however staff believe that the data available are sufficient to make a determination on listing status. Two reviewers addressed the threat from cats, with differing opinions on the potential impact to shrews. An additional citation was added in the Threats section, and staff have noted this as a potential area for future study during SAP revision. Two reviewers questioned the density estimates. The Biological Review Group (BRG) used both 14 shrews/hectare and a very conservative 1 shrew per square kilometer to draw their conclusions. One reviewer suggested that the review was too conservative at 1 shrew/square kilometer and the other that the review overestimated abundance at 14 shrews/hectare. Staff concur that there are no specific density estimates that apply across multiple habitats in Florida, and have edited the text to reflect this. Using the most conservative estimate of 1 shrew/square

kilometer, the Homosassa shrew did not meet the listing criteria, and adjusting the density estimate to a less conservative estimate would not change the BRGs evaluation. One reviewer pointed out the need for additional genetic studies; staff concur and these needs will be addressed in the SAP.

The complete scientific reviews are provided in Appendix 3. Staff of the FWC gratefully acknowledge the assistance of the members of the Biologica Review Group and of the Independent Reviewers.

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Biological Status Review Information
Findings

Species/taxon: Homosassa Shrew (Sorex longirostris eionis)
Date: 08/15/2017
Assessors: Chris Winchester, John Kilgo, Dan Pearson

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

Criterion/Listing Measure	Data/Information	Data Type*	Sub-Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Sub-Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	No data directly related to population size or potential reduction. Loss of habitat as an indicator of declines has not ceased.	I	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 directly related to population size or potential reduction. Loss of habitat as an indicator of declines has not ceased.	I	N	See Additional Notes (# 1) for further explanation of estimated population decline based on habitat loss.
(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]	No data directly related to population size or potential reduction. Habitat loss has not ceased. The 6% estimate of population decline does not meet criteria.	I, P	N	Zwick & Carr (2006), Barrett (2017). See Additional Notes (# 1) for further explanation of estimated population decline based on habitat loss.
(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 directly related to population size or potential reduction.	I	N	Zwick & Carr (2006), Barrett (2017)
[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	The estimated EOO based on range size presented by Jones et al. (1991) is 8,044 sq. miles.	I, P	N	Jones et al. (1991). See Additional Notes (#2) for explanation of the EOO estimate.

(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Not enough data on habitat use and locations to directly determine AOO. Based on calculations by FWC staff, maximum AOO inferred to be 24,544 km^2. No ability to determine if estimates are off by order of magnitude.	I	N	Barrett (2017)
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	No data available. Based on recent data and AOO, populations are considered fairly continuous throughout their range and the Homosassa shrew is more of a generalist species with respect to habitat.	I	N	Jones et al. (1991), Barrett (2017), Teets and Doonan (2015), Smith et al. (2015)
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 in AOO of approximately 5.1% by 2020 and 8.0% by 2060 based on FWC GIS analysis and Zwick and Carr (2006).	I, P	Y	Barrett (2017), Zwick and Carr (2006)
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. No evidence of extreme fluctuations, but no evidence of stability either. Relative stability of habitat suggests populations wouldn't fluctuate.	I	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	No densities have been directly calculated for *Sorex* shrews from Florida. Density is inferred by considering the AOO (24,544 km^2) and assuming 1 shrew per km^2 (just as a base line or lowest density in occupied habitat); at that level the inferred population size is greater than 10,000.	I, P	N	Smallwood and Smith (2001), Barrett (2017) See Additional Notes (#3) for density estimate information.
(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	The projected population decline is estimated to be only 6%, which is likely an overestimate based on data layers.	I, P	N	Zwick and Carr (2006), Barrett (2017). See Additional Notes (# 1) for further explanation of estimated population decline based on habitat loss.
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	Projected population decline of approximately 6% based on FWC GIS analysis and Zwick and Carr (2006).	I, P	N	Zwick and Carr 2006, Barrett (2017). See Additional Notes (# 1) for further explanation of estimated population decline based on habitat loss.

a. Population structure in the form of EITHER (i) No subpopulation estimated to contain more than 1000 mature individuals; OR	No data available. Based on life history, individuals reach maturity quickly and are therefore prominent in the population. Population structure is unknown, but no evidence of a highly fragmented population composed of isolated subpopulations.	I	N	French (1980b), Jones et al. (1991), Barrett (2017)
(ii) All mature individuals are in one subpopulation	No data available. Individuals reach maturity quickly and are therefore prominent in the population. Population structure is unknown, but no evidence of a highly fragmented population composed of isolated subpopulations.	I	N	French (1980a), French (1980b)
b. Extreme fluctuations in number of mature individuals	No data available. No evidence of extreme fluctuations in habitat quantity or quality. Based on life history, population is inferred to be relatively stable.	I	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 *Sorex* 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), Barrett (2017), Smallwood and Smith (2001).
(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 presented by Jones et al. (1991) is 8,044 sq miles The AOO is estimated to be 24,544 km^2. No ability to determine if estimates are off by an order of magnitude. No range-wide location data are available, but number of locations are believed to be more than 5 based on recent survey data.	E, I	N	Jones et al. (1991), Smallwood and Smith (2001), Barrett (2017). Teets and Doonan (2015) show Homosassa shrews have been captured at more than 5 location in the last 5 years.

(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/sub-criteria OR Does not meet any of the criteria/sub-criteria)	Reason (which criteria/sub-criteria are met)
Does not meet any of the criteria.	
Is species/taxon endemic to Florida? (Y/N)	N (but see Additional Notes # 4)
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/sub-criteria OR Does not meet any of the criteria/sub-criteria)	Reason (which criteria/sub-criteria are met)
Does not meet criteria	

1	Biological Status Review Information Regional Assessment	Species/taxon: Homosassa Shrew (Sorex longirostris eionis)
2		Date: 8/15/2017
3		Assessors: Chris Winchester, Dan Pearson, John Kilgo
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 –

1. The BRG inferred that population trends for the Homosassa shrew are directly correlated with trends in available habitat. The GIS analysis by FWC staff (Barret 2017), using the Cooperative Land Cover (CLC) data layers, version 3.2 updated in 2016, combined with projected future development data from Zwick and Carr (2006) indicated a 5.1% decline in available habitat by 2020, 7.2% loss by 2040, and 8.0% loss by 2060. Based on these projections the BRG inferred an approximate 6% decline in the Homosassa shrew population over the next 10 years as an average between 5.1% and 7.2%

2. The BRG 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) analyzed specimens from across the range of *S. longirostris* and concluded that *S. l. eionis* was a valid subspecies with a range that included most of peninsular Florida (as opposed to the restricted locality in Citrus and Hernando Counties). The EOO is inferred to be the area of all counties within the currently accepted Homosassa shrew range presented by Jones et al. (1991).

3. Density estimates for shrews in literature cited here range from 14 to 44 shrews/hectare. No Florida specific density estimates for Sorex have been provided, and the group consensus 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 (AOO), which led to a population greater than 10,000. In addition, given the reported rates of capture for *S. l. eionis* (e.g., Teets and Doonan 2105, Smith et al. 2015) we assumed a minimum of 1 individual per km^2 as a conservative lowest density estimate across the AOO. This method also results in a population greater than 10,000.

4. Without molecular genetic data the BRG could not clearly determine whether the range of *S. l. eionis* may extend into Georgia. Given that there are no barriers to movement between Florida and Georgia, the BRG inferred *S. l. eionis* occurs in Georgia

APPENDIX 1. Brief biographies of the Homosassa shrew Biological Review Group members.

Chris Winchester is a Research Associate with the Florida Fish and Wildlife Conservation Commission. He has a B.A. in Biological Sciences from the University of Delaware (1998) and an M.S. from the University of Georgia in Wildlife Ecology (2007). He has worked for FWC since 2012 and has conducted research on eastern chipmunk and mink populations in Florida. Responsibilities include designing and implementing research and managing project budgets. He has over 10 years of experience conducting wildlife research.

John C. Kilgo has a Ph.D. in Wildlife Ecology from the University of Georgia, Athens. Since 1997 he has been employed as a Research Wildlife Biologist with the USDA Forest Service Southern Research Station. He also is a Certified Wildlife Biologist and an adjunct faculty member at Clemson University, the University of Georgia, and North Carolina State University. His work has focused on various wildlife species, including songbirds, bats, herps, small mammals, deer, and wild turkeys.

Daniel Pearson has an M.S. Wildlife Ecology and Conservation from University of Florida, Gainesville. Dan has worked as a biologist with the Florida Park Service for more than25 years and has conducted surveys for various wildlife species including the Homosassa Shrew.

APPENDIX 2. Summary of letters and emails received during the solicitation of information from the public period of May 10, 2017 through June 26, 2017.

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

Appendix 3. Peer Reviews of Independent Scientists

United States Department of The Interior
U.S. Geological Survey
Ecosystems Division

Virginia Cooperative Fish and Wildlife Research Unit
106 Cheatham Hall
Virginia Tech
Blacksburg, VA 24061

Fax: (540) 231-7580
Phone: (540) 231-5927
Email: wmford@vt.edu

September 9, 2017

Melissa Tucker
Assistant Section Leader/Protected Species Coordinator
Species Conservation Planning Section
Florida Fish and Wildlife Conservation Commission
620 S. Meridian Street
Mail Station 2A
Tallahassee, FL 32399

Dear Ms. Tucker:

After reviewing the materials provided by the Florida Fish and Wildlife Conservation Commission and the assessment of Biological Review Group relative to the status of the Homosassa shrew, I concur that this subspecies of Southeastern shrew (*Sorex longirostris*) does not merit listing or any special status. Moreover, I would posit your minimum number of individuals occurring in Florida is overly conservative and the actual population is much higher. I base my conclusions primarily on the expanded range and additional distributional records provided since the previous status review. While I have no experience with this subspecies, I have worked with Southeastern shrews throughout the upper Coastal Plain, Piedmont and Southern Appalachians throughout the Southeast and mid-Atlantic. The most recent study findings from Florida largely concur with what I have found from decades of pitfall trap surveys in the region. Rarely are Southeastern shrews overly abundant and are always caught with less frequency that other Soricids – however throughout much of the Southeast at elevations below 200 m, the probability of occurrence in upland hardwoods, pine and bottomland hardwood types approaches 90% (Ford et al. 2006). I also concur that conditions that promote or provide abundant coarse wood debris benefit shrews in general, and probably as well the Homosassa shrew (Moseley et al. 2008). Accordingly, this may be habitat component that might be at odds with short fire-return intervals in longleaf pine (*Pinus palustris*) stands, but undoubtedly is not limited in most upland or bottomland hardwood systems, mesic hammocks or unthinned pine plantations in Florida. Our studies have also shown that in some settings, least shrews (*Cryptotis parva*) will replace Southeastern shrews immediately following timber harvest during the 3-7 period when regenerating stands approximate oldfield habitat.

Thank you for the opportunity to comment on this unique part of Florida's fauna. Please do not hesitate to contact me if you have additional questions or need further clarification.

Sincerely,

W. Mark Ford, Ph.D.
Unit Leader and Associate Professor

Literature Cited

Ford, W.M., T.S. McCay, M.A. Menzel, W.D. Webster, C.H. Greenberg, J.F. Pagels and J. Merritt. 2006. Influence of elevation and forest type on shrew community assemblage and species distribution in the central and southern Appalachians. Pages 303-315 In: J.F. Merritt, S. Churchfield, R. Hutterer and B.A. Sheftel (eds.). Advances in the Biology of the Shrews II. Special Publication of the International Society of Shrew Biologists, No. 1, New York. 468 p

Menzel, M.A., S.B. Castleberry, W.M. Ford, and T.S. McCay. 2005. Effects of a group selection timber harvest on the small mammal community in a southern bottomland hardwood forest. Pages 389-396 In: L. Fredrickson, (ed). Proceedings of the Symposium on Ecology and Management of Bottomland Hardwood Systems: the State of Our Understanding. University of Missouri Press, Columbia

Moseley, K.R., A.K. Owen, S.B. Castleberry, W.M. Ford, J.C. Kilgo and T.M. McCay. 2008. Soricid response to coarse woody debris manipulations in Coastal Plain loblolly pine forests. Forest Ecology and Management 255:2306-2311.

NC STATE UNIVERSITY

Fisheries, Wildlife, and Conservation Biology
Department of Forestry & Environmental Resources
College of Natural Resources
Turner House Campus, Box 7646
Raleigh, NC 27695-7646

9/29/17

To Whom It May Concern:

I thoroughly reviewed the Biological Status Review Report for the Homosassa shrew and judge it to be complete and accurate. The assumptions, interpretations of the limited data, and conclusions all are valid. The 3-person Homosassa Shrew Biological Review Group represents a wide range of expertise relevant to the review, making the trio highly qualified to make appropriate recommendations.

Previous research on the subspecies suggested it inhabits a range of vegetation types across a significant portion of Florida. However, these studies were localized and were based on relatively few captures of Homosassa shrew. Additionally, the subspecies' habitat requirements and relationship with *Sorex longirostris longirostris* are poorly described.

Although the status and trajectory of the Homosassa shrew population is not known, it is likely that habitat for the subspecies has declined over the previous decade and that these declines will continue because of rapid urbanization. Hence, it is critical that additional data be gathered to help inform conservation of the shrew subspecies. Shrews are cryptic and notoriously difficult to survey because they have high mortality rates when captured, so data gathering will continue to be a challenge. Given the lack of information to direct a decision on the subspecies' listing, additional research would aid future listing decisions.

Please email (chris_moorman@ncsu.edu) or call (919-515-5578) if you have questions.

Sincerely,

Christopher Moorman, PhD
NCSU Faculty Scholar
Professor and Coordinator; Fisheries, Wildlife, and Conservation Biology Program
Department of Forestry and Environmental Resources
North Carolina State University
Chris_moorman@ncsu.edu
(919) 523-6548

From: Timm, Robert Mark
To: Imperiled; Sunquist, Claire
Subject: Homosassa Shrew Peer Reviewer--R. M. Timm
Date: Monday, October 23, 2017 3:51:33 PM
Attachments: image001.png
oledata.mso
ForReview_HomosassShrewBSR_Draft_Sept2017.pdf

Dear Dr. Tucker:

I found the Homosassa shrew (*Sorex longirostris eionis*) Biological Status Review Report by the Florida Fish and Wildlife Conservation Commission a very thorough, professional assessment and review of what is currently known about the abundance and conservation issues concerning this shrew. I concur with the conclusions of the report that this shrew not be listed as a Threatened species and that it be removed from the Species of Special Concern list.

However, that being said, I herein comment on related issues that deserve further study and continued efforts by the FWC.

1) It is hard to believe that *S. l. eionis* populations are in general as high as 14/ha (the low end estimate used herein). They must certainly be lower. In suitable habitats in FL, both *Blarina* and *Cryptotis* are fairly abundant in adequate habitats when pitfall sampling is employed, whereas *Sorex* has not been taken as frequently or in the numbers in Florida. It must far less abundant than these other shrews even in appropriate habitats.

2) What is the Homosassa shrew? Additional note #4 on page 13 of the document brings up a critical point, "Without molecular genetic data…" The publication that the taxonomy of this shrew is based on (Jones et al. 1991, JM 72:263–272), was a professional systematic study of *Sorex longirostris* for the time—given the lag time in publication, that study was completed nearly three decades ago. These authors used seven morphological characters to evaluate the species *longirostris* throughout its range. They found that *eionis* was slightly larger in four cranial characters, and intermediate in one cranial character and one external character.

We now know that subtle morphological differences are not necessarily a definitive answer to assess geographic variation and what might be thought of as "species" or "subspecies" level differences between populations. Soricids have been shown to respond morphologically to environmental variables at the population level, as well as at the generation level. Local populations of northern shrews have been found to have reduced size and mass during winter months. Hence, size in these short-lived mammals may be more plastic than was recognized previously. Complicating this further may be the peninsular effect in Florida and the modest sample size of these shrews available in the late 1980s might not have discerned this. Thus, if there is intergradation or not with more northern or western populations of *S. longirostris*, that is currently unknown. Is *eionis* morphologically distinct? Should *eionis* be considered a genetically distinct population? A valid taxon worth recognition as a subspecies? As a full species? A modern taxonomic assessment of the taxon could clarify these questions.

I applaud the FWC efforts to control introduced snakes—snake predation on shrews is well-documented in the scientific literature. However, what isn't as well-documented is the

predation on shrews by domestic cats as pointed out by Layne. Everywhere I have personally worked on shrews (three different continents and a wide variety of species), I have found that the domestic cats kill an unfathomable number of shrews. Cat predation on birds is better documented than it is on mammals, but a recent study concluded that, “free-ranging domestic cats kill 1.3–4.0 billion birds and 6.3–22.3 billion mammals annually” [see Loss et al. 2013; doi:10.1038/ncomms2380]. I don’t believe that we have an even slightly reasonable estimate as to the number of shrews killed annually by cats.

Continued efforts on addressing the issues of habitat degradation and the impacts of introduced species is critically needed for all small mammals including shrews throughout their ranges.

I hope that these comments assist you in your efforts to understand and conserve Florida’s interesting wildlife,

R. M. Timm

Robert M. Timm, Ph.D.
Department of Ecology
and Evolutionary Biology
University of Kansas
Lawrence, Kansas 66045 USA

Opinion on whether to delist the Homosassa shrew, *Sorex longirostris eionis*, in Florida, submitted by Robert K. Rose, Professor Emeritus, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23592-0266 brose@odu.edu

I agree with the decision of the Biological Review Group (BRG) to delist the Homosassa shrew, *Sorex longirostris eionis,* in Florida. My reasons relate mostly to its relatively wide distribution, in at least eight Florida counties (i.e., beyond just Homosassa Springs, from which the specimens were taken when it was described as a new subspecies), and more importantly, to the broad range of habitats in which the Homosassa shrew has been observed. Further, many of these habitats, while not on publicly held lands, are not likely to be developed, including cypress swamps, bay swamps, and hydric hammocks. Further, clear-cutting many kinds of forests quickly converts a habitat that had supported a low density of shrews to one that supports a much higher density of shrews, when the grassy/shrubby habitats of early succession quickly produce a thick litter layer that in turn supports many kinds of invertebrates, the basis for shrew diets. Thus, in my opinion, whereas clear-cutting eliminates habitat for some species, such as white-footed mice and other forest-dwelling small mammals, it quickly provides superior habitat for other small mammals, namely the shrews, including the Homosassa shrew. In addition, I do not see feral cats or most other mammalian carnivores as major threats to shrews as tiny as the Homosassa shrew; no feral cat will exclusively or actively hunt 3-4 g shrews when 100-150 g cotton rats are available in the same habitat.

The Virginia Department of Game and Inland Fisheries came to a similar decision a few years ago, specifically to delist *Sorex longirostris fisheri*, another subspecies of southeastern shrew with a limited distribution in eastern Virginia. Originally believed to be limited to the swamp forest of southeastern Virginia called The Dismal Swamp, with an area of about 50,000 ha, studies that my students and I conducted in the 1980s and 1990s showed that Fisher's southeastern shrew had a much broader distribution than was once believed. The shrew also occupied a wider range of habitats than just the wet peaty soils of the Dismal Swamp. With the consistent use of 0.25 ha grids with 25 pitfall

traps for 21 days, we also learned that densities were highly variable and that often Fisher's southeastern shrew was the most common small mammal taken with pitfall traps, even more common than short-tailed shrews (*Blarina* spp). Densities almost always were lower in forested habitats than in more open habitats, whether the latter were grassy fields or *Phragmites* swamps. Later studies revealed that Fisher's southeastern shrew was present in several counties in eastern Virginia, and was not always associated with wet or damp soils.

Thus, in many ways I see these two subspecies of southeastern shrews as being similar: originally described from a single wet (springs or swamp) location but on further study revealed to have broader distributions, including in more mesic sites. That is, each is not restricted to wet sites. Further, each has broader habitat tolerances than first believed, and is found in a range of habitats, from open through forested habitats. Densities of both subspecies are variable and at least in Virginia, are much lower in forests than in habitats in earlier stages of biological succession. Whether the higher densities in Virginia than in Florida are due to differences in methodologies of trapping is moot, but in my opinion it seems likely that the lower densities of *Sorex longirostris eionis* compared to *S. l. fisheri* are real.

More details of my studies of the southeastern shrew in eastern Virginia can be found in Banisteria 47(2016):9-13, the abstract of which is attached.

The Small Mammals of Southeastern Virginia as Revealed by Pitfall Trapping

Robert K. Rose, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266

ABSTRACT___. Pitfall trapping is a poor method to catch small mammals but the only way to catch and study the Southeastern Shrew (*Sorex longirostris*), the primary mammal of interest in the field studies reported here. While learning much about its distribution and abundance, still more was learned about the other small mammals present in forests and fields of eastern Virginia. A total of 15 species was captured at 19 locations during the 1990-2013 period, including five shrews, two moles, and eight rodents, representing all but one of the common small mammals in eastern Virginia.

Key words: moles, pitfall trapping, rodents, shrews, small mammals, Virginia.

Peer Review
Justin Hoffman
McNeese State University

I have reviewed the following proposal along with all the supplemental material and previous proposal from 2011. Based on that review I agree that there is not sufficient evidence to recommend listing of *S. l. eionis*. However, I disagree somewhat with recommendation to remove this subspecies from the list of the Species of Special Concern. My reasons are much the same as those given for the 2011 report in that there doesn't seem to be sufficient evidence. For instance it does not appear to me that any new information has been provided since the 2011 report, especially as it pertains to population size reduction, habitat loss and population size trends. I do see that some new surveys have been conducted but it doesn't appear that any of the pertinent measures (ie. population size) have changed. Given that there is little change from the 2011 report I do not see how there is justification to remove *S. l. eionis* from the Species of Special Concern list.

Its unfortunate none of the new surveys (Teets and Doonan 2015, Smith et al. 2015) were able to provide densities of shrews which could be used to determine a new estimate of population size. However, based on those surveys it doesn't seem that *S. l. eionis* is locally abundant which further indicates to me that more research is needed, specifically on *S. l. eionis* density in Florida, before it is removed from the Species of Special Concern list.

It was not clear to me how the projections of habitat loss were determined. For instance, its stated on page 4 that "The preferred habitat of the Homosassa is not known…" If so what was the criteria used to generate projections of preferred habitat using the CLC data layers?

There are a few publications that I found that were not used in this report which could provide some valuable information:

Laerm, J., Ford, W.M. and Chapman, B.R., 2007. Southeastern shrew, *Sorex longirostris*.

Humphery, S. R. 1992. Mammals *in* Rare and Endangered Biota of Florida (Vol 1). University of Florida Press.

Webster, W.D., Moncrief, N.D., Gurshaw, B.E., Loxterman, J.L., Rose, R.K., Pagels, J.F. and Erdle, S.Y., 2009. Morphometric and allozymic variation in the southeastern shrew (Sorex longirostris). *Jeffersoniana*, *21*, pp.1-13.

- This publication (Webster et al.) provides evidence that *S. l. eionis* occurs in Georgia which extends its known current range.