Big Cypress Fox Squirrel Biological Status Review Report

March 31, 2011

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

Biological Status Review Report
for the
Big Cypress fox squirrel
(*Sciurus niger avicennia*)
March 31, 2011

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of November 8, 2010 that had not undergone a status review in the past decade. Public information on the status of the Big Cypress fox squirrel 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 Elina Garrison (FWC lead), Bob McCleery (University of Florida), and John Kellam (National Park Service) (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 Big Cypress fox squirrel using criteria included in definitions in 68A-27.001, F.A.C., and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. Please visit http://myfwc.com/wildlifehabitats/imperiled/listing-action-petitions/ to view the listing process rule and the criteria found in the definitions.

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

The Big Cypress fox squirrel BRG concluded from the biological assessment that the Big Cypress fox squirrel met listing criteria. Based on the literature review, information received from the public, and the BRG findings, FWC staff recommends listing the Big Cypress fox squirrel as a Threatened species.

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

BIOLOGICAL INFORMATION

Taxonomic Classification – The Big Cypress fox squirrel (*Sciurus niger avicennia*), one of 3 subspecies of the fox squirrel occurring in Florida, is defined on the basis of size (it is smaller than both *S. n. niger* and *S. n. shermani*; Moore 1956; Turner and Laerm 1993 as cited in Wooding 1997). *Sciurus n. a.* has been variously known as the Big Cypress fox squirrel,

mangrove fox squirrel, Everglades fox squirrel, and south Florida fox squirrel (Hafner *et al*. 1998).

Life History – Big Cypress fox squirrels are large tree squirrels with variable dorsal fur color. Most commonly, individuals have a black head and dorsal fur with buff sides and belly, buff and black tail, and white nose and ears (Florida Natural Areas Inventory 2001). They are a primarily ground-dwelling species that inhabits stands of cypress, slash pine savanna, mangrove swamps, tropical hardwood forests, live oak woods, coastal broadleaf evergreen hammocks, and suburban habitats including golf courses, city parks, and residential areas (Hafner *et al*. 1998; Humphrey and Jodice 1992; Jansen 2008; Munim et al. 2007; Williams and Humprey 1979). In Big Cypress National Preserve, one of the most important habitat components is the presence of large cypress domes with good adjacent foraging habitat (Jansen 2008; Kellam and Jansen 2010). Optimum habitat for *S. n. avicennia* includes an open understory free of bushes and undergrowth (Brown 1978 as cited in Hafner *et al*. 1998).

Reproductive behavior of *Sciurus niger* is summarized as follows for the species in general (see Koprowski 1994 for additional citations). Fox squirrels can mate at any time of the year but most breeding occurs between November and February with a peak in December and between April and July with a peak in June. On a golf course in western Collier County, more reproduction was observed in the warm summer/autumn season than in the winter/spring season because exotic foods supplemented a limited summer native diet (Ditgen and Shepherd 2007). *Sciurus niger* females go into estrus for only one day during which several males aggregate on a female's home range and form linear dominance hierarchies. Females mate with more than one of these males. Average litter size is generally 2 or 3 offspring. Females can become sexually mature at 8 months of age, but more generally wait to reproduce until they are over a year old and then may breed for more than 12 years.

Territorial behavior of *Sciurus niger* is also summarized as follows for the species in general (see Koprowski 1994 for additional citations). *Sciurus niger* adults, especially females, defend exclusive core areas but home ranges of individuals overlap and territoriality is not observed. Average home ranges are 0.85-17.2 ha for females and 1.54-42.8 ha for males. All juveniles disperse from their natal area but some may remain with their mother during the first winter. Big Cypress fox squirrels translocated from Naples, Florida, to Big Cypress National Preserve exhibited inconsistent site fidelity and movements of up to 32km that could be attributed to dispersal, post-release investigative behavior, or long-distance foraging (Jodice 1993).

Crude estimates of Big Cypress fox squirrel population densities have been calculated at 0.0009 squirrels/ha in typical Big Cypress Swamp habitat in Corkscrew Swamp Sanctuary and 0.0192 squirrels/ha in ranchland woodlots (Jodice and Humphrey 1993). Humphrey and Jodice (1992) stated that these densities are probably much too low, however, because they included some unoccupied habitat. Densities estimated for other squirrels in the southeastern United States are 0.05 squirrels/ha for *S. n. niger* (as summarized in Koprowski 1994) and a range of 0.04 to 0.38 squirrels/ha for *S. n. shermani* (Kantola and Humphrey 1990; Wooding 1997; Humphrey et al. 1985; Kantola 1986; and Moore 1957 as cited in Kantola 1992).

Big Cypress fox squirrels have been documented eating java plum, *Ficus* sp., fig fruit, Bischofia berries, acorns, red maple samaras, bottlebrush and silk oak flowers, insects, fungi, bromeliad buds, thistle seed, pond apple fruit, cabbage palm fruit, holly fruit, queen palm fruit, saw palmetto fruit, pine seeds, slash pine cones, and cypress cones (Ditgen and Shepherd 2007; Jansen 2008; Jodice and Humphrey 1992; Kellam and Jansen 2010). Pine cones, cypress cones, and queen palm fruits are scatter hoarded (Ditgen and Shepherd 2007; Jodice and Humphrey 1992).

Nests of individuals translocated into Big Cypress National Preserve were either stick structures or were nestled among the leaves of bromeliads in co-dominant or dominant cypress trees in cypress or mixed-swamp habitat (Jodice 1993). Fox squirrels living in Big Cypress National Preserve have been found to build nests in bald cypress trees (98% of nests), cabbage palm trees, and slash pine trees (only 1 nest; Kellam and Jansen 2010). Four types of nest are built: (1) stick nests, (2) stick nests that also contain thinly stripped cypress bark, (3) bromeliad nests with stripped bark, or (4) cabbage palm nests with stripped bark.

Geographic Range and Distribution – The Big Cypress fox squirrel is the only species of fox squirrel endemic to Florida (Turner and Laerm 1993 as cited in Wooding 1997). It can be found in the southwestern tip of peninsular Florida, in Hendry and Lee Counties south of the Caloosahatchee River, Collier County, mainland northern Monroe County, and extreme western Miami-Dade County (a strip of land that is largely in Big Cypress National Preserve; Williams and Humphrey 1979; Moore 1956; see summary in FWS 2002). *Sciurus niger avicennia* occupies "the mangrove, the pinelands, and the Big Cypress west of the Everglades and south of the Caloosahatchee River" (Moore 1956).

Population Status and Trend –The status of Big Cypress fox squirrels in the core of their range in Big Cypress National Preserve and the Everglades is largely unknown because of the difficulty of studying and observing squirrels in such habitat (Jansen 2008; Jodice and Humphrey 1992; Jodice and Humphrey 1993; Maehr 1993). According to Humphrey and Jodice (1992), "since the Big Cypress National Preserve was established in 1974, preserve staff have recorded progressively fewer fox squirrels, concluding that the population is not prospering there." Furthermore, according to the IUCN Rodent Specialist Group, *S. n. avicennia* has not been seen recently in the Everglades and is currently restricted in distribution to Big Cypress Swamp and its adjacent pinelands (Brown 1978). In particular, the Big Cypress fox squirrel is no longer present at the Cape Sable coast of Everglades National Park in the vicinity of Flamingo, Monroe County (USFWS 2002). Big Cypress fox squirrels have also been completely extirpated from Corkscrew Swamp Sanctuary and Everglades City (Jodice and Humphrey 1992). Isolation of Big Cypress fox squirrel populations has occurred in western Lee and Collier counties due to rapid urbanization (Ditgen and Shepherd 2007; Endries *et al*. 2009; Kellam and Jansen 2010).

In the future, the Big Cypress fox squirrel is likely to lose some habitat to urbanization, agriculture, and mining. Furthermore, although at least fifty-five percent of potential Big Cypress fox squirrel habitat exists in conservation lands and is therefore protected from development (USFWS 2002; Endries *et al*. 2009), analyses by Florida's Wildlife Legacy Initiative indicate that the majority of *S. n. avicennia*'s habitat (natural pineland and pine

rockland) is both poor in quality and declining (FWC 2005). Big Cypress fox squirrels are, however, fairly adaptable; they can be found in disturbed/transitional habitat such as on private ranches and in urban areas like golf courses (Ditgen and Shepherd 2007; FWC 2005; USFWS 2002; Jodice and Humphrey 1992), although status on private ranches has been difficult to verify (Munim et al. 2007). It is important to note, however, that although Big Cypress fox squirrels are found in these urban and developed habitats, these habitats are able to support fox squirrels only when food supply and habitat characteristics are adequate (P. Jodice, personal communication). Furthermore, due to increased predation and road mortality, these suburban areas may act as population sinks (P. Jodice, personal communication, Munim et al. 2007).

Quantitative Analyses – A population viability analysis was carried out on the Big Cypress fox squirrel using demographic information from the species as a whole (Root and Barnes 2006; Endries *et al*. 2009). The baseline model estimated juvenile survivorship at 0.5, adult survivorship at 0.66, adult fecundity at 0.4125, and juvenile survivorship to adulthood at 0.25, resulting in a growth rate of 0.9725. Distance between populations was estimated at 5km. Initial abundance was estimated at 0.025 while carrying capacity was estimated at 0.18. Results revealed that small changes in the model had large impacts on population trends. Risk of extinction in the next 100 years was found to be zero for both managed habitat and all potential habitat. The risk of large declines, however, was quite large. The probability of a 95% decline in abundance in the next 100 years was about 50%. Abundance was particularly reduced when only managed habitat was considered. The model was sensitive to changes in the adult survival value and adult fecundity. Only the largest populations containing at least 200 individuals survived throughout the 100 year simulation indicating that smaller populations will not persist without dispersal into the population.

BIOLOGICAL STATUS ASSESSMENT

Threats – The biggest threat to Big Cypress fox squirrels on the periphery of their range is destruction of habitat and habitat fragmentation due to encroaching development (FWC 2005; FWC 2008; Jansen 2008; Jodice and Humphrey 1992; Munim et al. 2007; Koprowski 1994; Zwick and Carr 2006). Rapid urbanization has isolated Big Cypress fox squirrel populations in fragmented habitat in western Lee and Collier counties (Ditgen and Shepherd 2007). Similarly, the conversion of rangeland to citrus groves has destroyed Big Cypress fox squirrel habitat in the flatwoods region of Hendry County (Ditgen and Shepherd 2007) while fire suppression has led to the decline of Big Cypress fox squirrel numbers in seasonally inundated areas of Big Cypress Swamp and the Everglades because extensive understory growth makes forests uninhabitable (Ditgen and Shepherd 2007). Although urban greenspaces, such as golf courses, may provide suitable habitat if the understory is open and there is abundant food supply, mortality due to vehicle collision are high, and these areas may act as population sinks (Munim et al. 1997).

A skin fungus is known to cause mortality of Big Cypress fox squirrels in urban areas but no researchers have indicated that this fungus could be a major threat to populations as a whole (as summarized in USFWS 2002). In 2010, a Big Cypress fox squirrel was found in the summer to be infected with Squirrel Poxvirus (J, Kellam, unpublished data). Squirrel Poxvirus has a 75-100% mortality rate in squirrels infected with the disease which can spread throughout a population through contact among conspecifics (NPS 2010). The US National Park Service is

currently monitoring Big Cypress fox squirrels in Big Cypress National Preserve for an outbreak of Squirrel Poxvirus (NPS 2010).

Historically, Big Cypress fox squirrel was an important game species (Williams and Humphrey 1979). Due to a general decline in the population, legal hunting ended within the range of Big Cypress fox squirrels in 1972 (Duever et al. 1986; Wooding 1997). Many authors believed that illegal hunting continued after the hunting closure and that the impact from mortality due to hunting was significant (Duever et al. 1986; Humphrey and Jodice 1992; Williams and Humphrey 1979). However, the US Fish and Wildlife Service stated that it did not have evidence to support this claim (USFWS 2002).

The US Fish and Wildlife Service reviewed the status of the Big Cypress fox squirrel in 2002 and concluded that this subspecies did not qualify for listing as an endangered or threatened species due to any of the five factors as defined in the Endangered Species Act (USFWS 2002). S*ciurus niger avicennia* is currently listed as Lower Risk, conservation dependent by the IUCN Rodent Specialist Group "based on the historical loss of habitat and restricted number and distribution of populations of *S. n. avicennia*, probably including Big Cypress National Preserve" (Hafner *et al*. 1998).

Recommended actions of the IUCN Rodent Specialist Group (Hafner *et al*. 1998) are:

- "Conduct studies to determine the optimum habitat requirements of *S. n. avicennia*, and survey for presence of populations in Big Cypress National Preserve
- Conduct controlled burns to open up the understory for better foraging areas for *S. n. avicennia*
- Set aside remaining occupied habitat as refuges for *S. n. avicennia* (Brown 1978)"

Population Assessment – Findings from the Biological Review Group are included in the Biological Status Review Information Findings table, following.

LISTING RECOMMENDATION

Staff recommends that the Big Cypress fox squirrel be listed as a Threatened species because the species met two of the listing criteria as described in 68A-27.001, F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

Comments were received from 7 reviewers; Dr. Reed Noss (University of Central Florida), Mr. John Wooding (North Carolina Wildlife Resources Commission), Ms. Deborah Jansen (National Park Service, Big Cypress National Preserve), Dr. Jack Stout (University of Central Florida), Dr. Bill Giuliano (University of Florida), Dr. Brad Bergstrom (Valdosta State University) and Dr. Patrick Jodice (Clemson University). Appropriate editorial changes recommended by the reviewers were made in the report.

One reviewer expressed concern that the tone of the "Population status and trends" section may be misleading regarding the Big Cypress fox squirrel's adaptability to urban and

developed habitats. The reviewer pointed out that fox squirrels are only able to survive in urban and developed areas when sufficient food and open understory are available. Furthermore, threats from car mortality and predation may be more important in these urban setting than in natural settings. The reviewer also suggested it was important to further emphasize to the lack of population trend data. Staff agreed with these concerns and the report was edited accordingly.

Another reviewer commented that the report should take a more detailed look at the historical impacts from hunting on the fox squirrel population and distribution. The reviewer also suggested the report should expand on the status of fox squirrels in open agricultural lands. We edited the review to address these comments.

All 7 reviewers concurred with the staff recommendation to list the Big Cypress fox squirrel as a Threatened species. Peer reviews are available at MyFWC.com.

LITERATURE CITED

Brown, L.N. 1978. Mangrove fox squirrel. Pages 5-6 in J. N. Layne (ed.), Inventory of rare and endangered biota of Florida Vol. I. Mammals (J.N. Layne, ed.). University Press of Florida, Gainesville, 52pp.

Cox. J., R. Kautz, M. MacLaughlin and T. Gilbert. 1994. Closing the gaps in Florida's wildlife habitat conservation system. Florida Game and Fresh Water Fish Commission, Tallahassee, 239 pp.

Ditgen, R.S., J.D. Shepherd and S. R. Humphrey. 2007. Big Cypress fox squirrel (*Sciurus niger avicennia*) diet, activity and habitat use on a golf course in southwest Florida. American Midland Naturalist 158 (2):403-414.

Duever, M.J., J.E. Carlson, J.F. Meeder, L.C. Duever, L.H. Gunderson, L.A. Riopelle, T.R. Alexander, R.L. Meyers and D.P. Spangler. 1986. The Big Cypress National Preserve, National Audubon Society, New York, New York, 444 pp.

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

Florida Fish and Wildlife Conservation Commission (FWC). 2005. Florida's Comprehensive Wildlife Conservation Strategy. Florida's Wildlife Legacy Initiative. Tallahassee, Florida, USA.

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

Florida Natural Areas Inventory. 2001. Field guide to the rare animals of Florida. http://myfwc.com/docs/FWCG/sherman_fox_squirell.pdf

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

Humphrey, S.R., J.F. Eisenberg and R. Franz. 1985. Possibilities for restoring wildlife of a longleaf pine savanna in an abandoned citrus grove. Wildlife Society Bulletin 13:487-496.

Humphrey, S.R. and P.G.R. Jodice. 1992. Big Cypress fox squirrel *Sciurus niger avicennia*. Pages 224-233 in S.R. Humphrey (ed.), Rare and endangered biota of Florida. Vol. I. Mammals. University Press of Florida. Gainesville, Florida.

Jansen, D. 2008. Big Cypress fox squirrel study preliminary report. National Park Service.

Jodice, P.G.R. 1993. Movement patterns of translocated Big Cypress fox squirrels (*Sciurus niger avicennia*). Florida Scientist 56(1):1-6

Jodice, P.G.R. and S.R. Humphrey. 1992. Activity and diet of an urban population of Big Cypress fox squirrels. The Journal of Wildlife Management 56(4):685-692.

Jodice, P.G.R. and S.R. Humphrey. 1993. Activity and diet of an urban population of Big Cypress fox squirrels: A reply. The Journal of Wildlife Management 57(4):930-933.

Kantola, A.T. 1986. Fox squirrel home range and mast crops in Florida. M.S. thesis, University of Florida, Gainesville. 68pp.

Kantola, A.T. 1992. Sherman's fox squirrel *Sciurus niger shermani*. Pages 234-241 in S.R. Humphrey (ed.), Rare and endangered biota of Florida. Vol. I. Mammals. University Press of Florida. Gainesville, Florida.

Kantola, A.T. and S.R. Humphrey. 1990. Habitat use by Sherman's fox squirrel (*Sciurus niger shermani*) in Florida. Journal of Mammalogy 71(3):411-419

Kellam, J. Documentation of a Poxvirus (Squirrel Fibromatosis) infected Big Cypress fox squirrel within Big Cypress National Preserve – July 2010. National Park Service administrative letter. Department of the Interior.

Kellam, J. and D. Jansen. 2010. The ecology of the Big Cypress fox squirrel within its natural habitat. Report. National Park Service – Big Cypress National Preserve. 5pp.

Koprowski, J.L. 1994. *Sciurus niger*. Mammalian Species 479:1-9.

Maehr, D.S. 1993. Activity and diet of an urban population of Big Cypress fox squirrels: A comment. The Journal of Wildlife Management 57(4):929-930.

Moore, J.C. 1956. Variation in the fox squirrel in Florida. American Midland Naturalist 55(1):41-65.

Moore, J.C. 1957. The natural history of the fox squirrel *Sciurus niger shermani*. Bulletin of the American Museum of Natural History 113:1-71.

Munim, D., R. F. Noss and J. M. Watermark. 2007. The status and distribution of Big Cypress fox squirrel, *Sciurus niger avicennia*. Final Report. Study No. 24036024. University of Central Florida, Orlando, Fl. 41pp.

National Park Service. 2010. Big Cypress Squirrel Poxvirus Information Brochure. US Department of the Interior.

Root, K.V. and J. Barnes. 2006. Risk assessment for a focal set of rare and imperiled wildlife in Florida. Florida Fish and Wildlife Conservation Commission.

Turner, D.A. and J. Laerm. 1993. Systematic relationships of populations of the fox squirrel (*Sciurus niger*) in the southeastern United States. Pages 21-36 in N.D. Moncrief, J.W. Edwards, and P.A. Tappe, eds. Proceedings of the second symposium on southeastern fox squirrels, *Sciurus niger*. Va. Museum of Natural History Special Publication. No. 1. 84pp.

U.S. Fish and Wildlife Service. 2002. Endangered and Threatened Wildlife and Plants; 12-month Finding for a Petition To List the Big Cypress Fox Squirrel. Federal Register 67(37): 8499-8503.

Williams, K.S. and S.R. Humphrey. 1979. Distribution and status of the endangered Big Cypress fox squirrel (*Sciurus niger avicennia*) in Florida. Florida Scientist 42:201-205.

Wooding, J.B. 1997. Distribution and population ecology of the fox squirrel in Florida. Ph.D. dissertation. University of Florida. 139pp.

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.

Biological Status Review Information
Findings

Species/taxon:	Big Cypress Fox Squirrels (*Sciurus niger avicennia*)
Date:	11/04/10
Assessors:	John Kellam, Elina Garrison, Robert McCleery
Generation length:	Generation length = 3 years, used 10 year time frame as 3 generations is < 10 years.

Criterion/Listing Measure	Data/Information	Data Type*	Sub-Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Sub-Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	There has not been a 50% decline in the past 10 years where the causes of reduction are clearly reversible or understood.	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]	Direct observation of reduction, no longer found at certain localities. Decline in area of occupancy and quality of habitat. Biologist from multiple state and federal agencies concur that BCFS sightings have remained extremely low in the past 10 years. The lands these biologists manage represent the core of the BCFS range. Extent of decline difficult to quantify.	I	N	Ditgen and Shepherd 2007; Endries et al. 2009; Humphrey and Jodice 1992; Jansen 2008; Jodice and Humphrey 1992; Kellam and Jansen 2010; Koprowski 1994. J. Kellam, D. Jansen and S. Bass (National Park Service), M. Owen (Florida Fish and Wildlife Commission) and E. Carlson (Corkscrew Swamp Sanctuary); personal communications.
(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 human population growth from 2010 through 2020 for the counties (Hendry, Lee, and Collier) in which the species occurs, is projected to increase by 26.1%. We suspect BCFS population reduction will occur due to habitat loss and fragmentation, as a result of development and habitat degradation due to changes in land management practices (e.g. fire reduction); also there is a possible population reduction due to disease (i.e. squirrel poxvirus). However, it is unknown what the relationship between habitat loss and population reduction is.	I	N	Zwick and Carr 2006, John Kellam (NPS), unpublished data.

(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]	See above A(a)3.	I	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	Extent of occurrence was calculated by adding up the area of all counties of occurrence. Total area came to 16,679 km^2.	E, I	Y	Williams and Humphrey 1979, Wooding 1997; Moore 1956, Endries et al. 2009, John Kellam, personal communication.
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Estimated areas of occupancy based on GIS habitat analyses range from 1,677 km^2 to 3,840 km^2. However, current research being conducted at Big Cypress National Preserve is finding that GIS based habitat models have overestimated the potential habitat and therefore the actual area of occupancy.	E, I	Y	Cox et al. 1994, FWS 2002, Endries et al. 2009, J. Kellam and D. Jansen (NPS), unpublished data.
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Populations are known to be severely fragmented in western Lee and Collier Counties and in other isolated patches of habitat in urban areas. However, extent of the fragmentation is unknown.	I	N	Ditgen and Shepherd 2007; Endries et al. 2009; Kellam and Jansen (NPS), unpublished data.
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	Decline projected in (ii), (iii), (iv), and (v). See A(a)3 and C(c)2b.	I, P	Y	FWS 2002; Jansen 2008; Jodice and Humphrey 1992; Koprowski 1994.

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	Extreme fluctuations in area of occurrence, area of occupancy and number of locations or subpopulations have occurred in the Cape Sable coast of Everglades National Park, Corkscrew Swamp Sanctuary and Big Cypress National Preserve. Extreme fluctuations in the number of mature individuals occurred in Corkscrew Swamp Sanctuary between mid-70's and mid-80's (Ed Carlson, personal communication). In addition, in the mid-1990s, BCFS in Corkscrew Swamp Sanctuary were found dead or dying, followed by a period of absence for years afterward (Ralph Arwood, personal communication).	I	Y	Jodice and Humphrey 1992; J. Kellam, E. Carlson and R. Arwood, personal communications.
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Density estimates for BCFS range from 0.09 to 1.92 squirrels/km^2. Using Endries et al. 2009, available habitat (2,858 km^2) would result in a population size of 257 - 5,487 squirrels. Although these density estimates are believed to be low, interviews with state and federal biologists, concurred that population size of mature individuals is well below 10,000.	I	Y	Cox et al. 1994, FWS 2002; Endries et al. 2009, Jodice and Humphrey 1992, J. Kellam and D. Jansen, personal communication.
(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	No estimates of population trend are available..	I	N	
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	See additional notes and citations in B2b.	I	Y	
a. Population structure in the form of EITHER	Unknown	I	N	
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	No	I	N	
b. Extreme fluctuations in number of mature individuals	See above B(b)2c. In addition, Squirrel poxvirus has been detected recently in BCFS within Big Cypress National Preserve. This highly virulent disease (mortality rate of 75-100%) has the potential to cause significant population loss.	I	Y	J. Kellam (NPS), unpublished data.
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	There are more than 1000 estimated mature individuals.	I	N	

(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	AOO is greater than 20 km^2 and number of locations is greater than 5.	I	N	
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	PVA did not show probability of extinction of at least 10%. However, the PVA model used was based upon a habitat model that overestimated the actual AOO.	P	N	Endries et al. 2009, J. Kellam, personal communication. Also see notes on Bb2.

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria/sub-criteria are met)
Yes, meets 2 criteria	Bb ii, iii, iv, v, cii, iii, iv; C2b
Is species/taxon endemic to Florida? (Y/N)	Yes
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria/sub-criteria are met)
Meets 2 criteria	Bb ii, iii, iv, v, cii, iii, iv; C2b

APPENDIX 1. Brief biographies of the Big Cypress fox squirrel Biological Review Group members.

Elina Garrison has a M.S. in Wildlife Ecology and Conservation from the University of Florida. She has worked as a biologist in FWC's Terrestrial Mammal Research Subsection since 2004. Ms. Garrison has experience with a variety of Florida mammals, including black bears, white-tailed deer, and fox squirrels, and she has assisted with fox squirrel risk assessments and compiling statewide range maps.

John Kellam has a BS in Biology from Humboldt State. John has been the lead biologist on a field study of Big Cypress fox squirrels in Big Cypress National Preserve since 2007. To date, 20 radio-collared individuals have been monitored 3 times per week to determine movements, habitat use, food preferences, and nest tree selection.

Robert McCleery has a Ph.D. in Wildlife Science from Texas A & M University. He currently serves as an assistant professor in the Department of Wildlife Ecology and Conservation at the University of Florida. Dr. McCleery has over 15 years experience in research and conservation of wildlife and has worked extensively on the ecology of fox squirrels, Key Largo woodrats, Keys marsh rabbits, Florida Key deer and Indiana bats.

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

There is a thriving population of fox squirrels in the pine lands, about 11- 14 miles north of US 41, off sand road. I have observed as many as 10 at one location, along with others in the area. Several color variations.

- Dick Kempton