# Supplemental Information for the Short-tailed Snake

# Biological Status Review Report

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

March 31, 2011

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**Peer review #1 from Kenneth Wray**

**From:** Ken Wray
**To:** Imperiled
**Subject:** Re: Deadline reminder for peer reviews of BSR reports
**Date:** Monday, January 31, 2011 7:41:43 PM
**Attachments:** BSR Florida Keys Mole Skink.docx
BSR Key Ringneck Snake
BSR Lower Keys Population of the Florida Brown Snake.docx
BSR Lower Keys Population of the Peninsula Ribbon Snake.docx
BSR Lower Keys Population of the Red Rat Snake.docx
BSR Rim Rock Crowned Snake.docx
BSR Short-tailed Snake.docx

Greetings Dr. Haubold-

Attached you will find seven BSR reviews for species/populations I was asked to review. Please let me know if there is anything else you need from me.

Best regards,

Ken Wray

## Independent Review of the Biological Status Review for the Short-tailed Snake (*Lampropeltis extenuata*)

Kenneth P. Wray

**1. Completeness and accuracy of the biological information and data analyses:**

This review is thorough, particularly when considering the lack of natural history information for this species. Comparison with the mole kingsnake (*L. calligaster*) is suspect given the differences in size, life history, and geography. Data analyses are appropriate.

**2. Reasonableness and justifiability of the assumptions, interpretations of the data, and conclusions:**

Any assumptions made are conservative and reasonably grounded in the available data for this, and related, species. Data interpretation is fair and sound.

However, I disagree with the panel's choice of invoking the precautionary principle with this species and recommending it as 'threatened'. Given their findings and conservative use of the data, this species did not meet the criteria for listing it as 'threatened'. Among the main reasons for this recommendation is due to a lack of knowledge concerning "life history, habitat requirements, and population size and trends". Yet, a conservative approach using available data in these areas did not meet the requirements. Further, listing this species will add to the difficulty

of future studies designed to address these fundamentally lacking questions, a realistic issue in research concerning protected species. Based on this review, a status of threatened ***does not*** seem warranted for this taxon.

**Peer review #2 from Dr. Steve Godley**

**From:** Steve Godley
**To:** Imperiled
**Subject:** Peer Review of BSR for Short-tailed Snake
**Date:** Thursday, February 17, 2011 4:51:13 PM

I concur with the finding of the Biological Review Group (BRG) that there are insufficient data to conclude that the short-tailed snake *(Lampropeltis extenuata*) is not threatened.

While I do not have access to all of the unpublished records of *L. extenuata* available to the BRG, I am somewhat surprised that they did not comment more fully on the seeming rarity of this fossorial species in good to excellent habitat, but did state that it "may be locally common", without much support. During the tenure of myself and Roy McDiarmid at USF in the 1970s and early 1980s, when good sandhill still dominated much of the surrounding area, we never documented more than 1 or 2 individuals each year, most collected by interested citizens on carports, etc in March and April. In 30+ years of work at the USF Ecological Research Area (60 acres of managed sandhill with abundant *Tantilla* populations; Mushinsky and Witz [1993]), Henry Mushinsky (pers. comm.) and other researchers/students only collected about 3 individuals. The FNAI database only lists 53 locality records for Florida (11% from the USF area).

Finally, the fact that short-tailed snakes feed principally Tantilla relicta, which can reach high densities, does not necessarily mean that the predator is common. For example, in a 3-year study of its congener (*L. gutula*) in a 2.71-ha water hyacinth/canal bank community at Rainey Slough, Glades County, FL, I found that the total population of common kingsnakes ranged from 13 – 21 individuals/yr (mark-recapture estimates with > 50% recaptures each yr), but the available snake prey base of appropriate size for consumption (hyacinth sieve estimates) totaled 9,194 snake prey, or 1 kingsnake for 439.1 – 709.4 potential snake prey (only other snakes were found in the diet at this site). However, I do agree with the BRG that > 1 mature short-tailed snake likely is present for every 23 ha of identified potential habitat.

Thanks for the opportunity to comment.

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

**Copy of the Short-tailed snake BSR draft report that was sent out for peer review**

**Biological Status Review**
**for the**
**Short-tailed Snake**
(*Lampropeltis extenuata*)

## 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 1 September 2010. Public information on the status of the short-tailed snake was sought from September 17 through November 1, 2010. The 5-member biological review group (BRG) met on November 18, 2010. Group members were Kevin Enge (FWC lead), Steve Johnson (University of Florida), Thomas Ostertag (FWC), Rick Owen (Florida Department of Environmental Protection), and David Printiss (The Nature Conservancy) (Appendix 1). In accordance with rule 68A-27.0012 F.A.C, the BRG was charged with evaluating the biological status of the short-tailed snake using criteria included in definitions in 68A-1.004 and following 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/docs/WildlifeHabitats/Imperiled_EndangeredThreatened_FinalRules.pdf to view the listing process rule and the criteria found in the definitions.

Although they found that the short-tailed snake did not meet any of the criteria that would result in it being listed as a Threatened species, the BRG was not confident in its ability to infer or project trends for several of those listing criteria because data are lacking for this species. Under the guidelines for applying the listing criteria that call for using the precautionary principle, FWC staff recommends that the short-tailed snake remain listed as a Threatened species because it is a Florida endemic with a restricted geographic range, 57% of its potential habitat is privately owned, it inhabits upland habitats that are in great demand for development, and information is lacking on its life history, habitat requirements, and population size and trends.

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

## BIOLOGICAL INFORMATION

**Taxonomic Classification** – The short-tailed snake (Brown 1890) was formerly *Stilosoma extenuatum*, a monotypic genus. Highton (1956) described 3 subspecies, but these are no longer recognized (Highton 1976). Dowling and Maxson (1990) found *Stilosoma* to fall within kingsnakes (*Lampropeltis*) based on immunological distance data. The genus was not changed until further phylogenetic analyses of mtDNA sequences demonstrated that recognition of *Stilosoma* as a genus rendered *Lampropeltis* paraphyletic (Crother 2008). Pyron and Burbrink (2009) supported placing the genus *Stilosoma* into synonymy with *Lampropeltis*.

**Life History and Habitat Requirements** – Information on the short-tailed snake has been summarized by Campbell and Moler (1992) and Ernst and Ernst (2003). It primarily inhabits areas with well-drained sandy soils, particularly longleaf pine (*Pinus palustris*)/xeric oak (*Quercus* spp.) sandhills, but also scrub and xeric hammock habitats (Van Duyn 1939, Carr 1940, Campbell and Moler 1992, Enge 1997). It is primarily fossorial and spends most of its time burrowed in sand. It has been plowed up by farmers and dug up by gardeners and builders (Van Duyn 1939, Highton 1956, Woolfenden 1962). Some specimens have been found under fallen logs or other cover, including sphagnum moss (Carr 1940), and one was seen entering a gopher tortoise (*Gopherus polyphemus*) burrow (Florida Natural Areas Inventory [FNAI] Element Occurrence Record 34112). Most records are from March–April and October–November, which are apparently times of the year when it spends more time crawling on the surface (Campbell and Moler 1992, Florida Museum of Natural History and FNAI records). It has been found active in the daytime as well as at night (Highton 1956). Nothing is known regarding its reproduction or clutch size. Its prey is mostly small, smooth-scaled snake species, particularly crowned snakes (*Tantilla relicta*) (Carr 1934, Mushinsky 1984, Campbell and Moler 1992, Rossi and Rossi 1993), but a few captives have eaten small lizards in captivity (Allen and Neill 1953, Ashton and Ashton 1981). The nonnative Brahminy blind snake (*Ramphotyphlops braminus*) provides an additional food source (Godley et al. 2008). Eastern coral snakes (*Micrurus fulvius*) and domestic cats and dogs are known predators (Highton 1956, Godley et al. 2008; K. Enge, FWC, pers. commun. 2010).

**Population Status and Trend** – There is no information, but the population is assumed to have declined as the human population in Florida has increased and converted suitable habitat to urban, agricultural, and other land uses. The species has been recorded from the following counties since 2008: Alachua, Citrus, Hernando, Levy, Marion, and Pasco (museum and FNAI records). There are 38 museum records from Alachua County, but only 1 record exists from Columbia (1975) and Seminole (1892) counties. Short-tailed snakes may be locally common, and residents living in suitable habitat occasionally find them in carports, woodsheds, foundation excavations, driveways, and yards (Florida Museum of Natural History records; B. Kellner, Citrus County Mosquito Control District, pers. commun. 2009). Steve Christman (pers. commun. 2010) claims to have found approximately 2 dozen live or dead short-tailed snakes during the past 40 years. At least 8 snakes were found between April 2009 and October 2010 (Florida Museum of Natural History Records; K. Enge, FWC, pers. commun. 2010).

**Geographic Range and Distribution –** The short-tailed snake is endemic to peninsular Florida, occurring from Columbia and Suwannee counties southward to Highlands County (Fig. 1). It is primarily confined to the central ridges, but its range extends west to the Gulf Coast from Levy County southward to Hillsborough and Pinellas counties (Campbell and Moler 1992).

**Quantitative Analyses –** We are not aware of a population viability analysis for the short-tailed snake. However, we believe that it is unlikely that the species will become extinct within the next 100 years based upon the large acreage of suitable habitat contained in conservation lands throughout Florida and its adaptability to some habitat alteration. A GIS analysis of potential habitat for the short-tailed snake identified 102,070 ha (252,212 acres) of potential habitat on conservation lands, preserves, or easements, which represents 43.3% of the potential habitat (B. Stys, FWC, pers. commun. 2010). The condition of sandhill habitats on protected lands may improve in the future because of the Gopher Tortoise Management Plan

(Gopher Tortoise Management Plan Team 2007) and various projects to restore degraded sandhill and scrub habitats.

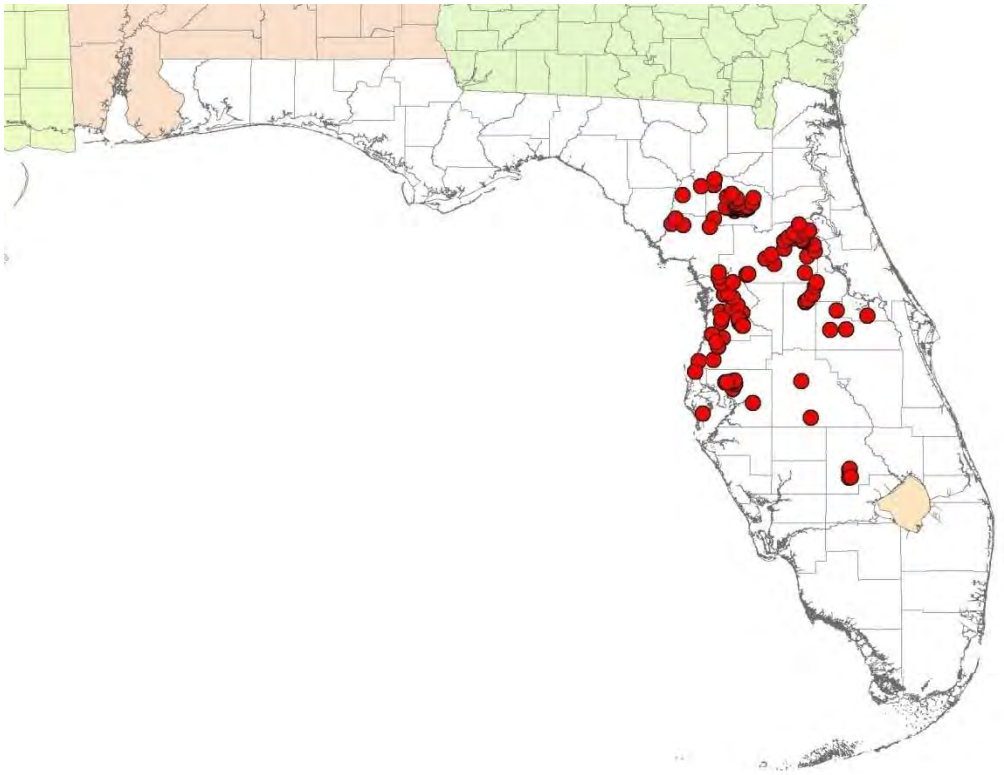

Fig. 1. Locality records from museums, FNAI, and the literature for the short-tailed snake (the record for Suwannee County is not mapped).

## BIOLOGICAL STATUS ASSESSMENT

**Threats –** The greatest threat to short-tailed snakes is loss and alteration of xeric upland habitats resulting from commercial and residential development, silviculture, agriculture, and mining. Intact xerophytic upland ecosystems inhabited by short-tailed snakes have suffered severe losses in Florida, including longleaf pine-dominated sandhill as well as scrub habitat on the ridges of central Florida and the Gulf Coast of Florida (Means and Grow 1985, Myers 1990, Kautz 1998, Enge et al. 2003, Kautz et al. 2007). Short-tailed snake populations can coexist with human development in some areas; populations persist in subdivisions as long as some natural ground cover is retained (Ashton and Ashton 1981; Campbell and Moler 1992; K. Enge, FWC, pers. commun. 2010). It is thought that harvest of longleaf pines and subsequent timber management that produces turkey oak (*Quercus laevis*)-dominated communities, as well as clear-cutting and other timber management programs in sand pine scrub, may serious affect the species (Campbell and Moler 1992). However, short-tailed snake populations can persist in unburned sandhill habitat that has undergone ecological succession to oak-dominated xeric hammock (Trescott 1998; K. Enge, FWC, pers. commun. 2010).

Crowned Snakes, the primary prey of the short-tailed snake, typically have the highest densities of any snake species in xeric habitats (Mushinsky and Witz 1993, Enge 1997). Any factor that reduces crowned snake populations would be expected to impact short-tailed snake

populations. Predation by red imported fire ants (*Solenopsis invicta*) has been suggested as a reason for declines in some oviparous snake populations in the Southeastern Coastal Plain (Mount 1981). Because of their fossorial nature and small size, short-tailed snakes and crowned snakes would appear to be particularly susceptible to fire ants. Domestic dogs and cats, as well as landowners, occasionally kill short-tailed snakes (Godley et al. 2008; K. Enge, FWC, pers. commun. 2010). Highway mortality may be a threat during periods of surface activity, and dead snakes have been found on driveways and unpaved and paved roads (B. Kellner, pers. commun. 2009, Florida Museum of Natural History records).

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

## LISTING RECOMMENDATION

Although they found that the short-tailed snake did not meet any of the criteria that would result in it being listed as a Threatened species, the BRG was not confident in its ability to infer or project trends for several of those listing criteria because data are lacking for this species. Under the guidelines for applying the listing criteria that call for using the precautionary principle, FWC staff recommends that the short-tailed snake remain listed as a Threatened species because it is a Florida endemic with a restricted geographic range, 57% of its potential habitat is privately owned, it inhabits upland habitats that are in great demand for development, and information is lacking on its life history, habitat requirements, and population size and trends.

## SUMMARY OF THE INDEPENDENT REVIEW

To be included after the peer review

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## Biological Status Review Information
Findings

Species/taxon: Short-tailed Snake
Date: 11/19/10
Assessors: Enge, Johnson, Krysko, Ostertag, Printiss

Generation length: 6 years

| Criterion/Listing Measure | Data/Information | Data Type* | Criterion Met? | References |
|---|---|---|---|---|
| *Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N). | | | | |
| **(A) Population Size Reduction**, ANY of | | | | |
| (a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1] | Causes of reduction (decline in extent and quality of habitat) have not ceased | S | 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] | <30% population size reduction because only 23.5% increase in human population since 1990 and acquisition of conservation lands. From 1985–89 to 2003, 15.5% of Florida's sandhill habitat and 12.4% of its scrub habitat were converted to other uses, primarily urban or other developed uses. | S | N | Ashton and Ashton (1981), Campbell and Moler (1992), Kautz et al. (2007), U.S. Census Bureau |
| (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] | <30% population size reduction because although the human population is projected to increase by 31.7% in next 20 years in the 17 counties of occurrence, 43% of the potential habitat is in conservation lands and the species can survive in some residential areas because of its small size and fossorial nature. | S | N | Zwick and Carr (2006), GIS analysis of potential habitat by B. Stys (FWC) |
| (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] | <30% population size reduction (see A2 and A3) | S | N | Zwick and Carr (2006) |
| [1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites. | | | | |
| **(B) Geographic Range**, EITHER | | | | |
| (b)1. Extent of occurrence < 20,000 $km^2$ (7,722 $mi^2$ ) OR | 31,760 $km^2$, excluding 4 counties | E | N | |

| | | | | |
|---|---|---|---|---|
| (b)2. Area of occupancy $< 2{,}000$ km$^2$ (772 mi$^2$) | 2,356 km$^2$ | E | N | GIS analysis of potential habitat by B. Sys (FWC) |
| AND at least 2 of the following: | | | N | |
| a. Severely fragmented or exist in $\leq 10$ locations | | S | N | |
| b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals | | P | Y | |
| 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 | | S | N | |
| **(C) Population Size and Trend** | | | | |
| Population size estimate to number fewer than 10,000 mature individuals AND EITHER | Group suspects >10,000 mature individuals, although there are insufficient data for estimation | S | N | GIS analysis of potential habitat by B. Sys (FWC) and density data for similar-sized snake species |
| (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 | | S | Y | See Sub-criterion A3 |
| (c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following: | | P | Y | See Sub-criterion A3 |
| a. Population structure in the form of EITHER | | | | |
| (i) No subpopulation estimated to contain more than 1000 mature individuals; OR | | S | N | See Sub-criterion B2 |
| (ii) All mature individuals are in one subpopulation | | O | N | |
| b. Extreme fluctuations in number of mature individuals | | S | N | |
| **(D) Population Very Small or Restricted**, EITHER | | | | |
| (d)1. Population estimated to number fewer than 1,000 mature individuals; OR | >10,000 mature individuals | E | N | See Criterion C |
| (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 | 2,356 km$^2$ | E | N | GIS analysis of potential habitat by B. Sys (FWC) |
| **(E) Quantitative Analyses** | | | | |
| e1. Showing the probability of extinction in the wild is at least 10% within 100 years | No PVA | | N | |

| Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria) | Reason (which criteria are met) |
|---|---|
| Not Threatened | |
| | |
| Is species/taxon endemic to Florida? (Y/N) | Y |
| If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below. | |
| | |
| Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria) | Reason (which criteria are met) |
| Not Threatened | |

**Additional notes** – Generation length is defined as the average age of parents of the current cohort, which is greater than the age at first breeding and less than the age of the oldest breeding individual. No demographic data or longevity records are available for the species, which is now considered a kingsnake. Ecologically, its habits are most similar to the yellow-bellied kingsnake (*Lampropeltis calligaster*), which attains sexual maturity in 2–3 years and may live to be 10 years old in the wild in Kansas (>20 years old in captivity) (Ernst and Ernst 2003). However, the short-tailed snake might reach sexual maturity earlier because it lives in a warmer climate than Kansas, and its smaller adult size may lead to higher predation rates and a shorter lifespan in the wild. We infer a mean generation length of 6 years.

**Sub-criterion A2**. – We assume that the short-tailed snake population has declined as the human population in Florida has increased and converted suitable habitat to urban, agricultural, and other land uses. According to the U.S. Census Bureau, Florida's human population increased by 23.5% from 1990 through 2000 and by 16.0% from 2000 through 2009. From 1985–89 to 2003 (a period of 14–18 years), 15.5% of Florida's sandhill habitat and 12.4% of its scrub habitat were converted to other uses, primarily urban or other developed uses (Kautz et al. 2007). Actual estimates of short-tailed snake populations do not exist, but we suspect that loss and degradation of habitat would not have resulted in a $\geq$30% population decline within the past 18 years, particularly considering Florida's programs for purchasing public conservation lands (e.g., Preservation 2000 and Florida Forever). Short-tailed snakes occur in both in frequently burned sandhill habitat and in the oak-dominated communities (e.g., xeric hammocks) resulting from ecological succession in the absence of fire. Trescott (1998) had more records of short-tailed snakes from hammocks than from sandhills. The fact that snake populations persist in degraded or former sandhill habitat lends support to our suspicion that populations have not seriously declined in the past 18 years. Collection for pets is not a significant threat because of its specialized diet and fossorial habits.

**Sub-criterion A3**. – Three generations from 2010 would be 2028. If we add up the projected human population in 2010 and 2030 for the 17 counties in which the species occurs, the population in these counties is projected to increase by 31.7% from 2010 through 2030 (Zwick and Carr 2006). However, the exact relationship between human population increase and habitat loss is unknown. Much of the population increase could occur in urban areas, and residential development in suburban and rural areas may not eliminate snake populations. Very little life history information is available for this species and its ability to persist in developed areas in the long term. Efforts are being made to restore degraded sandhill habitat. For example, a 3-year multi-state sandhill ecological restoration project will enhance restoration on public and private lands by providing additional resources to meet sandhill restoration goals, significantly increasing the quality and quantity of habitat for wildlife species on 6,740 ha (16,655) acres of sandhill habitat in Florida by 2012 (http://myfwc.com/wildlifelegacy/fundedprojects/GrantDetails.aspx?ID=215). Of the potential habitat identified using GIS analysis, 43.3% is in conservation lands, and presumably short-tailed snake populations will continue to persist on most of these lands, particularly the larger parcels. However, just because land is protected does not mean that it is properly managed. There are ca. 900,000 ha (2.2 million acres) of fire-dominated natural communities on all publicly managed state lands, and ca. 336,000 ha (830,000) acres were reported to have been prescribe burned in fiscal year 2009–10 within the fire interval necessary to maintain optimal habitat conditions

(State of Florida Land Management Uniform Accounting Council 2010). This means that 61% of fire-dominated communities are being fire suppressed. This trend of backlogged, fire-suppressed communities has occurred each year all the way back to the mid-1970's when state agencies in Florida first began using fire as a management tool, and these backlogged acres, on average, are not decreasing (R. Owen, Florida Department of Environmental Protection, pers. commun. 2010). Because of this downward trend, the available optimal habitat for upland species is projected to continue to decrease on the very lands that were meant to conserve them.

**Sub-criterion B1**. – The extent of occurrence was calculated by adding up the area of all counties of occurrence. The short-tailed snake has been documented from Alachua (874 $mi^2$), Citrus (584 $mi^2$), Columbia (797 $mi^2$), Gilchrist (349 $mi^2$), Hernando (478 $mi^2$), Highlands (1,028 $mi^2$), Hillsborough (1,051 $mi^2$), Lake (953 $mi^2$), Levy (1,118 $mi^2$), Marion (1,579 $mi^2$), Orange (907 $mi^2$), Pasco (745 $mi^2$), Pinellas (280 $mi^2$), Polk (1,874 $mi^2$) Putnam (722 $mi^2$), Seminole (308 $mi^2$), and Suwannee (688 $mi^2$) counties. The extent of occurrence is calculated as 37,127 $km^2$ (14,335 $mi^2$), although it might have decreased. The 2 northernmost records of the species are from Columbia (may actually be from Alachua County) and Suwannee counties, and these records are from the extreme southern portion of these counties. The only record from Seminole County is from 1892. If we delete the acreages of Columbia, Seminole, and Suwannee counties, along with Pinellas County (old records from heavily developed Tarpon Springs and St. Petersburg), then the extent of occurrence is 31,759 $km^2$ (12,262 $mi^2$).

**Sub-criterion B2**. – A GIS analysis of potential habitat for the species identified 2,356 $km^2$ (909 $mi^2$) of potential habitat (B. Stys, FWC, pers. commun. 2010), which we will assume is equivalent to the area of occupancy. The FWC 2003 land-cover classes that comprised the potential habitat were sandhill (1,353.1 $km^2$; 522.4 $mi^2$), hardwood hammocks and forest (364.8 $km^2$; 140.8 $mi^2$), sand pine scrub (330.5 $km^2$; 127.6 $mi^2$), mixed pine-hardwood forest (185.0 $km^2$; 71.4 $mi^2$), and xeric oak scrub (122.1 $km^2$; 47.1 $mi^2$). In order to be included in the model, most of the land-cover classes also had to have appropriate soil polygons and be situated within 100 m of sandhill habitat; patches <5 ha (12.5 acres) in size were excluded (*see* Cox and Kautz 2000). Because of the emphasis on sandhill habitat, most of the remaining potential habitat identified was on the Brooksville Ridge (Cox and Kautz 2000). If some of the potential habitat identified using GIS analysis is not actually occupied by short-tailed snakes, the area of occupancy could be <2,000 $km^2$. A continuing population decline in area of occupancy, number of locations, and number of mature individuals can be inferred because of continuing habitat loss and degradation, but there is no evidence of extreme fluctuations, and the range of the species is not severely fragmented. In a GIS analysis conducted by Cox and Kautz (2000), 13 public conservation lands were each estimated to contain >1,000 ha (2,500 acres) of potential habitat. Because of these large tracts of remaining habitat and the ability of populations to persist with some human development, we did not consider the species to have a seriously fragmented distribution. More than half of the area of occupancy is probably not in small and isolated habitat patches incapable of supporting viable populations.

**Criterion C**. – We are uncertain whether there are >10,000 mature short-tailed snakes. In order for there to be fewer than 10,000 snakes in this much habitat, then there could only be 0.04 snakes/ha or 1 snake every 23 ha (57 acres) of potential habitat identified. Based upon population density data available for similar-sized snake species elsewhere in North America

(0.4 to 100/ha; http://www.pwrc.usgs.gov/neparc/Products/RiskAssessPDFs/Squamata/Density_squamates.pdf), we suspect short-tailed snakes occur at higher densities than 0.04 snakes/ha in good habitat. However, there are no records from some areas of potential habitat identified, and low densities might occur in some scrub and degraded habitats.

## Appendix 1. Biological Review Group Members Biographies

**Kevin M. Enge** received his M.S. in Wildlife Ecology and Conservation from the University of Florida and B.S. degrees in Wildlife and Biology from the University of Wisconsin–Stevens Point. He is currently an Associate Research Scientist in the Reptile and Amphibian Subsection of the Wildlife Research Section, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission (FWC). He has worked for FWC since 1989, serving as a nongame survey and monitoring biologist and the Herp Taxa Coordinator. He has conducted numerous surveys of both native and exotic amphibians and reptiles, and he has published >60 scientific papers and 25 reports.

**Steve A. Johnson** received his Ph.D. from the University of Florida and M.S. and B.S. degrees from the University of Central Florida. He is an Assistant Professor of Urban Wildlife Ecology at the University of Florida, and he holds a teaching and extension position in the Department of Wildlife Ecology and Conservation, Gulf Coast Research and Education Center. His area of expertise is natural history and conservation of amphibians and reptiles, especially those using isolated wetlands, and he has >60 publications.

**Richard D. Owen** received his M.S. and B.S. in Biology from the University of Central Florida. He is currently a District 2 Environmental Specialist for the Department of Environmental Protection, Florida Park Service specializing in aquatic systems and prescribed fire management at 40 north Florida state parks. He has over 22 years of vertebrate survey and monitoring experience in the southeastern United States. His area of expertise is natural history and distribution of Florida's amphibians and reptiles. He has been involved with over 30 publications on amphibians and reptiles.

**Thomas E. Ostertag** received his M.S. in Biological Sciences from the University of West Florida and B.S. degrees in Anthropology and Biological Sciences from Florida State University. He is currently the Listed Species Conservation Ecologist in the Species Conservation Planning Section of the Division of Habitat and Species Conservation, FWC. His areas of expertise are the ecology of ephemeral ponds and fire ecology. He has published several papers on the effects of fire in upland pine ecosystems.

**David Printiss** received B.S. in Biological Sciences from Florida State University. He is currently the Northwest Florida Program Director for The Nature Conservancy and is responsible for management and restoration of over 30,000 acres across 12 preserves. As a Conservancy Field Zoologist, he has surveyed nearly all conservation lands in northern Florida in order to provide rare species and natural community inventories and management plans. Although much of his current work is related to natural community restoration, his early training was in herpetology, and he co-authored many survey and management recommendation reports when he worked for the Florida Natural Areas Inventory.

**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.**

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

## APPENDIX 3. Information and comments received from independent reviewers.

Will be added later.