

**U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Pituophis ruthveni*

COMMON NAME: Louisiana pine snake

LEAD REGION: 4

INFORMATION CURRENT AS OF: April 2, 2010

STATUS/ACTION:

Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

New candidate

Continuing candidate

Non-petitioned

Petitioned - Date petition received: 7/20/2000

90-day positive - FR date:

12-month warranted but precluded - FR date: May 4, 2004 (via CNOR)

Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for the species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The "Progress on Revising the Lists" section of the current CNOR (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months.

Listing priority change

Former LP:

New LP:

Date when the species first became a Candidate (as currently defined): 10/01/1999

Candidate removal: Former LP:

A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

- F – Range is no longer a U.S. territory.
- I – Insufficient information exists on biological vulnerability and threats to support listing.
- M – Taxon mistakenly included in past notice of review.
- N – Taxon does not meet the Act’s definition of “species.”
- X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Reptile – Colubridae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Louisiana and Texas

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE:
Louisiana: Bienville, Natchitoches, Vernon and Sabine Parishes; Texas: Newton, Sabine, Jasper and Angelina Counties

LAND OWNERSHIP: Current potentially occupied habitat in Louisiana and Texas is estimated to be approximately 65,910.4 hectares (ha) or 162,867.5 acres (ac); 53.4 percent (35,206.5 ha or 86996.8 ac) occurring on public lands and 46.6 percent (30,704.8 ha or 75,872.9 ac) in private ownership.

LEAD REGION CONTACT: Rob Tawes, 404/679-7142, Robert_Tawes@fws.gov

LEAD FIELD OFFICE CONTACT: Lafayette, Louisiana Field Office, Deborah Fuller, 337/291-3124, Deborah_fuller@fws.gov

BIOLOGICAL INFORMATION

Species Description

Pine snakes (genus *Pituophis*) are large, short-tailed, powerful constricting snakes with keeled scales, a single anal plate (the scale covering the cloaca) and disproportionately small heads (Conant and Collins 1991, pp. 201-202). Their snouts are pointed and they are good burrowers. The Louisiana pine snake (*P. ruthveni*) has a buff to yellowish ground color with dark brown to russet dorsal blotches covering its total length (Conant and Collins 1991, p. 203; Vandeventer and Young 1989, p. 35). The belly of the Louisiana pine snake may be unmarked or boldly patterned with black markings. The Louisiana pine snake resembles a rather heavy-bodied bullsnake (*P. melanoleucus sayi*), but differs from this species by having less dorsal blotches (40 or less). The Louisiana pine snake is variable in both coloration and pattern, but a characteristic feature is that its body markings are always conspicuously different at opposite ends of its body. Blotches run together near the head, often obscuring the ground color, and then become more separate and well-defined towards the tail. Typically, there are no noticeable head markings, although rarely a light bar or stripe may occur behind the eye. The length of adult Louisiana pine snakes ranges from 122 to 142 centimeters (cm)(48 to 56 inches (in)) (Conant and Collins 1991, p. 203).

Taxonomy

Stull (1929, pp. 2-3) formally described the Louisiana pine snake as a pine snake subspecies (*P. m. ruthveni*) based on two specimens taken in Rapides Parish, Louisiana. Reichling (1995, p. 192) reassessed this snake's taxonomic status and concluded that the Louisiana pine snake was geographically isolated and phenetically distinct, and thus a valid evolutionary species. The Louisiana pine snake has subsequently been accepted as a full species, *P. ruthveni* (Collins and Taggart 2002, p. 33; Crother 2000, p. 69; Rodriguez-Robles and Jesus-Escobar 2000, p. 46). We have carefully reviewed the taxonomic research for the Louisiana pine snake and conclude that this species is a valid taxon.

Habitat

Louisiana pine snakes are endemic to the westerly extent of the longleaf pine ecosystem that historically existed in Louisiana and Texas. Louisiana pine snake habitat consists of sandy, well-drained soils in open pine forest (especially longleaf-pine savanna), a sparse midstory, and well-developed herbaceous ground cover dominated by grasses and forbs (Rudolph and Burgdorf 1997, p. 117). These conditions are created and maintained by recurrent low-intensity ground fires that occur on a 3 to 5 year return interval. In the absence of recurrent fire, suitable Louisiana pine snake habitat conditions are lost due to vegetative succession. Baird's pocket gophers (*Geomys breviceps*) appear to be an essential habitat component (Ealy et al. 2004, p. 393). Louisiana pine snakes have also been found in grasslands and pine plantations that contain sufficient herbaceous ground cover, sandy soils, and pocket gophers (Himes et al. 2006, p. 107; Reichling et al. 2008, p. 9). Telemetry data indicate that Louisiana pine snakes are most often found within or near pocket gopher burrow systems (Ealy et al. 2004, p. 389; Himes et al. 2006, p. 107), and that they use these burrow systems as nocturnal refugia, as hibernacula, and to escape from fire (Rudolph and Burgdorf 1997, p. 117; Rudolph et al. 1998, p. 147; Ealy et al. 2004, p. 386). Pocket gophers are the primary prey of the Louisiana pine snake (Himes 2000, p. 97; Rudolph et al. 2002, p. 58), although the species has also been known to eat eastern moles (*Scalopus aquaticus*), mice (*Peromyscus* sp.), cotton rats (*Sigmodon hispidus*), and turtle (probably *Trachemys scripta*) eggs (Rudolph et al. 2002, p. 59).

Life History

Sexual maturity may be attained at an approximate length of 120 cm (4 feet (ft)) and an age of approximately three years (Himes et al. 2002, p. 686). Ealy et al. (2004, p. 390) documented that the species spent 59% of daylight hours (sunrise to sunset) below ground and moved an average of 163 meters (m) per day. Louisiana pine snake used Baird's pocket gopher burrows (80.9%), decayed or burned stumps (15.4%), or nine-banded armadillo (*Dasyus novemcinctus*) burrows (3.7%) as underground refugia (Ealy et al. 2004, p.389). Himes et al. (2006, p.107) found that Louisiana pine snakes moved 118 m (range 2 – 1159 m) between consecutive days, and that the average home range size was 33.2 ha (82 ac)(range 6.5 – 108 ha (16 – 267 ac)). Captive Louisiana pine snakes may live over 30 years, but females have not reproduced beyond the age of 18 years (Reichling 2008, p. 4, p. 16). Captive Louisiana pine snakes have a low reproductive rate, with a mean clutch size of 4 eggs (Reichling 1990, p. 221). No nests of this species have been located in the wild.

Historical Range/Distribution

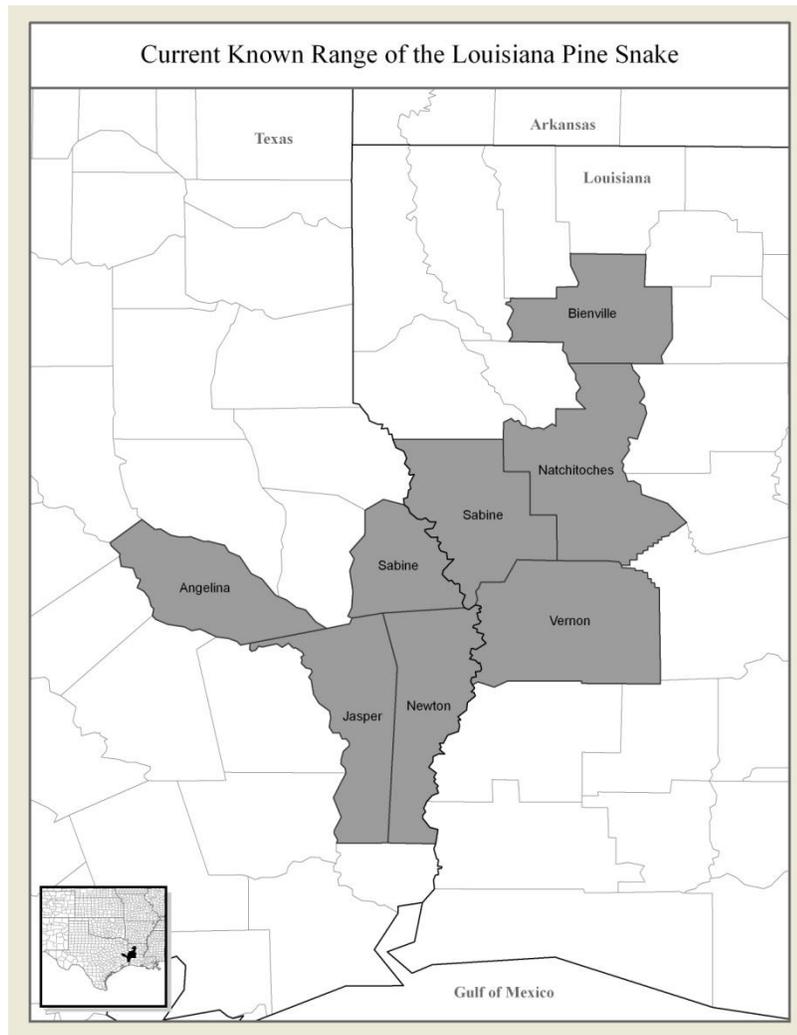
The Louisiana pine snake historically occurred in portions of west-central Louisiana and extreme east-central Texas. This area coincides with a disjunct portion and the most westerly occurrence of the longleaf pine ecosystem situated west of the Mississippi River. The U.S. Forest Service Wildlife Habitat and Silviculture Laboratory in Nacogdoches, Texas, has compiled a 'historical records' database of all known Louisiana pine snake locations (excluding telemetry data) from 1927 to 2007 (n = 189 records). Based on this database, there are historical records for the Louisiana pine snake from seven parishes in Louisiana (Bienville, Jackson, Natchitoches, Sabine, Vernon, Rapides, and Beauregard) and 12 counties in Texas (Wood, Houston, Trinity, Polk, Hardin, Tyler, Jasper, Newton, Sabine, San Augustine, Angelina and Nacogdoches). Single Louisiana pine snake records exist for Calcasieu and Jefferson Davis Parishes in Louisiana (Williams and Cordes 1996, p. 35), but these records are considered suspect by the Natural Heritage Division of the Louisiana Department of Wildlife and Fisheries (S. Shively 1999, pers. comm.) and have not been included in the historical records database. Similarly, a previously reported Louisiana pine snake record from Cherokee County, Texas, was erroneous (J. Pierce, U.S. Forest Service, pers. comm., 2009), and two historical Louisiana pine snake records from Montgomery and Walker Counties in Texas were excluded from the database because these specimens have been re-classified as *Pituophis catenifer* (J. Pierce, U.S. Forest Service 2008, pers. comm.). It should be noted that most of the sandy longleaf pine-dominated savannas preferred by the Louisiana pine snake had been lost by the mid-1930's (Bridges and Orzell 1989, p. 246, Frost 1993, p.30). Therefore, it is extremely likely that other undocumented populations of this species historically occurred but were lost before the 1930s, since virtually all virgin timber in the south was cut during intensive logging from 1870 to 1920 (Frost 1993, p.38).

Current Range/Distribution

Louisiana pine snake trapping has been conducted by the U.S. Forest Service, the Department of Defense, the Memphis Zoo, and the Louisiana Department of Wildlife and Fisheries (LDWF). In total, trapping from throughout the historic range (excluding 10 captures in 2008 and 2009) of the Louisiana pine snake has resulted in 61 captures during 251,059 trap days. Based on counties or parishes with multiple recent (1990-2007) observations, extant Louisiana pine snake populations occur in four parishes (Bienville, Natchitoches, Sabine, and Vernon) in Louisiana and four counties (Jasper, Newton, Sabine, and Angelina) in Texas. However, the distribution of Louisiana pine snakes within these parishes and counties is restricted because intensive land use activities and the disruption of natural fire regimes has decreased the quantity and quality of the intervening areas as habitat for this species (Rudolph et al. 2006, p. 470). Existing Louisiana pine snake populations occur in seven general areas, all of which are primarily concentrated on public lands (military installations and national forests) or privately-owned industrial timberlands. A single observation of a Louisiana pine snake crossing a road in 1994 may indicate that an additional remnant Louisiana pine snake population exists in Tyler County, Texas.

In their status assessment, Rudolph et al. (2006, p. 469) concluded that the failure to document existing Louisiana pine snake populations at known historical localities, coupled with the extensive documented loss, degradation, and fragmentation of longleaf pine habitat, indicates

that the Louisiana pine snake has been extirpated from significant portions of its historical range. This assertion is supported by range-wide trapping results and the historical records database. Based on the absence of Louisiana pine snake captures during 118,052 trap days, and the lack of recent (1990 – 2007) sightings, the Louisiana pine snake has likely been extirpated from three parishes (Jackson, Rapides, and Beauregard) in Louisiana and 7 counties (Wood, Houston, Trinity, Polk, Hardin, San Augustine, and Nacogdoches) in Texas.



Rudolph et al. (2006, p. 467) assessed habitat conditions during 1999 and 2000 at the locations of all historical Louisiana pine snake records ($n = 118$ localities). Rudolph et al. (2006, p. 467) found that 70% (26 of 37) of the localities on public lands were in excellent or good condition, whereas only 33% (27 of 81) of the localities on private lands were in the excellent or good condition. Due to habitat fragmentation, most sites with excellent or good habitat were isolated and small (typically a few hundred hectares, or less; Rudolph et al. 2006, p. 466). Based on the low capture rates and limited habitat availability, Rudolph et al. (2006, p. 468) concluded that remnant Louisiana pine snake populations are not large.

Currently, trapping (which is expensive and labor intensive) is the only systematic method for

surveying Louisiana pine snake populations. Although the general habitat requirements for the Louisiana pine snake are known, no habitat models exist that delineate the distribution of potential habitat within the occupied range of this species. Due to the time required and expense of trapping and the lack of predictive habitat models, sufficient Louisiana pine snake surveys have not occurred in all areas of potential habitat. Thus, trapping efforts to date have not been sufficient for precisely delineating the boundaries of extant populations. Consequently, although trapping data and opportunistic sighting records were used to determine the boundaries of extant populations (see below), the estimates derived from these data are approximations of the actual boundaries of extant populations.

A population is defined here as a group of Louisiana pine snakes with the potential for genetic exchange, that is isolated from other such groups. In their status assessment paper, Rudolph et al. (2006, p. 467) used a combination of individual records and the presence of contiguous habitat to determine that six Louisiana pine snake populations were in existence. However, since the time of that assessment, an additional Louisiana pine snake population has been located on the Kisatchie District of the Kisatchie National Forest in Louisiana. To estimate the acreage of habitat occupied by each of these seven populations, all recent (1990 to 2007) Louisiana pine snake records (n = 110) containing location data were plotted in a Geographic Information System (GIS). Three individual records were excluded because they were separated from extant populations by unsuitable habitat or presumed landscape barriers (e.g., large wetland drainages). Using ArcMap (Version 9.2), a minimum convex polygon (MCP) was drawn around the clusters of records within each population, and a one kilometer (km) (0.6 mile [mi]) buffer was drawn around each MCP. The MCP was buffered to accommodate the fact that trap locations were not placed on the landscape with the intent of delineating population boundaries. Because trapping results are a function of trap location selection, trap success, and true presence or absence, trapping data only approximate Louisiana pine snake use of an area. A one km (0.6 mi) buffer was used because telemetry data indicate this is a reasonable approximation of the area a Louisiana pine snake may use during one or more years (C. Rudolph 2008a, pers. comm.). For each extant Louisiana pine snake population, the buffered MCP was used to estimate the acreage of occupied habitat and to determine land ownership. This method may underestimate or overestimate the actual amount of occupied habitat for each population. The acreage of occupied habitat may be underestimated if undocumented Louisiana pine snakes occur outside of the current estimated population boundaries. Conversely, even though unsuitable features (i.e., water and cities) were excluded from these estimates, the acreage of occupied habitat may be overestimated because the actual amount of suitable habitat (based on soils and vegetation) within each polygon is currently unknown.

Using this method, it can be estimated that the seven extant Louisiana pine snake populations occur on 26,482 ha (65,438 ac) of Department of Defense lands, 8,640 ha (21,350 ac) of U.S Forest Service lands, 84 ha (206 ac) of State Lands, and 30,705 ha (75,873 ac) of private lands. In Louisiana, the following populations and acreages have been identified: (1) the Bienville population (located on privately owned industrial timberland in Bienville Parish and a section of the Winn District of the Kisatchie National Forest in extreme northern Natchitoches Parish) occupies 27,966 ha (69,105 ac) of private land, 588 ha (1,452 ac) of Forest Service land, and 84 ha (206 ac) of State Lands; (2) the Kisatchie population (located on the Kisatchie District of the Kisatchie National Forest in Natchitoches Parish) occupies 1,514 ha (3,741 ac) of Forest Service

land; (3) the Peason Ridge population (located on Peason Ridge Military Reservation in Vernon and Sabine Parishes) occupies 1,923 ha (4,751 ac) of Department of Defense lands and 12 ha (29 ac) of private lands; and (4) the Fort Polk population (located on Fort Polk Military Reservation and the Calcasieu / Vernon District of the Kisatchie National Forest in Vernon Parish) occupies 24,559 ha (60,687 ac) of Department of Defense lands, 2,382 ha (5,885 ac) of Forest Service lands, and 36 ha (88 ac) of private lands. In Texas, the following populations and acreages have been identified: (5) the Sabine population (located on the southern section of the Sabine National Forest in Sabine county) occupies 320 ha (791 ac) of Forest Service lands and 71 ha (176 ac) of private lands; (6) the Scrappin' Valley population (located on privately owned industrial timberland in Newton county) occupies 2,047 ha (5057 ac) of private land; and (7) the Angelina population (located on the southern section of the Angelina National Forest in Angelina and Jasper counties) occupies 3,837 ha (9,482 ac) of Forest Service lands and 574 ha (1,418 ac) of private lands.

Habitat modeling and additional field surveys are needed to improve estimates of the amount and location of currently occupied and potentially suitable Louisiana pine snake habitat.

Population Estimates/Status

The Louisiana pine snake is recognized as one of the rarest snakes in North America (Young and Vandeventer 1988; Himes et al. 2006, p. 114). The Louisiana pine snake was classified in 2007 as endangered on the IUCN (World Conservation Union) Red List of Threatened Species (version 3.1; <http://www.iucnredlist.org/>). Because basic life history information is lacking for this species, no estimates exist regarding the acreage or population size necessary to support a viable Louisiana pine snake population. Snakes are vulnerable to increased intentional and unintentional mortality when they disperse outside of their home ranges and into developed areas (Bonnet et al. 1999, p. 47). Roads and associated vehicular traffic, in particular, have been identified as important causes of snake mortality and population declines (Rudolph et al. 1999, p. 130; Himes et al. 2002, p. 686). The intervening habitats between extant Louisiana pine snake populations have been lost and degraded due to urbanization, increased road density, disruption of natural fire regimes, agriculture, and intensive pine plantation silviculture. Because of increasing trends towards fire suppression and intensive land use activities on private lands in the historic range of the species, it is highly unlikely that Louisiana pine snakes will be able to naturally re-colonize isolated habitat patches or successfully disperse between extant populations. In addition, the prospects are low for securing and restoring habitat corridors between most extant populations. Consequently, the current and future status of the Louisiana pine snake must be viewed in light of the fact that most remnant Louisiana pine snake populations will probably remain demographically and genetically isolated into the future.

Due to its semi-fossorial habits, rarity, and secretive nature, Louisiana pine snakes are difficult to locate, even in areas where they are known to occur (Ealy et al. 2004, p. 384). To date, most Louisiana pine snake records have been from trapping and opportunistic sightings. Data from all known trapping efforts have been compiled by the U.S. Forest Service Wildlife Habitat and Silviculture Laboratory in Nacogdoches, Texas. These data are used to estimate trap success (i.e., the number of trap days required to catch one snake) for each extant population. Trapping has provided important information on Louisiana pine snake occurrences. However, population

densities cannot be estimated from trapping data because mark-recapture analyses cannot be conducted due to insufficient numbers of Louisiana pine snake recaptures. Consequently, no estimates of Louisiana pine snake population densities exist. The best available indices of Louisiana pine snake population abundance are trap success and the number of occurrence records per population. Although we report these indices for each extant population, it is unknown how these metrics relate to true population size.

(1) The Bienville population. Trap success for this population is estimated to be 1:751 (35 captures out of 26,296 trap days). While trapping success may vary annually, the trapping success in this area continues to be significantly better than for any other populations. Fifty-nine recent records exist for this population. Based on trap success and occurrence records, the Bienville population is widely believed to be the largest extant Louisiana pine snake population (Rudolph et al. 2006, p. 465; Reichling et al. 2008, p. 10). Within occupied habitat, most records for this population have occurred on 12,353 ha (30,525 ac) of privately-owned industrial timberlands in Bienville Parish, Louisiana (Reichling et al. 2008, p. 1). On this timberland, two disjunct Louisiana pine snake Core Management Areas (the 344 ha [851 ac] Kepler site and the 348 ha [859 ac] Sandy Lands site) have been voluntarily established by the private landowners. These sites are managed for the Louisiana pine snake with thinning, longleaf pine restoration, restricted herbicide use, and prescribed burning. Based on information presented during the 2008 Louisiana pine snake stakeholder meeting, 10 ha (24 ac) and 16 ha (39 ac) were converted to longleaf in the Kepler and Sandy Lands sites, respectively, during 2007 and 2008. In total, the private landowners have converted 187 ha (462 ac) of the Kepler site and 210 ha (518 ac) of the Sandy Lands site to longleaf. Based on information presented at the 2008 Louisiana pine snake stakeholder meeting, the Kepler Lake site has demonstrated the greatest trap success (1:326) and number of occurrence records ($n = 26$) of any site sampled within the range of the Louisiana pine snake. Consequently, Reichling et al. (2008, p. 10) believed this site was critical for the preservation of this species. There are no estimates of the amount of habitat necessary to support a viable Louisiana pine snake population. Nonetheless, Reichling et al. (2008, p. 10) did not believe that isolated management areas that were 324 – 405 ha (800 – 1000 ac) in size were sufficient to support viable Louisiana pine snake populations, and that therefore the snakes in the Kepler Lake site were likely dependent upon snake population density in the surrounding habitat. Consequently, Reichling et al. (2008, p. 10) felt that it was essential to Louisiana pine snake conservation to restore and preserve the thousands of hectares (acres) of privately owned upland xeric habitat that surround the Kepler Lake site. Many of the timberlands surrounding Kepler Lake and the Sandy Lands sites have recently been converted to short-rotation loblolly pine plantations. Although the broadcast application of herbicides has been restricted in these plantations, these sites are managed with clearcutting at 25-year harvest rotations and the use of targeted herbicides instead of prescribed burning (T. Smith 2008, pers. comm.). Louisiana pine snakes have been found within loblolly pine plantations at these sites (Reichling et al. 2008, p. 6). However, based on trapping surveys and location records, Rudolph et al. (2006, p. 470) concluded that private lands managed with these intensive silvicultural practices (e.g., clearcutting, short rotations, planting of off-site pine species, and the use of herbicides instead of prescribed fire) do not support viable Louisiana snake pine populations. Consequently, it is likely that the increasingly intensive land use within occupied habitat outside of the two Core Management Areas has degraded the quality of this habitat for the Louisiana pine snake. The entire 12,353 ha (30,525 ac) parcel of Louisiana pine snake habitat on this property in Bienville

Parish was purchased by a Timber Investment Management Organization (TIMO) in 2006. In 2008, this entire property was sold to a different Timber Investment Management Organization. The previous two landowners have been actively involved with Louisiana pine snake conservation, as evidenced by their proactive habitat management efforts in the two Core Management Areas and their participation in the annual Louisiana pine snake meetings. There has been very little habitat management reported since that time; however representatives from the TIMO attended the 2009 pine snake stakeholders meetings and appear to be interested in continuing habitat management. Nonetheless, the recent conversion of a large portion of occupied habitat to short-rotation pine plantations highlights the potential conflicts between Louisiana pine snake conservation and economics on private lands. Despite the beneficial management in the two Core Management Areas and the fact that trapping and occurrence records indicate this is the largest remaining Louisiana pine snake population, no formal conservation agreements exist for habitat occupied by this population. In addition, this population is likely experiencing habitat loss and degradation as result conversion to pine plantation management. Consequently, the status of this Louisiana pine snake population is uncertain.

(2) The Kisatchie population. No Louisiana pine snakes were captured during 11,940 trap days on the Kisatchie District of the Kisatchie National Forest. However, three recent Louisiana pine snakes records exist for this population. Past trapping did not occur in the locations of the Louisiana pine snake records. Substantial amounts of suitable habitat exist on the Kisatchie District, and past trapping did not sample the best remaining habitat (Rudolph et al. 2006, p.469). Active habitat management for the federally endangered red-cockaded woodpecker (*Picoides borealis*; RCW) and the Louisiana pine snake occur at this site. Based on information presented during the 2009 Louisiana pine snake stakeholder meeting, 100% of the 1,517 ha (3,748 ac) of occupied habitat was prescription burned during 2006 – 2009. The Kisatchie District has 8,452 ha (20,886 ac) of potential Louisiana pine snake habitat (based on soils data); 2,061 ha (5,093 ac) of potential habitat was burned in 2006, 1,196 ha (2,956 ac) of potential habitat was burned in 2007, and 2,456 ha (6,068 acres) in 2009. This population is not threatened by ongoing habitat loss. The existence of three Louisiana pine snake sightings since 2002 is encouraging, but estimates of trap success are not currently useful because insufficient trapping efforts have occurred in potential suitable habitat. In addition, it is unknown whether past habitat loss and degradation has reduced the current size of this population to the point where it is vulnerable to decreased demographic viability or stochastic environmental factors (e.g., weather events, disease). Consequently, the status of this population is uncertain.

(3) The Peason Ridge population. Trap success for this population has been estimated to be 1:11,038 (1 capture out of 11,038 trap days). Four recent records (1997-2006) exist for this population. Active habitat management for the RCW and the Louisiana pine snake occurs at this site. Based on information presented during the 2009 Louisiana pine snake stakeholder meeting, 56% (825 ha [2,039 ac] out of 1,463 ha [3614 ac]) of occupied habitat was prescription burned during 2007 – 2009. Peason Ridge contains 11,169 ha (27,600 ac) of potential Louisiana pine snake habitat. In total, 65% (7,240 ha [17,891 ac] out of 11,169 ha (27,600 ac) of potential Louisiana pine snake habitat was prescription burned and thinned during 2007 – 2009. An additional 261 ha (644 ac) of potential habitat was thinned in 2008-2009. Extensive potential Louisiana pine snake habitat exists at this site, and active habitat management for the RCW and

the Louisiana pine snake has likely stabilized or increased the amount of potential habitat that exhibits suitable vegetative characteristics. However, trap success and occurrence records are low, and it is unknown whether past habitat loss and degradation has reduced the current size of this population to the point where it is vulnerable to decreased demographic viability or stochastic environmental factors. Consequently, the status of this population is uncertain.

(4) The Fort Polk population. Trap success for this population has been estimated to be 1:5,245 (16 captures out of 83,919 trap days). Seventeen recent records exist for the main post population. The majority of occupied habitat for this population occurs on Fort Polk Main Post (Department of Defense lands) and on the Vernon Unit of the Kisatchie National Forest. Based on information presented during the 2009 Louisiana pine snake stakeholder meeting, Fort Polk Main Post prescription burned 74% (8,028 ha [19,838 ac]) out of 10,785 ha [26,650 ac]) of occupied Louisiana pine snake habitat during 2007 – 2009, and 53% (8,723 ha [21,556 ac]) out of 16,351 ha [40,405 ac]) of potential habitat during 2008 – 2009. An additional 376 ha (930 ac) of potential habitat was thinned in 2008-2008. Based on information presented at the 2009 Louisiana pine snake stakeholders meeting, the Vernon Unit prescription burned 100% of occupied Louisiana pine snake habitat (10,802 ha [26,693 ac]) during 2006 – 2008. Similarly, the Vernon Unit prescription burned 100% of potential Louisiana pine snake habitat (44,778 ha [110,649 ac]) during 2006 – 2009. Extensive occupied and potential Louisiana pine snake habitat exists at this site, and active habitat management for the RCW and the Louisiana pine snake has likely stabilized or increased the amount of habitat that has suitable vegetative characteristics. Despite the relatively poor trap success, the large number of occurrence records and the large amount of potentially suitable habitat under active management suggest that this Louisiana pine snake population is stable.

(5) The Sabine population. Trap success for this population is estimated to be 1:2,581 (4 captures out of 10,325 trap days). Four recent records (all from trapping data) exist for this population. The Sabine National Forest contains 7,689 ha (19,000 ac) of potential Louisiana pine snake habitat, of which 4,047 ha (10,000 ac) currently exhibit suitable vegetative characteristics. In 2007, 1,214 ha (3,000 ac) of potential habitat was prescription burned. Despite the large amount of potential habitat, the majority of occupied habitat for this population occurs on one management compartment within the Sabine National Forest. Based on information presented during the 2008 Louisiana pine snake stakeholder meeting, 100% of occupied habitat (~283 ha [~700 ac]) within this compartment was managed with prescribed burning and thinning during 2006 – 2008. Active habitat management for the RCW and the Louisiana pine snake occurs within Habitat Management Areas (HMA) at this site. Based on information presented during the Louisiana pine snake annual meeting in 2009, 25% to 47% of the RCW HMA in the Sabine National Forest was burned during the period 2007 to 2009. This patch of currently occupied habitat is surrounded by lands that have become unsuitable for the Louisiana pine snake due to intensive silviculture and fire suppression (C. Rudolph 2008b, pers. comm.). In addition, Louisiana pine snakes in this patch of habitat have been negatively affected by vehicular traffic (C. Rudolph 2008b, pers. comm.). No Louisiana pine snake records have been reported from this site since 1995. In addition, no Louisiana pine snakes were captured during 5,180 trap days at this site in 2007, 2008, and 2009. The information above suggests that this population may have become extirpated or that it is vulnerable to decreased demographic

viability or stochastic environmental factors. Consequently, the status of this population is uncertain.

(6) The Scrappin' Valley population. Trap success for this population is estimated to be 1:1443 (7 captures out of 10,099 trap days). Twelve recent records exist for this population. This privately-owned property is being maintained, in part, as a hunting preserve. Approximately 405 ha (1,000 ac) of potential habitat have been maintained as suitable Louisiana pine snake habitat for several decades because of active prescribed burning that has occurred on this site for game and RCW management (C. Rudolph 2008b, pers. comm.). Additional potential habitat (approximately 4,047 ha [10,000 ac] in size) surrounding this population has historically been fire suppressed and unsuitable for Louisiana pine snake populations. However, active management is currently improving the suitability of much of this area as habitat for the Louisiana pine snake (C. Rudolph 2008b, pers. comm.). The levels of trap success, Louisiana pine snake occurrences, and proactive habitat management indicate the status of this population is stable.

(7) The Angelina population. Trap success for this population is estimated to be 1:3,256 (7 captures out of 22,794 trap days). Thirteen recent records exist for this population. Active habitat management for the RCW and the Louisiana pine snake occurs within Habitat Management Areas (HMA) at this site. Based on information presented during the Louisiana pine snake annual meeting in 2007, the Angelina National Forest contains 8,903 ha (22,000 ac) of potential Louisiana pine snake habitat, of which 4,856 ha (12,000 ac) currently exhibit suitable vegetative characteristics. In 2007, 5,928 ha (14,648 ac) of potential habitat was prescription burned. Based on information presented during the Louisiana pine snake annual meeting in 2009, 41% to 46% of the RCW HMA was prescription burned during the same time period in the Angelina National Forest. Although trap success is only moderate, the relative large number of occurrence records and large amount (3,837 ha [9,482 ac]) of potential habitat under active management suggest that the status of this population is stable.

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

The historical distribution of the Louisiana pine snake corresponds with the historical range of the longleaf pine ecosystem in Louisiana and Texas. Both the quantity and quality of the longleaf pine ecosystem have declined sharply in Louisiana and Texas since European settlement. The loss and degradation of the longleaf pine ecosystem, and hence of Louisiana pine snake habitat, was historically caused by logging, turpentine, fire suppression, alteration of fire seasonality and periodicity, conversion to off-site pine plantations, agriculture, and urbanization (Frost 1993, pp.24-30). Between the 1930s and the 1980s, most of the remaining acreage of longleaf pine forest in Louisiana and Texas was converted to extensive pine plantation monocultures (Bridges and Orzell 1989, p. 246). Consequently, the longleaf pine forest that exists in Louisiana today has been reduced to 15 percent of the acreage that existed in 1935; in Texas, the current acreage of longleaf pine forest is less than 8 percent of the acreage that existed in 1935 (Bridges and Orzell 1989, p. 246). Importantly, the estimated 1935 acreages were a fraction of those that existed pre-European settlement, since virtually all virgin timber in the

south was cut during intensive logging from 1870 to 1920 (Frost 1993, p.30). For example, only 2.9 percent of longleaf pine forests in Louisiana and Texas were uncut old-growth stands in 1935 (Bridges and Orzell 1989, p. 246). Therefore, estimates of habitat loss based on differences between 1935 and the late 1980s underestimate the true extent of habitat loss (and hence Louisiana pine snake population declines), because most of the habitat loss had already occurred by 1935. The large-scale destruction and degradation of the longleaf pine ecosystem has been implicated in the population declines of many species that are characteristic of this ecosystem, including the black pine snake (*Pituophis melanoleucus lodingi*) (a federal candidate species), the endangered red-cockaded woodpecker, and the endangered Mississippi sandhill crane (*Grus canadensis pulla*) (Hunter et al. 2001, p.442; USFWS 2007, p. 9).

All seven extant Louisiana pine snake populations have been affected by habitat loss, and all require active management (prescribed burning) to maintain suitable habitat conditions. Potential Louisiana pine snake habitat has been maintained or increased in some populations, whereas in other populations existing habitat continues to be lost and degraded, albeit at a slower rate than that which occurred historically. On private lands, open pine habitats containing dense herbaceous vegetation are being converted to densely-stocked off-site pine plantations that are managed with herbicides instead of fire. The use of fire is heavily restricted on private timberlands because of the expense of fire liability insurance, the reduced tolerance of off-site pine species to fire, and because of smoke management issues. In addition, the increasing trend towards the divestiture of industrial forest lands in the Southeast complicates establishing public-private partnerships and long-term forest management agreements.

The Bienville Parish population of Louisiana pine snakes, arguably the largest extant population (Reichling et al. 2008, p. 10), primarily occurs on private industrial forest land. Much of this industrial forest has recently been converted to short-rotation loblolly pine plantations. Two disjunct Louisiana pine snake Core Management Areas, each approximately 364 ha (900 ac), are being beneficially managed (via longleaf pine restoration) for the Louisiana pine snake by the private landowners. If the conversion of forests outside of the Core Management Areas to short-rotation loblolly plantations results in a decrease in the suitability of these areas as Louisiana pine snake habitat (Rudolph et al. 2006, p. 470), the Louisiana pine snakes occupying the Core Management Areas may become fragmented into isolated populations. If isolation occurs, the long-term persistence of Louisiana pine snakes in the Core Management Areas has been questioned by some authorities (Reichling et al. 2008, p. 10) based on the belief that it is unlikely that either Core Management Area is large enough to support a viable Louisiana pine snake population. The recent buying and selling of the Bienville properties by Timber Investment Management Organizations adds additional uncertainty regarding the future land use priorities on these sites. The Bienville properties are located near an area which is undergoing increasing natural gas exploration activities in association with a formation known as Haynesville shale. It is currently unknown if and at what level the Louisiana pine snake would be affected by those activities.

Pine forest management on public lands typically includes longer rotations than commercial forestry, as well as the retention of longleaf pine and the use of prescribed fire. Recent Louisiana pine snake records on public lands are mainly from areas where the use of fire has been effective in suppressing hardwood midstory development and in promoting well-developed herbaceous

groundcover (Rudolph et al. 2006, p. 470). Forest fragmentation by roads and private inholdings, and the concomitant smoke management and liability concerns, have hindered prescribed burning and have caused natural fires to be suppressed. The quality of Louisiana pine snake habitat has been a concern on federal lands in Louisiana and Texas in recent decades due to midstory encroachment and high stand density (Rudolph et al. 2006, p. 470). These factors, coupled with insufficient burning, have limited the development of healthy ground layer herbaceous vegetation. Abundant ground layer herbaceous vegetation is important for Louisiana pine snakes and their primary prey, the Baird's pocket gopher. However, since the signing of the Louisiana pine snake Candidate Conservation Agreement (CCA 2003) in 2003, the signatories of the CCA have performed extensive beneficial habitat management (prescribed burning and thinning) within occupied and potential Louisiana pine snake habitat on federal lands. The increases in the acreages of burning and thinning conducted by the signatories of the CCA appears to have improved habitat conditions on many federal lands that support Louisiana pine snake populations (C. Rudolph 2008c, pers. comm.).

On federal lands, signatories of the Louisiana pine snake CCA currently conduct habitat management (i.e., prescribed burning and thinning) that is beneficial to the Louisiana pine snake. All federal lands that contain extant Louisiana pine snake populations use prescribed burning and thinning to manage habitat for the federally endangered RCW. Because Louisiana pine snakes and RCWs both require open pine forests with fire-suppressed midstories, habitat management for the RCW generally benefits the Louisiana pine snake (Rudolph et al. 2006, p. 471). However, fire management for the RCW that is conducted in areas without well-drained sandy soils and pocket gophers will not directly benefit the Louisiana pine snake. In addition, fire management that occurs within occupied habitat is more beneficial than fire management that occurs within potential habitat. Therefore, information on the acreage of prescribed burning and thinning that is not directly related to occupied habitat overestimates the benefit of this management to the Louisiana pine snake. In 2009, cooperating federal agencies conducted prescribed burning on 52,411 ha (129,510 ac) in occupied and potential pine snake habitat.

During the 2007 Louisiana pine snake annual stakeholder's meeting it was noted that, in some instances, prescribed burning and thinning was not occurring in areas that would benefit Louisiana pine snakes because management was being prioritized for the RCW. Improved Louisiana pine snake habitat models and distribution data are needed to ensure that proactive forest management conducted by the signatories of the CCA is located in areas that are currently occupied by the Louisiana pine snake. Such models are currently being developed. In addition, suggested amendments to the CCA, if adopted, will improve the ability of land managers to prioritize burning in areas that will benefit Louisiana pine snakes. The extensive amounts of proactive habitat management conducted by signatories of the CCA has likely slowed or reversed the rate of Louisiana pine snake habitat degradation (caused by inadequate burning and subsequent vegetative succession) on many portions of federal lands. Importantly, beneficial management within occupied Louisiana pine snake habitat has occurred on many federal lands in recent years. However, it is difficult to quantify the extent to which these management activities have improved conditions for Louisiana pine snakes because vegetative responses to habitat management are not typically reported. In addition, not all areas of occupied Louisiana pine snake habitat have received recent beneficial management.

Based on our evaluation, we conclude that there is sufficient information to develop a proposed listing rule for this species due to the present or threatened destruction, modification, or curtailment of its habitat or range.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Take of Louisiana pine snakes for commercial, recreational, scientific, or educational purposes is not currently considered a threat (J. Boundy 2008, pers. comm.). Given the restricted distribution, presumed low population sizes, and low reproductive potential of Louisiana pine snakes, it is likely that even moderate collecting pressure would negatively affect extant populations of this species. Webb et al. (2002, p. 64) concluded that, in long-lived snake species exhibiting low fecundity, the sustained removal of adults from isolated populations would eventually lead to extirpation. Because extant Louisiana pine snake populations are isolated, dispersal probably does not occur between most populations. However, the Louisiana pine snake is protected by State law in Texas, and most areas in Louisiana where extant Louisiana pine snake populations occur restrict public access or prohibit collection. In addition, the secretive nature, semi-fossorial habits, and rarity of the Louisiana pine snake likely make collection of this species difficult (B. Gregory 2008a, pers. comm.). Although current levels of Louisiana pine snake collection have not been quantified, there appears to be very little demand for this species by private collectors (S. Reichling 2008, pers. comm.).

C. Disease or predation.

Disease and natural predation are not currently considered to be threats to this species.

D. The inadequacy of existing regulatory mechanisms.

There are no existing regulatory mechanisms for the protection of the upland habitats required by the Louisiana pine snake. The Louisiana pine snake is listed as threatened by the state of Texas and is protected from unauthorized collection there. This regulation does not alleviate the loss of habitat which has caused the decline of the species. There is no state listing protection for the Louisiana pine snake in Louisiana (B. Gregory 2008b, pers. comm.). Collection or harassment of Louisiana pine snakes is prohibited on U.S. Forest Service properties in Louisiana (USDA Forest Service 2002, p. 1). Of the non-game wildlife, only venomous snakes may be killed on Fort Polk and Peason Ridge if determined to be an immediate threat to personnel (Department of the Army, p. 6). The capture, removal, or killing of non-game wildlife from Fort Polk and Peason Ridge is prohibited without a special permit (Department of the Army, p. 6). Malicious killing of snakes by humans is a significant issue in snake conservation because snakes arouse fear and resentment from the general public (Bonnet et al. 1999, p. 40). Intentional killing of black pine snakes by humans along the Gulf Coast has been documented (USFWS 2007, p. 8). The intentional killing of Louisiana pines snake by humans is likely, but the extent of the impacts of this stressor are unknown.

E. Other natural or manmade factors affecting its continued existence.

The historic and ongoing fragmentation of the longleaf pine ecosystem, and hence of Louisiana

pine snake habitat, has resulted in extant Louisiana pine snake populations that are isolated and small. Currently, the amount of habitat required to support viable Louisiana pine snake populations, and the necessary distribution of this habitat over the landscape, is not known. In addition, we currently do not know the minimum population size required to maintain self-sustaining populations of the Louisiana pine snake. Small, isolated populations may experience decreased demographic viability and increased susceptibility of extirpation from stochastic environmental factors (e.g., weather events, disease). Small, isolated populations may also experience increased threat of extirpation from genetic isolation and subsequent inbreeding depression and genetic drift. All seven extant Louisiana pine snake populations appear to be vulnerable to threats associated with fragmentation and isolation, and at least three of these populations (the Kisatchie, Peason Ridge, and Sabine populations) also appear to be vulnerable to threats associated with small population size.

The disruption of natural fire regimes has been detrimental to the health and extent of the longleaf pine forests within the Louisiana pine snake range. Insufficient fire, due to fire suppression and inadequate prescribed burning, is considered a primary factor responsible for the degradation of the remaining longleaf pine forest. The longleaf pine savannas occupied by Louisiana pine snakes have historically been maintained by fire. Habitat surveys conducted by Rudolph (2000, p. 7) indicate that changes in fire regimes may represent the greatest threat to Louisiana pine snake habitat quality in recent years. The use of prescribed burning as a management tool is being restricted by many foresters due to numerous factors, including liability issues, smoke management issues, limited funds and personnel, potential legal issues, and the planting of off-site pine species, which are more easily damaged by fire, instead of longleaf pine. Thus, prescribed burning is being replaced by herbicide use on many private forest properties. If herbicide use alters the composition and/or density of the ground cover vegetation and pocket gophers decline in response, it is likely that Louisiana pine snakes will decline in numbers as well (Rudolph and Burgdorf 1997, p. 118).

Road bound and off-road motor vehicle use may cause significant impacts to Louisiana pine snake population numbers. Himes et al. (2002, p.686) documented the death of 15 Louisiana pine snakes during their radio-telemetry study. Three of the 15 (20 %) deaths could be attributed to vehicle mortality. Roads with moderate to high traffic levels reduce adjacent snake populations by 50 to 75 percent and measurable impacts extend up to 850 meters (approximately one-half mile) from the roads (Rudolph et al. 1999, p. 130).

The Louisiana pine snake has an extremely low reproductive rate, producing a very small clutch of 4 large eggs (Reichling 1990, p.221). The Louisiana pine snake's low fecundity (reproductive output) and likely low population growth rate magnifies the effect of the above listed threats and increases the likelihood of local extirpations.

The extensive historic loss of habitat has reduced the Louisiana pine snake into seven isolated populations. Several of these populations may be vulnerable to threats associated with low population sizes. The historic and ongoing loss of potential habitat (via fire suppression, conversion to pine plantations, increases in the number and width of roads, and urbanization) on private lands in the matrix between these extant populations has essentially eliminated the potential for successful dispersal among remnant populations, as well as the potential for natural

re-colonization of vacant or extirpated habitat patches. Because extant Louisiana pine snake populations are few in number, small in size, and demographically isolated, any factor (i.e., habitat change, a loss of demographic viability, etc.) that results in a decline in Louisiana pine snake densities within a remnant population may be problematic for the long-term recovery of this species. Based on the assessment of the status of the seven extant populations, three populations appear to be large enough (based on trap success and occurrence data as indices to abundance) and to occur on sufficient amounts of appropriately-managed habitat as to be considered stable (the Fort Polk, Scrappin' Valley, and Angelina populations). The four other populations each have uncertain statuses: two because of apparently low population sizes (the Kisatchie and Peason Ridge populations), one because of apparently low population sizes coupled with low amounts of suitable habitat (the Sabine Population), and one because of threats resulting from activities (habitat conversion to short-rotation pine plantations) that are expected to decrease habitat quality (the Bienville population).

Based on our evaluation, we conclude that there is sufficient information to develop a proposed listing rule for this species due to the other natural or manmade factors affecting its continued existence.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The CCA (2003) for the Louisiana pine snake which includes the U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Department of Defense, Texas Parks and Wildlife Department, and Louisiana Department of Wildlife and Fisheries was completed in 2003 and is currently being implemented. The CCA is designed to identify and establish management for the Louisiana pine snake on federal lands in Louisiana and Texas, and provides a means for the partnering agencies to work cooperatively on projects that avoid and minimize impacts to the snake. It also sets up a mechanism to exchange information on successful management practices and coordinate research efforts. The Natural Resources Conservation Service, the Association of Zoos and Aquariums, and The Nature Conservancy have discussed potentially becoming additional signatories when the CCA is revised. Several private landowners previously indicated interest in becoming signatories to the CCA or similar agreements with the Service. However, as of September 2009, no private landowners were formal members to the CCA.

Federal partners to the CCA manage land representing an estimated 53 percent of occupied Louisiana pine snake habitat. These partners are addressing habitat management needs through pro-active land management including midstory removal, thinning, and prescribed burning. In 2001, the Service provided funds, through the Endangered Species Private Landowner Incentive Program, to the International Paper Company (IP) for habitat restoration and prescribed burning at Louisiana pine snake sites on the Bienville Parish property containing a known Louisiana pine snake population. A habitat management plan for those sites was developed, and in August of 2005, IP was awarded a \$45,400 Private Stewardship Grant for continued habitat improvement (e.g., longleaf pine restoration) on that same property.

The Louisiana Pine Snake Conservation Group consists of representatives from a variety of organizations having an interest in Louisiana pine snake conservation and includes approximately 90 individuals representing State and federal government, non-profit and private

organizations, and academia. This group has been holding annual stakeholder meetings since 2003. At these meetings, stakeholders discuss issues and threats to the Louisiana pine snake, identify possible strategies to deal with these threats, and discuss and share successful results. A number of important conservation issues have been discussed at these meetings, including: (1) the captive propagation program and associated research begun at the Memphis Zoo; (2) current field research and needs; (3) existing trapping methods and potential enhancements to increase effectiveness; (4) impacts resulting from all terrain vehicle (ATV) use on public lands where designated use areas are being employed to concentrate ATV use in areas unlikely to support the Louisiana pine snake; and (5) educational outreach efforts aimed at public acceptance and conservation of reptiles as a natural component of the longleaf pine ecosystem. Three other significant activities have recently resulted from cooperative effort of this group's members: (1) completion of a threats assessment (using expert opinion) for the Louisiana pine snakes (Wagner et al., 2009); (2) development and completion of a landscape-scaled resources selection function model; and (3) initiation of an experimental reintroduction program.

As a result of discussion during the 2007 pine snake stakeholders meeting, the need to better define threats to species in order to better design conservation and management activities was recognized. To address this gap, in 2009, a research team consisting of private and Forest Service biologists developed Delphi method survey instrument (matrix) to identify threats, stressors, stressor elements, and stressor element response levels. The matrix was designed to incorporate the traditional five-factor threats criteria used by the Service in species listing under the ESA as well as the Service's threats assessment guidance. This effort resulted in a "white paper" by Wagner et al. (2009) that identifies actions needed for each population and measures of success for those actions.

Although expert opinion has provided important insight into edaphic (soil-related) factors and vegetative requirements for the Louisiana pine snake, rigorous habitat models are not available. Landscape-scale models of potential and suitable habitat are essential to inform conservation management efforts for this species. To address this gap, in 2009, a research team consisting of private and Forest Service biologists developed a preliminary landscape-scale resource selection model of potential Louisiana pine snake habitat, using available Louisiana pine snake location data to delineate used and available units, and county/parish soil survey data as edaphic factor independent variables. The research team modeled selection of potential habitat using resource selection functions that estimate the proportionate probability of use of the resource units, which in this case, are soil type characteristics. The team developed a set of a priori resource selection function models based on combinations of soil attributes that were expected to influence the snake's use, and have identified the model that best fits the data from that a priori set. Model predictions have been extrapolated across the Louisiana pine snake's historic range, providing a continuous map of the relative probability that an area possesses the edaphic factors selected by Louisiana pine snakes. The team presented their final results at the 2009 Louisiana pine snake stakeholder meeting. The model will be used to determine: (1) if there are areas of suitable habitat within the historic range that have not been adequately surveyed for the Louisiana pine snake; (2) identify focus areas for management, restoration, and reintroduction potential; and (3) quantify the spatial extent and location of Louisiana pine snake habitat within protected lands.

In consideration of the results from the Louisiana pine snake captive program, CCA habitat

management activities, the threats assessment and the resource selection function model presented at the 2009 stakeholders meeting, an informal committee was formed to develop and implement an experimental reintroduction of the Louisiana pine snake. The project has two goals: (1) demonstrating the feasibility of reintroducing a population to restored habitat using individuals from a captive population; and (2) establishing a viable population in restored habitat. To date, potential reintroductions sites were identified in unoccupied habitat on the Kisatchie National Forest within the historic range, using the resource selection model and site visits. Snakes are being reared in captivity by a consortium of zoos. The project will be implemented (e.g., release, monitoring, etc.) by a partnership of cooperating agencies. The LDWF, using funding provided by the Service will also conduct monitoring and concurrently train the pine snake scent dog. The initial reintroduction is proposed to occur in 2010.

SUMMARY OF THREATS

The Louisiana pine snake is listed as a candidate species, thereby indicating the Service has sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened. The summary below indicates that significant threats to the Louisiana pine snake continue to support the ranking as a candidate species.

The primary threats to this species stem from extensive historic habitat losses, coupled with the disruption of natural fire regimes, which have reduced the Louisiana pine snake to seven isolated populations. Several of these remnant populations may be vulnerable to factors associated with low population sizes and demographic isolation. The historic and ongoing loss of potential habitat (via fire suppression, conversion to pine plantations, increases in the number and width of roads, and urbanization) on private lands in the matrix between these extant populations reduces the potential for dispersal among remnant populations and the potential for natural re-colonization of vacant habitat patches. Because it is unlikely that corridors linking extant populations will be established, the loss of any extant population is likely to be permanent. Louisiana pine snake populations on federal lands have received increased management attention (via prescribed burning and thinning) in recent years, and as a result the successional degradation of occupied and potential habitat within these populations has been stabilized or reversed. Nonetheless, not all areas of occupied habitat on federal lands have received recent prescribed burning, and in the absence of adequate burning Louisiana pine snake habitat becomes degraded via vegetative succession. The largest and perhaps most important extant Louisiana pine snake population exists on private industrial timberlands. Although two conservation areas are managed to benefit Louisiana pine snakes on this property, the majority of the occupied habitat between the conservation areas is threatened by land management activities (habitat conversion to short-rotation pine plantations) that are expected to decrease habitat quality.

Additional threats which may occur even within quality Louisiana pine snake habitat include: (1) road mortality; (2) off road mortality due to all terrain vehicle use; (3) collection for the pet trade; (4) intentional killing (the public's general dislike for snakes, which also contributes to 1 and 2 above); (5) the loss of demographic viability and increased susceptibility to stochastic environmental factors resulting from small isolated populations; and (6) genetic isolation and susceptibility to genetic drift and inbreeding depression resulting from small isolated populations. Finally, with a mean clutch size of 4 eggs, the Louisiana pine snake has an

extremely low reproductive rate, thereby magnifying the effects of the above listed threats. We find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

RECOMMENDED CONSERVATION MEASURES

Conservation Recommendations

- Enhance existing and/or establish longleaf pine forests within occupied and potential Louisiana pine snake habitat;
- Within occupied and potential Louisiana pine snake habitat, reduce and or remove midstory component within pine forest stands to a level that allows maintenance by fire;
- Within occupied and potential Louisiana pine snake habitat, implement a prescribed fire program (typical 3 to 5 year intervals once the forest is in a management condition) to reduce the midstory forest component and maintain the herbaceous layer;
- Within occupied and potential Louisiana pine snake habitat, thin timber to allow insolation to the ground layer thereby enhancing the herbaceous layer and pocket gopher habitat;
- Within occupied and potential Louisiana pine snake habitat, manage timber primarily for ecological restoration or on longer rotations and for higher end products such as saw timber and poles;
- Within occupied and potential Louisiana pine snake habitat, limit off-road vehicular use;
- Provide conservation education to the general public, and to managers and recreational users to avoid killing or otherwise impacting snakes in the wild;
- Educate collectors and other members of the public on the rarity of the Louisiana pine snake and the need to refrain from removing the species from the wild.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
	Non-imminent	Subspecies/population	3
		Monotypic genus	4
		Species	5*
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9

	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:

The Louisiana pine snake has been reduced to seven extant populations; all of these populations have been impacted by habitat loss and all require active habitat management. Most of the loss of Louisiana pine snake habitat occurred historically and much of the habitat that remains has been degraded for reasons discussed previously. On public lands (53% of the potential current range) Louisiana pine snake habitat is receiving increased management emphasis. Much of this land area is now being managed on longer rotations (i.e., 70+ years) where silvicultural prescriptions include midstory removal, thinning and prescribed fire. This type of silviculture is well-suited to maintaining and/or enhancing Louisiana pine snake habitat. All extant populations are currently isolated and fragmented by the historic and ongoing loss of potential habitat (via fire suppression, conversion to pine plantations, increases in the number and width of roads, and urbanization) that has occurred on the private lands between the seven remnant populations. The loss of potential habitat in the intervening areas reduces the potential for dispersal among remnant populations and the potential for natural re-colonization of vacant habitat patches. Several of the remnant populations may be vulnerable to decreased demographic viability or other factors associated with low population sizes and demographic isolation. In addition, a large portion of potentially occupied habitat for one extant Louisiana pine snake population is threatened by activities (habitat conversion to short-rotation pine plantations) that are expected to decrease habitat quality.

The potential threats to a large percentage of extant Louisiana pine snake populations leads us to conclude that the magnitude of the threats to this species remain high.

Imminence:

The loss in quantity and quality of longleaf pine habitat is the most significant historical threat to the Louisiana pine snake. Several localized threats continue to impact extant Louisiana pine snake populations and their habitat. As noted above, many current silvicultural practices on private lands degrade habitat quantity and quality for the Louisiana pine snake. However, voluntary management on private lands is maintaining and improving habitat conditions within portions of occupied habitat for two extant Louisiana pine snake populations. Management by signatories of the CCA is currently stabilizing and improving the quality of habitat for Louisiana pine snake populations on federal lands.

Based on the assessment of the status of the seven extant populations, three populations appear to be large enough (based on trap success and occurrence data as indices to abundance) and to occur on sufficient amounts of appropriately-managed habitat as to be considered stable. The four other populations have uncertain statuses: two because of uncertainty regarding their population sizes, one because of apparently low population sizes and apparently low amounts of suitable habitat, and one because of potential threats resulting from activities (habitat conversion to short-rotation pine plantations) that are expected to decrease habitat quality. Three extant Louisiana pine snake populations appear to be both small and isolated. These populations are therefore vulnerable to the loss of demographic viability and to increased susceptibility to stochastic environmental factors (e.g., weather events, disease). Although these remnant Louisiana pine snake populations are intrinsically vulnerable and thus threatened by these

factors, it is not known if they are presently actually facing these threats. To the extent that conversion to pine plantation degrades habitat quality, the Bienville population is likely experiencing ongoing habitat degradation in the lands outside of the Core Management Areas. The condition of occupied or potentially occupied habitat in the other six extant populations appears to be stable or improving due to active management.

Based on the above facts, we conclude that threats to the Louisiana pine snake population as a whole are non-imminent.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No, most of the longleaf pine habitat of the Louisiana pine snake has been destroyed for decades and much of the remaining habitat has been degraded. Louisiana pine snake habitat loss is, however, continuing at a slower rate than in the past, and is being stabilized or reduced on federal lands. Voluntary, proactive management actions to restore degraded habitat, reduce threats, and maintain Louisiana pine snake populations are being conducted on public lands in accordance with the ongoing 2003 CCA and private landowners have successfully competed for Private Stewardship Grants to directly address Louisiana pine snake conservation on private lands. Private landowners are also demonstrating interest in the CCA through their presence and involvement at annual meetings in 2003 – 2009.

We do not believe that emergency listing is warranted at this time.

DESCRIPTION OF MONITORING

Trapping surveys for the Louisiana pine snake continue to occur within limited sections of occupied habitat for most (6 out of 7) extant Louisiana pine snake populations. Results of those surveys are discussed at annual Louisiana pine snake meetings.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: Louisiana

Indicate which State(s) did not provide any information or comments: TX

The Louisiana pine snake is included as a species of concern in the Wildlife Action Plans for both Louisiana and Texas.

LITERATURE CITED

Bailey, M.A., J.N. Holmes, K.A. Buhlmann, and J.C. Mitchell. 2006. Habitat Management Guidelines for Amphibians and Reptiles of the Southeastern United States. Partners in Amphibian and Reptile Conservation Technical Publication HMG-2, Montgomery,

- Alabama. 88p.
- Bonnet, X., G. Naulleau, and R. Shine. 1999. The dangers of leaving home: dispersal and mortality in snakes. *Biological Conservation* 89:39-50.
- Bridges, E.L. and S.L. Orzell. 1989. Longleaf pine communities of the West Gulf coastal Plain. *Natural Areas Journal* 9:246-253.
- Boundy, J. 2008. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA, e-mail. March 13, 2008.
- Candidate Conservation Agreement (CCA) for the Louisiana pine snake (*Pituophis ruthveni*). 2003. 33 p. <<http://www.fws.gov/southeast/news/2004/pinesnake/LA-pinesnake-agreement.doc>>. Accessed 23 April 2008.
- Collins, J.T. and T.W. Taggart. 2002. Standard common name and current scientific names for for North American amphibians, turtles, reptiles, and crocodylians. Fifth Edition. Publication of the Center for North American Herpetology, Lawrence, KS. iv + 44pp.
- Conant, R. and J.T. Collins. 1991. A field guide to reptiles and amphibians of eastern and central North America, third edition. Houghton Mifflin Company, Boston, MA. 450 pp.
- Crother, B.I. (editor) 2000. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. SSAR Herpetological Circular 29, Shoreview, MN. 82 pp.
- Department of the Army. 2008. Joint Readiness Training Center (JRTC) and Fort Polk (FP) Regulation 210-18. Headquarters, Joint Readiness Training Center and Fort Polk. 15 p.
- Ealy, M.J., R.R. Fleet, and D.C. Rudolph. 2004. Diel activity patterns of the Louisiana pine snake *Pituophis ruthveni* in eastern Texas. *Texas Journal of Science* 56:383-394.
- Frost, C.C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. Pgs. 17-43 In: S.M. Hermann (ed.). Proceedings of the Tall Timbers Fire Ecology Conference, No. 18, The longleaf pine ecosystem: ecology, restoration and management. Tall Timbers Research Station, Tallahassee, FL.
- Gregory, B. 2008a. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA, e-mail. March 14, 2008.
- Gregory, B. 2008b. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA, e-mail. March 10, 2008.
- Himes, J.G. 2000. Burrowing ecology of the rare and elusive Louisiana pine snake, *Pituophis ruthveni* (Serpentes: Colubridae). *Amphibia-Reptilia* 22:91-101.

- Himes, J.G., L.H. Hardy, D.C. Rudolph, and S.J. Burgdorf. 2002. Growth rates and mortality of the Louisiana pine snake. *Journal of Herpetology* 36:683-687.
- Himes, J.G., L.H. Hardy, D.C. Rudolph, and S.J. Burgdorf. 2006. Movement patterns and habitat selection by native and repatriated Louisiana pine snakes *Pituophis ruthveni*: Implications for conservation. *Herpetological Natural History* 9:103-116.
- Hunter, W.C., D.A. Buehler, R.A. Canterbury, J.L. Confer, and P.B. Hamel. 2001. Conservation of disturbance-dependent birds in eastern North America. *Wildlife Society Bulletin* 29:440-455.
- Pierce, J. 2008. U.S. Forest Service, Nacogdoches, TX, e-mail. March 8, 2008.
- Pierce, J. 2009. U.S. Forest Service, Nacogdoches, TX, e-mail. March 9, 2009.
- Reichling, S.B. 1990. Reproductive traits of the Louisiana pine snake *Pituophis melanoleucus ruthveni* (Serpentes: Colubridae). *The Southwestern Naturalist* 35:221-222.
- Reichling, S.B. 1995. The taxonomic status of the Louisiana pine snake (*Pituophis melanoleucus ruthveni*) and its relevance to the evolutionary species concept. *Journal of Herpetology* 29:186-198.
- Reichling, S.B. 2008. Louisiana pine snake species survival plan. Unpublished report submitted to the U.S. Fish and Wildlife Service, Lafayette, LA. 15 pp. + tables and appendices.
- Reichling, S.B., D.C. Rudolph, D. Ferri, and C. Baker. 2008. Relative abundances of snakes in Louisiana industrial forest, with special emphasis on *Pituophis ruthveni*. Unpublished report submitted to the U.S. Fish and Wildlife Service, Lafayette, LA. 11 pp. + tables.
- Reichling, S. 2008. Memphis Zoo, Memphis, TN, e-mail. March 14, 2008.
- Rodriguez-Robles, J.A., and Jesus-Escobar, J.M. 2000. Molecular systematics of new world gopher, bull, and pinesnakes (*Pituophis*: Colubridae), a transcontinental species complex. *Molecular Phylogenetics and Evolution* 14:35-50.
- Rudolph, C. 1999. U.S. Forest Service, Nacogdoches, TX, meeting record. May 6, 1999.
- Rudolph, D.C. 2000. Habitat quality at historical Louisiana pine snake localities. Unpublished report submitted to U.S. Fish and Wildlife Service, Jackson, MS. 11 pp. + tables and appendices.
- Rudolph, C. 2008a. U.S. Forest Service, Nacogdoches, TX, e-mail. March 10, 2008.
- Rudolph, C. 2008b. U.S. Forest Service, Nacogdoches, TX, telephone conversation. March 10, 2008.

- Rudolph, C. 2008c. U.S. Forest Service, Nacogdoches, TX, e-mail. March 11, 2008.
- Rudolph, D.C., and S.J. Burgdorf. 1997. Timber rattlesnakes and Louisiana pine snakes of the west gulf coastal plain: Hypotheses of decline. *Texas Journal of Science* 49:111-122.
- Rudolph, D.C., S.J. Burgdorf, R.N. Conner, and R.R. Schaefer. 1999. Preliminary evaluation of the impact of roads and associated vehicular traffic on snake populations in eastern Texas. Pages 129-136 in G.L. Evink, P. Garrett and D. Zeigler (eds.), *Proceedings of the Third International Conference on Wildlife Ecology and Transportation*, FL-ER-73-99, Missoula, Montana.
- Rudolph, D.C., S.J. Burgdorf, R.N. Conner, C.S. Collins, D. Saenz, R.R. Schaefer, T. Trees, C.M. Duran, M. Ealy, J.G. Himes. 2002. Prey Handling and Diet of Louisiana Pine Snakes (*Pituophis ruthveni*) and Black Pine Snakes (*P. Melanoleucus lodingi*), with Comparisons to other Selected Columbrid Snakes. *Herpetological Natural History* 9(1), 2002:57-62.
- Rudolph, D.C., S.J. Burgdorf, and R.R. Schaefer, R.N. Conner, and R.W. Maxey. 2006. Status of *Pituophis ruthveni* (Louisiana pine snake). *Southeastern Naturalist* 5:463-472.
- Rudolph, D.C., S.J. Burgdorf, J.C. Tull, M. Ealy, R.N. Conner, R.R. Schaefer, R.R. Fleet. 1998. Avoidance of fire by Louisiana pine snakes, *Pituophis melanoleucus ruthveni*. *Herpetological Review* 29:146-148.
- Shively, S. 1999. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA, telephone message. March 16, 1999.
- Smith, T. 2008. TimberSTAR SW, LA, telephone conversation. March 7, 2008.
- Stull, O.G. 1929. The description of a new subspecies of *Pituophis melanoleucus* from Louisiana. *Occasional Papers of Museum of Zoology, University of Michigan* 205:1-3.
- U.S.D.A. Forest Service Manual (FSM) 2600 – Fish, Wildlife, and Sensitive Plant Habitat Management. 2002. <<http://www.fs.fed.us/r6/sfpnw/issssp/documents/ag-policy/20021200-fs-sensitive-species-key-policies.pdf>>. Accessed 23 April 2008.
- U.S. Fish and Wildlife Service (USFWS). 2007. Species assessment and listing priority assignment form for the black pine snake *Pituophis melanoleucus lodingi*. 13 pp.
- Vandeventer, T.L. and R.A. Young. 1989. Rarities of the longleaf: the black and Louisiana pine snakes. *Vivarium* 1:32-36.
- Wagner, R.O., D. Hightower, B. Thatcher, and D/C Rudolph. 2009. Using expert opinion to assess threats to Louisiana pine snake (*Pituophis ruthveni*) populations. Unpublished report submitted to the U.S. Fish and Wildlife Service, Lafayette, LA. 18 pp.
- Webb, J.K., B.W. Brook, and R. Shine. 2002. What makes a species vulnerable to extinction?

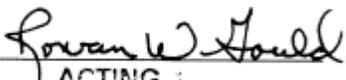
Comparative life-history traits of two sympatric snakes. *Ecological Research* 17:59-67.

Williams, A.A. and J.E. Cordes. 1996. *Pituophis ruthveni* (Louisiana pine snake).
Herpetological Review 27:35.

Young, R.A. and T.L. Vandeventer. 1988. Recent observations on the Louisiana pine snake,
Pituophis melanoleucus ruthveni (Stull). *Bulletin of the Chicago Herpetological Society*
23:203-207.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  June 15, 2010
for Regional Director, Fish and Wildlife Service Date

Concur:  October 22,
ACTING Director, Fish and Wildlife Service Date: 2010

Do Not Concur: _____
Director, Fish and Wildlife Service Date _____

Director's Remarks:

Date of annual review:

Conducted by: Lafayette, Louisiana Field Office, 2010