Request to Evaluate the status of Sherman's fox squirrel (*Sciurus niger shermani*)

Scientific and common name of the species to be evaluated

Sherman's fox squirrel, *Sciurus niger shermani*

Name, address, and signature of the person submitting the request

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Introduction

This is to request that the Florida Fish and Wildlife Conservation Commission (FWC) review and evaluate the status of Sherman's fox squirrel (SFSQ; *Sciurus niger shermani*) under the provisions established in Rule 68A-27.0012, F.A.C. and determine whether it is appropriate to list SFSQ on the State-designated Threatened Species list (Rule 68A-27.003, F.A.C.).

The SFSQ was assigned Species of Special Concern status by FWC in 2011, during the prior status review (FWC 2011). For that review, the Listing Recommendation stated that given "...the *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)* cautioned 'assessors should adopt a precautionary but realistic attitude, and ... resist an evidentiary attitude to uncertainty when applying the criteria.' Staff recommends that the Sherman's fox squirrel be maintained as a Species of Special Concern until more data can be collected" (FWC 2011).

Additional scientific studies on SFSQ have now been conducted which have produced valid, relevant data. Further, FWC has now produced its Imperiled Species Management Plan (ISMP; FWC 2016), which provides a framework for management of SFSQ going forward, following the outcome of this requested evaluation.

Justification for the Evaluation Request

The procedures for listing species on the State-designated Threatened Species list (Rule 68A-27.0012, F.A.C.) stipulate that species may be petitioned through a species evaluation request submitted by the public or FWC staff. According to this rule, this request must include a biological score calculated using the process described by Millsap et al. (1990), the supporting data, or references to the data, and the score assigned for each biological variable used to determine the biological score. That information is provided below together with other available information on extent of occurrence, area of occupancy, and quantitative analyses, which is relevant for application of IUCN Red List Criteria to evaluate this request.

Biological Score

The total Biological Score = 22. Members of the Habitat and Species Conservation staff evaluated SFSQ using the best data available regarding the species and followed the process described in Millsap et al. (1990).

- **Population Size (2 out of 10).** 2 = 10,001-50,000 individuals, or size is unknown but suspected to be large. It is expected that SFSQ exists as one population with interbreeding across the entire range of the species. The actual population size is unknown. The current potential habitat model for SFSQ produced by FWC-FWRI (Mark Barrett, FWC, personal communication) shows 1,529,628 ha = 15,296 km^2 of potentially suitable habitat within the range. Greene and McCleery (2017) estimated between 1.4-3.6 fox squirrels/km^2 which gives a population size estimate of 21,414-55,066 for SFSQ. However, that estimate has large uncertainties with regard to the suitability of all habitats and variation in densities within the habitats.

- **Population Trend (8 out of 10).** 8 = Trend unknown but population size suspected to be decreasing. Sherman's fox squirrels are believed to have declined at least 85% from presettlement levels based on known levels of habitat loss (Kantola 1992). The downward trend in population size is expected to continue given the ongoing loss, fragmentation and degradation of natural habitats not protected on conservation lands as Florida's population continues to increase (Kantola and Humphrey 1990, Wooding 1997, FWC 2012). It has been predicted that between 2010 and 2020, approximately 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). Conversely, Florida's programs for purchasing public conservation lands (e.g., Preservation 2000 and Florida Forever) have likely offset some of these losses.

- **Range Size (4 out of 10).** 4 = 40,001-100,000 km^2, or about 1/4-3/4 the size of Florida. The exact geographic boundaries of *Sciurus niger shermani* are not fully agreed upon. Based on morphological characteristics, the range of *Sciurus niger shermani* is generally accepted as including most of peninsular Florida (Wooding 1997), south to the Caloosahatchee River along the west coast (Greene 2015) and southward on the east coast to Jupiter in Palm Beach County (Moore 1956, Wooding 1997). But, Humphrey and Jodice (1992) considered specimens south of Palm Beach County to be intergrades between the Sherman's fox squirrel and the Big Cypress fox squirrel. The range of *S. n. shermani* extends northward into southern and central Georgia (Turner and Laerm 1993) and westward through Levy, Gilchrist and Suwannee counties to the Suwannee River (Moore 1956, Wooding 1997). Kantola (1992) suggested *S. n. shermani* may extend westward to the Apalachicola River. Based on genetic data, Greene (2015) said fox squirrels in Florida north of the Caloosahatchee River "do not warrant recognition as separate subspecies and taxonomic revisions are needed," indicating the range of *S. n. shermani* may extend westward across the panhandle in Florida to the Alabama border.

  Using a conservative estimate for the range of *S. n. shermani* from the Caloosahatchee River north and west to the Apalachicola River the range encompasses a total of 3,778,181.2 ac (1,529,628.0 ha = 15,296 km^2) of potentially suitable habitat. Of that total, 1,623,874.6 ac (657,439.1 ha) occurs on conservation lands and 2,154,306.6 ac (872,188.9 ha) occurs on private lands. Forty-three percent of the potentially suitable habitat is on conservation lands.

- **Distribution Trend (5 out of 10).** 5 = Area occupied has declined by 25- 74%. Florida Natural Areas Inventory (FNAI) states >90% loss for sandhill and upland pine. Brady (1977) found

evidence fox squirrel populations were declining in most parts of Florida. The decline in distribution is expected to continue due to the persistent destruction of natural habitats occupied by *S. n. shermani* (Kantola and Humphrey 1990, Wooding 1997, FWC 2012). It is predicted that between 2010 and 2020, approximately 4% of Florida's total land area will be converted to urban areas (Zwick and Carr 2006). Probable increases in some habitats such as unimproved pasture and improved pasture that are known to be occupied by SFSQ may partially offset natural habitat loss.

- **Population Concentration (0 out of 10).** 0 = Does not concentrate. In general, fox squirrels do not congregate during any season of the year. Locally, some males concentrate around a single female in estrus, but when that occurs numbers are still low (Koprowski 1994, Wooding 1997).

- **Reproductive Potential for Recovery (3 out of 10).**
  - **Average number of offspring per female per year (3 out of 5).** 3 = 1-9 offspring/female/year. Sherman's fox squirrel typically has two breeding seasons each year. The winter breeding season is from October to February and the summer breeding season is from April to August (Wooding 1997). Females average one litter per year with a mean of 2.3 offspring per litter (Moore 1957, Wooding 1997), compared with 2.5-3.2 young for midwestern fox squirrels (Kantola 1992).

  - **Age at first reproduction (0 out of 5).** 0 = first reproduction at <2 years. Young are weaned at 90 days and sexual maturity is reached at about 9 months.

- **Ecological Specialization (0 out of 9.9).**
  - **Dietary specialization (0 out of 3.3).** 0 = Substantial shift in diet with little change in number of individuals in response to changes in availability of preferred food resources. Longleaf pine seeds and turkey oak acorns appear to be some of the main food items eaten by Sherman's fox squirrels. Additional food items include other acorns, fungi, bulbs, vegetative buds, insects, other nuts, and staminate pine cones (Kantola 1992). The highest quality habitat for Sherman's fox squirrel may therefore be habitat that includes both longleaf pine savanna adjoining to or interspersed with live oak forest. In addition, high quality habitat is expected to have a diversity of other plants present (e.g., ground cover plant species) that provide other important food resources (Kantola and Humphrey 1990).

  - **Reproductive specialization (0 out of 3.3).** Kantola and Humphrey (1990) stated: "SFS seldom den in tree cavities, therefore cavities unlikely to limit their populations." Sherman's fox squirrel typically has two breeding seasons each year. The winter breeding season is from October to February and the summer breeding season is from April to August (Wooding 1997). Males expand their home ranges during the breeding season and several males will cluster around a single female while she is in estrus (Wooding 1997; see Koprowski 1994 for a summary of breeding behavior in *Sciurus niger*).

  - **Other specializations (0 out of 3.3).** 0 = not specialized. *S. n. shermani* is not believed to have other ecological or behavioral specializations (e.g., no strict requirements for nest sites) that might limit population numbers.

IUCN Red List Criteria

Extent of Occurrence. At this time, the accepted extent of occurrence (EOO) for Sherman's fox squirrel includes 50 counties, from the Caloosahatchee River (Charlotte county on the west coast across to Martin county on the east coast), then north to the Georgia state line and west to the Apalachicola River. If the range of *S. n. shermani* is extended westward to the Alabama state line, then the EOO encompasses 60 counties.

Area of Occupancy. A FWC GIS analysis indicated the maximum area of occupancy (AOO), for SFSQ within potentially suitable habitats was 1,529,628 ha (15,296 km^2) (Mark Barrett, FWC, personal communication). Of that area, 43% (657,439 ha = 6,574 km^2) was either public or private conservation land. There is expected to be large variation with regard to the suitability of all habitats across the AOO, which increases variation in SFSQ densities within and among different habitats.

Quantitative analyses. A population viability analysis (PVA) was carried out on Sherman's fox squirrel using demographic information from the species as a whole (Root and Barnes 2006, Endries et al. 2009). The baseline model estimated a finite growth rate of 1.0034. Initial abundance was estimated at 0.025 while carrying capacity was estimated at 0.18. The risk of large declines was very small (for example, the probability of a 50% decline was ~18%). The risk of extinction in the next 100 years was zero for both managed habitat and all potential habitat. The model was very sensitive to small changes in survival and fecundity. Changes to the finite growth rate altered the probability of a large decline in the population as a whole, but did not change the probability of the species going extinct over the next 100 years. Considering that little is known about this species' demographics, the validity of the results from the PVA is questionable.

Threats

The biggest threat to Sherman's fox squirrels is loss of suitable habitats due to encroaching development (Kantola and Humphrey 1990, FWC 2012). Such habitat loss has already been significant; it is estimated that only 10-20% of original Sherman's fox squirrel native habitat is still intact, most of it having been logged, and converted for intensive agriculture and development (Bechtold and Knight [1982] as cited in Kantola [1992]). Florida's longleaf pine forests in particular were reduced by 88% between 1936 and 1986 (Wooding 1997). Many of the other habitat types in which Sherman's fox squirrels are found are declining. Mixed hardwood-pine forest is declining; natural pineland, sandhill, and scrub are in poor condition and declining; and the condition of disturbed/transitional habitat is unknown (FWC 2008). Such habitat loss is expected to continue because Florida's population is projected to continue expanding (Zwick and Carr 2006, FWC 2008, FWC 2012).

The IUCN Rodent Specialist Group also recognized "extensive loss of the habitat" as a threat to *Sciurus niger shermani* (Hafner et al. 1998). To mitigate those threats, Hafner et al. (1998) recommended establishment of "... large (several km^2) preserves of longleaf pine habitat ... [where] management should include a natural fire-cycle." Hafner et al. (1998) stated that "Populations of this squirrel on smaller parcels of land may not be viable in the long term..." Kantola (1992) also recommended preserving and reclaiming larger areas (at least 25 km^2) of potentially suitable habitat.

The decline in quality of remaining areas of longleaf pine savanna and other potentially suitable natural habitats is a further threat (Kantola and Humphrey 1990). Industrial logging and the suppression of fire have been two causes for those declines over large portions of *S. n. shermani's* historic range (Kantola and Humphrey 1990). But, burning longleaf pinelands too frequently (e.g., yearly) also can reduce habitat quality for fox squirrels and other wildlife (Kantola and Humphrey 1990).

Due to their slow gait, Sherman's fox squirrels are vulnerable to road mortality. Mortality due to vehicle collisions is likely to increase as Florida's human population increases, with associated increases in number and size (i.e., width) of roads, together with more vehicles.

Historically, hunting had been a threat to small, somewhat isolated populations of Sherman's fox squirrel that had low potential for recolonization (Kantola 1992). Given that hunting of Sherman's fox squirrel is no longer permitted, it is presumed that this threat has largely ended.

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