Status of *Pituophis ruthveni* (Louisiana Pine Snake)

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Abstract - Extensive trapping surveys across the historical range of *Pituophis ruthveni* (Louisiana Pine Snake) suggest that extant populations are extremely small and limited to remnant patches of suitable habitat in a highly fragmented landscape. Evaluation of habitat at all known historical localities of *P. ruthveni* documents the widespread degradation of the fire-maintained pine ecosystem throughout the historical range of the species. The primary factors leading to degradation of *P. ruthveni* habitat are intensive pine silviculture and alteration of the pre-European fire regime. Habitat restoration on public lands is feasible and could potentially restore populations of this critically rare species.

Introduction

Pituophis ruthveni Stull (Louisiana Pine Snake) has long been considered one of the rarest snakes in the United States (Conant 1956, Young and Vandeventer 1988). *Pituophis ruthveni* is restricted to eastern Texas and west-central Louisiana, a range that coincides with that of *Pinus palustris* Mill. (longleaf pine) on the west Gulf Coastal Plain (Conant 1956, Reichling 1995, Thomas et al. 1976). Prior to recent fieldwork, fewer than 60 records of *P. ruthveni* were represented in the literature or museum collections.

Until recently, very little was known concerning the ecology of *P. ruthveni*. Available information consisted primarily of distribution and habitat data based on collection records (Conant 1956, Thomas et al. 1976, Young and Vandeventer 1988) and reproductive biology in captivity (Reichling 1990). This paucity of information stimulated recent investigations into the ecology of *P. ruthveni* (Himes et al. 2002, 2006a, 2006b; Rudolph and Burgdorf 1997; Rudolph et al. 1998, 2002). This work suggests that alteration of the fire regime has led to habitat alteration resulting in declines of *Geomys breviceps* Baird (Baird's pocket gopher), a primary prey of *P. ruthveni* (Rudolph et al. 2002). These changes are thought to have led to population declines of *P. ruthveni*.

The limited range of *P. ruthveni*, combined with its apparent rarity, have led to recent concerns about the conservation status of the species (Reichling 1990, 1995; Young and Vandeventer 1988). Recent authors have suggested that range restrictions and population declines have been substantial

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(Reichling 1995, Young and Vandeventer 1988). Past and ongoing habitat alterations—due to loss of forest habitat, intensive silviculture, and alteration of fire regimes—have been severe throughout the range of the species, further heightening concern about the status of *P. ruthveni* (Reichling 1995, Rudolph and Burgdorf 1997, Rudolph et al. 1998). Vehicle-related mortality (Himes et al. 2002) and commercial collection are also causes of concern. In response to these developments, the US Fish and Wildlife Service has recently initiated an evaluation of the status of the species.

During the course of our investigations of the ecology of *P. ruthveni*, we have conducted extensive trapping for the species throughout its historical range, visited all known localities, and obtained data on habitat, diet, and behavior (Himes et al. 2002, 2006a,b; Rudolph and Burgdorf 1997; Rudolph et al. 1998, 2002). A substantial number of recent distributional records resulted from this field work, and it is appropriate to assess the current status and distribution of *P. ruthveni*.

Methods

Beginning in March 1993, traps were installed in Texas and Louisiana within the general limits of the historical range of *P. ruthveni*. Trap sites were initially chosen based on recent records and suitability of habitat to maximize the probability of capturing individuals. Subsequent sites were chosen from localities within the historical range of the species representing a range of habitat conditions.

Traps consisted of treated plywood tops and bottoms (1.2 x 1.2 m) supported by wooden uprights 0.45 m in height. The sides were screened with hardware cloth (3.2- or 1.5-mm mesh). A hinged door in the top allowed access by investigators. Snakes could enter the traps through 4 funnel entrances constructed of hardware cloth and placed in the midpoint of each side of the trap. Drift fences extended approximately 15 m from each funnel entrance. These were constructed of hardware cloth approximately 60 cm in width and buried approximately 10 cm in the soil. A water source was placed in each trap.

Traps were operational from early March to late October inclusive, the approximate activity period of *P. ruthveni* (D.C. Rudolph, unpubl. data). Captured *P. ruthveni* were brought to the laboratory. Each snake was sexed; snout-vent length, total length, and mass were recorded; and either a PIT tag or radio-transmitter, depending on current research needs, was implanted. Snakes were returned to the point of capture within 2–14 days of implanting procedures.

Habitat was assessed at each trap site. In addition, all historical localities of *P. ruthveni* were visited and their habitat assessed. For purposes of this research, habitats were ranked, on a four-category scale, from excellent to poor based on the following criteria: excellent = forested habitat, well-drained sandy soils predominate, at least 50% herbaceous cover, and pocket gophers widespread and common; good = forested habitat, well-drained sandy soils present, at least 25% herbaceous cover, and pocket gophers present; marginal = forested habitat, well-drained sandy soils present, at

least 10% herbaceous cover, and pocket gophers present (at least along highway and utility rights-of-way); and poor = failure to meet any one of the above minimum criteria. These general criteria were based on information in the literature and obtained during our radio-telemetry studies (Ealy et al. 2004, Himes et al.2002, Rudolph and Burgdorf 1997).

Results

Traps were placed at 14 sites (3–20 traps/site) in 10 counties in Texas and at 9 sites in 5 parishes in Louisiana between 1993 and 2001. A total of 101,828 trap-days were accumulated during this nine-year period, resulting in the capture of 2372 snakes of 23 species. Twenty-six *P. ruthveni* were captured, including two recaptures (Table 1). Overall, trap success was one *P. ruthveni* per 3775 trap days. However, for sites where at least one *P. ruthveni* was captured (n = 6), the success rate was one snake per 733 trap days (range = one

Table 1. Trap results for Louisiana Pine Snakes in Louisiana and Texas (1993–2001).

Location	County/parish	# traps	# trap days	# snakes captured	Mean # days/ capture
Louisiana					
Kepler Lake area	Bienville Parish	3–10	3900	11 (10)	355
Kisatchie NF[A], Winn District	Nachitoches /Winn Par.	18	5664	3	1888
Kisatchie NF, Kisatchie District	Nachitoches Parish	7	8575	0	-
Kisatchie NF, Vernon District	Vernon Parish	3	260	0	-
Cravens	Vernon Parish	5	2550	0	-
Hoy	Beauregard Parish	5	3675	0	-
Singer	Beauregard Parish	5	3675	0	-
Dido	Vernon Parish	5	735	0	-
Anacoco	Vernon Parish	5	2252	0	-
Texas					
Sabine NF, Foxhunter's Hill	Sabine County	4	5226	6 (5)	871
Sabine NF, Stark Tract	Newton County	5	2425	0	-
Sabine NF, San Augustine Sandhills	San Augustine County	5	1235	0	-
Sabine NF, pineland	San Augustine County	5	2425	0	-
Scrappin' Valley, north	Newton County	4	1260	3	420
Scrappin' Valley, south	Newton County	5	2425	0	-
Little Rocky	Jasper County	5	2208	0	-
Angelina NF, southern portion	Angelina/Jasper Cos.	5-10	3018	3	1006
Angelina NF, western portion[B]	Angelina County	20	22,270	0	-
Mill Creek Ranch	Wood County	5–15	4595	0	-
Roy E. Larsen Sandylands Preserve	Hardin County	5	5875	0	-
Brushy Creek	Trinity County	4	4480	0	-
Gus Engling WMA[A]	Anderson County	10	3640	0	-
Tonkawa	Nacogdoches County	10–15	9460	0	-
Total all areas			101,828	26	733[C]

[A]NF = National Forest, WMA = State Wildlife Management Area.
[B]Four closely associated sites.
[C]Locations with 0 captures deleted.

snake per 355 to 1888 trap days). Eleven of the 23 sites were within 15 km of a historical locality for *P. ruthveni*, and the species was captured at five of these sites. Nine of these eleven sites, including the 5 with *P. ruthveni* captures, had good or excellent habitat. The twelve remaining sites were within the general area of the historical range, but > 15 km from known locality records; *P. ruthveni* was not captured at any of these sites. Eleven of these 12 sites had some good or excellent habitat remaining. Habitat that qualified as good or excellent is currently rare in eastern Texas and west-central Louisiana due to habitat alteration. Most sites with good or excellent habitat remaining are small, typically a few hundred hectares or less, and isolated.

The 137 records of *P. ruthveni* available through 2001 are from 15 counties in Texas and nine parishes in Louisiana (Fig. 1). Since 1990, a total

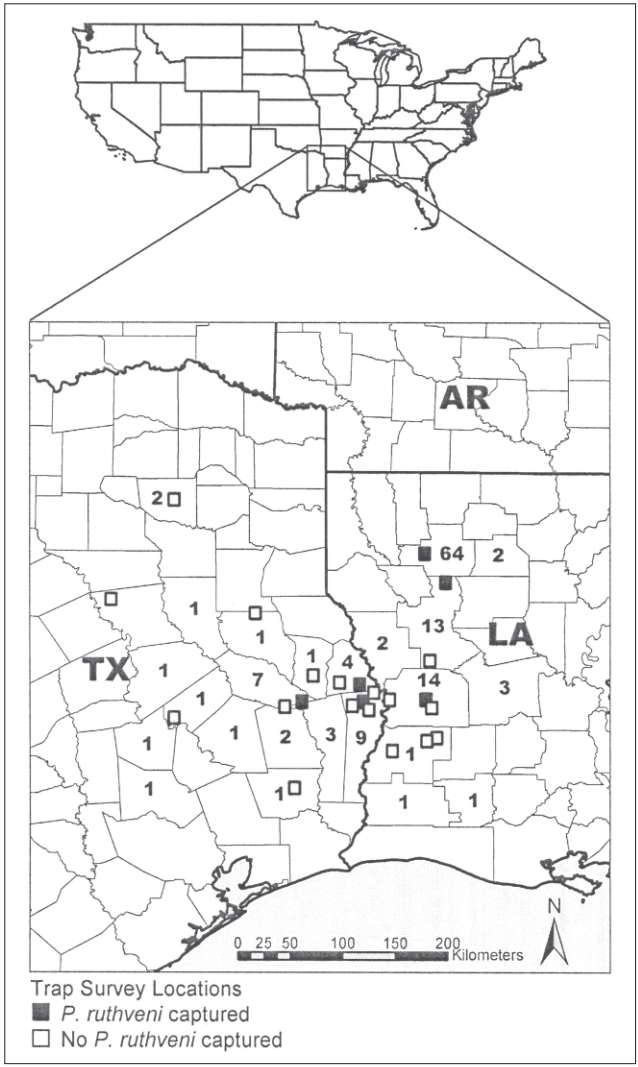

Figure 1. Louisiana Pine Snake records by county and parish, and localities of trapping surveys conducted during this study. Numbers indicate total records of Louisiana Pine Snakes, historical and this study, for each county or parish. Open squares indicate approximate location of trapping localities where pine snakes were not captured; solid squares indicate approximate location of trapping localities where snakes were captured or known to occur since 1990.

of 37 records of *P. ruthveni* are available. All but two of these records are from six limited areas in four counties (Angelina, Jasper, Newton, Sabine) in Texas and four parishes (Bienville, Natchitoches, Vernon, Winn) in Louisiana (Fig. 2). The two additional records are single individuals from Tyler and Montgomery Counties in Texas.

The recent habitat conditions (1999–2000) at all known *P. ruthveni* localities in Texas and Louisiana is summarized in Table 2. A total of 118 localities

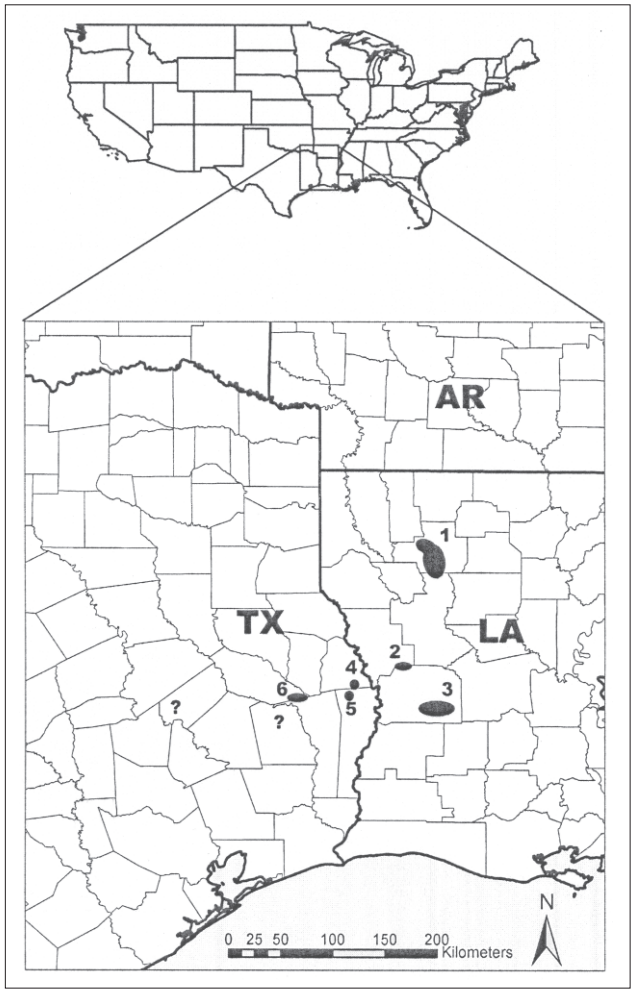

Figure 2. Approximate location (black) of extant populations of Louisiana Pine Snakes (multiple records since 1990). Numbers represent Bienville Parish and a portion of Natchtoches Parish (1), Peason Ridge Military Reservation (2), Fort Polk Military Reseservation (3), southern portion of Sabine National Forest (4), Scrappin' Valley (5), and southern portion of Angelina National Forest (6). Question marks indicate single records in areas lacking significant amounts of suitable habitat.

Table 2. Habitat quality assessments of historical Louisiana Pine Snake localities on public and private lands in eastern Texas and eastern Louisiana. Entries are numbers of localities, followed by the percentages of localities in parentheses, for all known records.

Ownership	Excellent	Good	Marginal	Poor
Public	16 (43)	10 (27)	3 (8)	8 (22)
Private	14 (17)	13 (16)	16 (20)	38 (47)
Total	30 (25)	23 (19)	19 (16)	46 (39)

were evaluated, and 53 (45%) of the localities retain some habitat in excellent or good condition. On public lands, 26 of 37 localities (70%) fall into the excellent or good categories, and on privately owned lands, only 27 of 81 (33%) of the localities retain some habitat in excellent or good condition.

Discussion

Pituophis ruthveni has always been considered rare (Conant 1956, Stull 1940). Recent studies have expressed concern about the current status of the species (Reichling 1990, 1995; Young and Vandeventer 1988). The results of our trapping surveys and our assessment of habitat condition at all known *P. ruthveni* localities support the concern that *P. ruthveni* may have declined in geographic distribution and possibly in local abundance. Detailed locality information is not provided due to the intense collecting effort to supply the commercial pet trade, especially in Louisiana.

Trap success was low at all sites where *P. ruthveni* is known to occur. We are, however, confident that our traps were effective in capturing snakes. Large numbers of snakes were captured, including all of the larger species regularly occurring in upland habitats in the region. Although our trap surveys were not designed to provide estimates of population size, low capture rates, occasional recaptures (n = 2), and limited habitat suggest that the currently existing populations are not large. How the current population densities compare to those prior to extensive habitat alteration is unknown.

Currently, *P. ruthveni* populations are known to exist, based on multiple records since 1990, in six general areas. In Texas, populations exist on the southern portion of the Angelina National Forest in Angelina and Jasper Counties, on the southern portion of the Sabine National Forest in Sabine County, and on private land immediately south of the Sabine National Forest in Newton County. In Louisiana, *P. ruthveni* populations currently exist on Fort Polk Military Reservation and the adjacent unit of the Kisatchie National Forest in Vernon Parish, and on Peason Ridge Military Reservation in Vernon and Natchitoches Parishes. Another population exists in an extensive area on primarily private lands, mostly industrial timber lands, in Bienville and extreme northern Natchitoches Parishes.

Much of the remaining suitable habitat in Bienville Parish is currently undergoing a major increase in the intensity of the silvicultural management of pine plantations, and the future of this population is unclear. In Sabine and Newton Counties in Texas, currently occupied habitat is limited to a few hundred hectares. Only three areas—Fort Polk Military Reservation and the adjacent unit of the Kisatchie National Forest, Peason Ridge Military Reservation in Louisiana, and the southern portion of the Angelina National Forest in Texas—have extensive areas of suitable, frequently burned longleaf pine habitat remaining that is not currently subject to extensive change in management intensity.

Our extensive trapping and collecting at 17 additional sites since 1993 failed to document the existence of other extant populations. Most of these sites are at or near historical *P. ruthveni* localities. We suggest that the

combined effects of habitat alteration and fragmentation have eliminated *P. ruthveni* from significant portions of its historical range. However, the single individuals recorded from Tyler and Montgomery Counties in Texas during the 1990s suggest that remnant populations may still persist in these fragmented and degraded habitats. In addition, substantial amounts of suitable habitat still exist on the Kisatchie District of the Kisatchie National Forest in southern Natchitoches Parish, LA. Historical records are known from the Kisatchie District and our trapping in this area did not, in retrospect, sample the best remaining habitat. This area probably has the highest potential for finding additional extant populations of *P. ruthveni*, and we recommend that surveys be conducted in this area.

Pituophis ruthveni is closely associated with longleaf pine growing on sandy, well-drained soils (Conant 1956, Himes et al. 2006b, Reichling 1995, Young and Vandeventer 1988). The once extensive longleaf pine ecosystem of the southeastern United States is one of the most threatened ecosystems in the United States (Bridges and Orzell 1989, Conner et al. 2001, Frost 1993). Less than 5% of the original extent of the longleaf pine ecosystem survives, and much that remains is extensively altered by changes in fire regimes, silviculture, and land use (Frost 1993). *Pituophis ruthveni* is also closely associated with a well-developed herbaceous ground cover of grasses and forbs, and with *Geomys breviceps* that are dependent on herbaceous vegetation (Ealy et al. 2004, Himes et al. 2006b, Rudolph and Burgdorf 1997, Rudolph et al. 2002). *Pituophis ruthveni* prey heavily on pocket gophers, and use pocket gopher burrow systems for subsurface retreats, including hibernacula and escape from fire (Rudolph and Burgdorf 1997; Rudolph et al. 1998, 2002; Young and Vandeventer 1988).

Most of the longleaf pine ecosystem that occurred on the West Gulf Coastal Plain has been converted to other land uses including urbanization, agriculture, and intensive silviculture. These land uses appear to be incompatible with the survival of *P. ruthveni* populations. The less intensive silvicultural practices of the past, specifically longer rotations and use of prescribed fire, were apparently more compatible with the existence of *P. ruthveni* populations. However, the development and increasing implementation of more intensive silvicultural practices is eliminating much of the remaining suitable habitat on private lands. These practices include clearcutting, intensive mechanical site preparation, planting of pine species other than longleaf, short rotations, fertilization, and use of herbicides instead of prescribed fire for control of competition. The substitution of herbicides for prescribed fire likely has an important impact on *P. ruthveni*. Silvicultural managers use herbicides to control herbaceous as well as woody vegetation, both of which compete with the pine crop. The absence of fire allows the continuous buildup of a thick duff layer further suppressing the herbaceous layer. The ultimate result is a highly altered forest with a minimal herbaceous component, conditions apparently unsuitable for pocket gophers or *P. ruthveni* (Reichling 1995, Rudolph and Burgdorf 1997).

The known existing populations of *P. ruthveni* are concentrated on public lands (national forests and military installations) and private lands

managed for a diversity of wildlife values. Compared to most private lands, management of public lands tends to include less intensive site preparation, longer timber rotations, retention of longleaf pine, and use of prescribed fire both for control of competing vegetation and management of a fire-maintained ecosystem. However, even on public lands, the current fire regime on most sites is insufficient to maintain a sparse midstory and diverse herbaceous understory (Conner and Rudolph 1989). Consequently, most pine habitat has a well-developed hardwood midstory and only a sparse herbaceous component due to competition from woody species in the mid- and understory. Recent records of *P. ruthveni* are primarily from the isolated patches of habitat where the influence of fire has been most effective in maintaining well-developed herbaceous understory conditions.

The situation on most private lands is different. Industrial forest lands and significant portions of smaller private ownerships are intensively managed for fiber production. The practices used, especially the short rotations and substitution of herbicides for prescribed fire, preclude the existence of a well-developed herbaceous community. These lands, based on recent records and trapping surveys, do not support viable populations of *P. ruthveni*.

Populations of *P. ruthveni* are also subject to impact by the increasing density of roads and associated vehicular traffic, including off-road vehicles. Although the absolute numbers were small, 20% (3 of 15) of mortalities of radio-tracked *P. ruthveni* were caused by vehicles (Himes et al. 2002). In addition, research conducted in association with surveys for *P. ruthveni* suggests that populations of large snake species may be reduced by 50% within 500 m of roads with moderate traffic levels (Rudolph et al. 1999). Most existing *P. ruthveni* habitat is within 500 m of currently existing roads.

Pituophis ruthveni is currently rare in the relict patches of fire-maintained pine habitat that remain, primarily on public lands. These areas are reasonably well dispersed throughout the historical range of the species. Intervening habitats that once supported populations of *P. ruthveni* are increasingly altered, primarily by intensive silviculture, and the species is, or may soon be, extirpated. The existing populations on national forests, military installations, and private lands are presumably small and increasingly fragmented due to habitat alteration. The long-term survival of these populations depends on sufficient management to reverse the decline of the fire-maintained pine ecosystem, primarily in the longleaf pine habitats.

Most critical is the restoration of a prescribed-fire regime sufficient to prevent the encroachment of a dense hardwood midstory and recovery of a vigorous herbaceous community. Economic considerations may preclude improvement on private lands, with the limited exception of small areas specifically managed for *P. ruthveni* and other species adapted to fire-maintained pine ecosystems. However, even on public lands, numerous obstacles exist, especially in implementing an adequate prescribed-fire regime. Managers need to resolve issues relating to liability, smoke management, air-quality standards, and agency regulations to effectively use fire as a management tool to support viable populations of *P. ruthveni* and overall biodiversity in the long term. Federal court rulings, in response to lawsuits

filed by environmental groups, limiting the use of prescribed fire on National Forests and Grasslands in Texas, constitute an additional obstacle.

The potential for restoration on public lands is considerably greater than on private lands. Management of national forest lands and military installations within the range of *P. ruthveni* currently include prescribed fire as a management tool. Increased use of prescribed fire is planned, driven primarily by the management needs of *Picoides borealis* (Vieillot) (Red-cockaded Woodpecker), a federally listed endangered species. Habitat management appropriate for *Picoides borealis* is also appropriate for *P. ruthveni*, and numerous additional species adapted to fire-maintained pine ecosystems, many of which are of conservation concern (Bridges and Orzell 1989, Conner et al. 2001).

The current status of *P. ruthveni* is presumed to be a result of habitat alteration due primarily to widespread intensive silviculture and alteration of the pre-European fire regime. Extant populations appear to be extremely small, and inhabit limited patches of suitable habitat that are highly fragmented and isolated. Without improved management of fire-maintained pine habitats, recovery—and possibly even survival—of *P. ruthveni* is unlikely.

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