Recovery Plan
for the
Louisiana Pinesnake *(Pituophis ruthveni)*

Photo courtesy of USFWS

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For:
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This Recovery Plan (Plan) provides guidance and describes recovery criteria for the Louisiana pinesnake. This Plan lists actions necessary to meet those criteria and estimates the time and cost for implementing recovery actions. Brief descriptions of the species status, habitat requirements, and limiting factors are included. Detailed information on these and other topics pertinent to the recovery of the Louisiana pinesnake can be found in the Species Status Assessment (SSA) (Service 2023) and the Recovery Implementation Strategy (RIS). The SSA and RIS are available at https://ecos.fws.gov/ecp/species/4092. The RIS and SSA are finalized separately from the Recovery Plan and will be updated regularly.

Species Status: The Louisiana pinesnake *(Pituophis ruthveni)* was listed as a threatened species under the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) (ESA) on April 6, 2018 (83 FR 14958). The Louisiana pinesnake is known from and associated with a disjunct portion of the historical, longleaf-dominated pine ecosystem in west-central Louisiana and east Texas (Figure 1). The Louisiana pinesnake has a recovery priority number of 8C (48 FR 43098; September 21, 1983), which reflects a moderate degree of threat and high recovery potential. The Louisiana pinesnake is ranked by the Louisiana Department of Wildlife and Fisheries as an S2, G1G2 species (imperiled in the state and critically imperiled globally; NatureServe 2019). The Texas Parks and Wildlife Department ranks the species as S1 and lists it as state threatened.

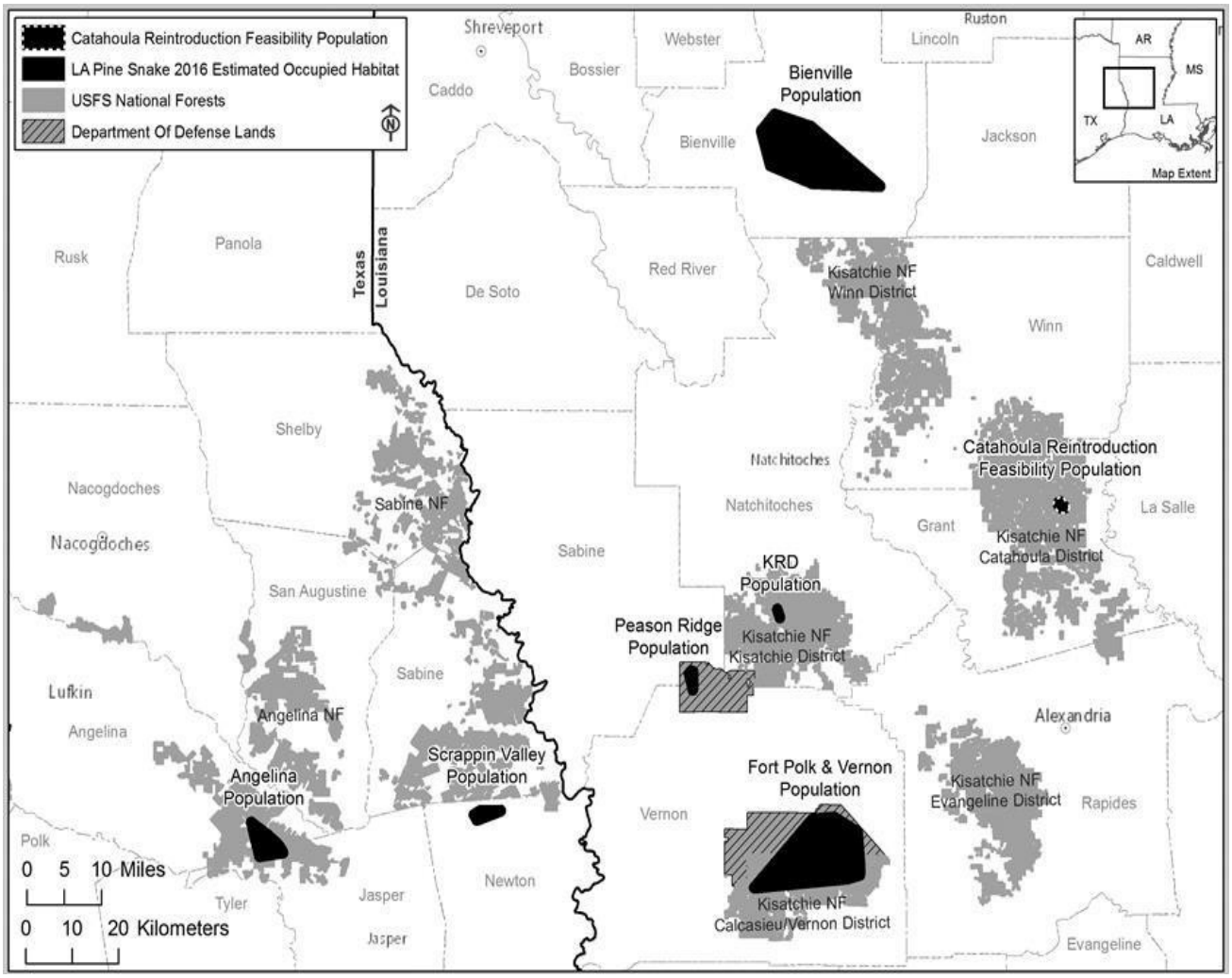

Figure 1. Estimated Occupied Habitat Areas for Louisiana pinesnake, 2016.

Habitat Requirements and Limiting Factors: The Louisiana pinesnake requires well-drained sandy soils with open-canopy forest, nonexistent or sparse midstory, low pine basal area, and an abundant, diverse herbaceous (non-woody) plant community with an adequate amount of forbs (non-grass herbaceous vegetation), which provides forage for the Baird's pocket gopher (*Geomys breviceps*), the primary prey of the Louisiana pinesnake (Rudolph and Burgdorf 1997, p. 117; Himes et al. 2006, pp. 110, 112; Wagner et al. 2017, p. 403). Louisiana pinesnakes and Baird's pocket gophers are known to be highly associated (Ealy et al. 2004, p. 389), and Baird's pocket gopher burrows are the primary refugia for the Louisiana pinesnake.

A main threat limiting the Louisiana pinesnake is loss, degradation, and fragmentation of habitat. The decline in or absence of fire, incompatible silviculture (such as clear cutting or lack of suitable habitat management), and roads have contributed to those impacts to habitat. However,

the Louisiana pinesnake's small population sizes have resulted in increased vulnerability to genetic factors and mortality events. The six remaining naturally occurring and one reintroduced Louisiana pinesnake populations are isolated and small, thus vulnerable to threats of unfavorable age class distribution, increased susceptibility of extirpation from stochastic environmental factors, and the potential loss of valuable genetic resources resulting from genetic isolation with subsequent genetic drift, decreases in heterozygosity, and potentially inbreeding depression (Lacy 1987). Roads have been found to fragment habitat for wildlife (Dodd et al. 2004; Clark et al. 2010), and these small populations may suffer greater impacts from predation and vehicle strike mortality on roads surrounding and traversing the remaining Louisiana pinesnake habitat (Himes et al. 2002; Pierce 2018, unpub. data; Rudolph et al. 1999). Unassisted recovery of a Louisiana pinesnake population by the existing individuals within the already small population is uncertain partly because of the species' low reproductive rate (smallest clutch size of any North American colubrid snake) (Reichling 1990) and reliance on the longevity of those few hatchlings to maintain or increase abundance.

Recovery Strategy: The recovery effort is designed to ensure the long-term survival of the Louisiana pinesnake by controlling or reducing threats to the extent that an adequate number of self-sustaining populations are present across the species' historical range.
To ensure species viability, the Service will engage federal and state partners, landowners, and other stakeholders to conserve, restore, and enhance habitat for the Louisiana pinesnake on private and federal land. The Service will need to fully understand the relationship between increased suitable habitat and increased abundance of the Louisiana pinesnake.

The Service will also assist our partners in monitoring all extant populations and continuing captive propagation and reintroduction efforts at the Kisatchie National Forest Catahoula District (Catahoula) site. Further efforts include augmentation of existing populations, expansion of reintroduction efforts, and potentially translocations in the species' historical range. The Service also intends to support efforts to increase the genetic resiliency of the captive breeding population, and to expand detection, monitoring, and research programs.

The Service will support efforts to conserve, restore and enhance suitable habitat through prescribed burning, thinning, woody vegetation control to enhance forbs and grasses, and reforestation of native habitats. This will be accomplished through conservation agreements (e.g., Candidate Conservation Agreements with Assurances [CCAA], Partners for Fish and Wildlife, Working Lands for Wildlife Program [WLFW]) and others under development (i.e., Safe Harbor Agreement [SHA]), to promote voluntary conservation efforts for protection of the species and its habitat. Reintroduction is already being used for recovery of the Louisiana pinesnake and will continue to be a major part of our recovery strategy. Reintroductions to establish populations have been successfully used for other reptiles (Soorae 2018; Roe et. al. 2015). The reintroduction feasibility project has shown so far that captive-bred Louisiana pinesnakes, introduced into an unoccupied area within their historical range, can survive for at least 9 years on suitable habitat without supplementary aid, and produce offspring. With more information on requirements to achieve a self-sustaining reintroduced population, we will expand reintroductions, augmentations, and

translocations as appropriate to suitable habitat in the historically occupied range. The precise number of Louisiana pinesnakes needed for a self-sustaining population is not known, and additional data and decisions about model assumptions will be required to generate a minimum viable population size and more precise viability prediction for Louisiana pinesnake populations.

Louisiana pinesnake recovery will require an increased understanding of the status of the species throughout its range; developing more information on life history (especially nesting), ecology, mortality, and habitat requirements; improving our understanding of some poorly understood threat factors potentially affecting the species, such as vehicle strikes and predation (natural and potentially introduced predators); and using that information to implement management actions to promote recovery.

Recovery efforts will focus on areas with the greatest potential to achieve the species' recovery. The existing Estimated Occupied Habitat Areas (EOHA) will be considered initially for recovery population sites. EOHAs are areas with multiple Louisiana pinesnake occurrence records meeting specific criteria (83 FR 14958; April 6, 2018). However, EOHAs will be evaluated to determine if maintaining or creating a viable population at that site is untenable (site with limited existing or potentially suitable habitat or management restrictions). Critical habitat, when designated, will also help guide choices for recovery population locations.

Delisting Criteria:

Recovery plans are not regulatory documents; instead, they are intended to establish goals for the conservation of listed species and define objective, measurable criteria that are designed to indicate when the threats facing a species have been removed or reduced to such an extent that the species may no longer need the protections of the Act. There are many paths to accomplishing recovery of a species, and recovery may be achieved without all criteria being fully met. Recovery of a species is a dynamic process requiring adaptive management that may, or may not, fully follow the guidance provided in a recovery plan.

(1) Six populations of Louisiana pinesnakes throughout its range, which could include the reintroduction population at the Catahoula site, and any other populations formed by introduction of captive-bred snakes, exist across the species' known historical range with no or low incidence of disease, self-sustaining through natural recruitment (i.e., no need for introduction of additional captive-reared snakes), genetically diverse, and have a resiliency score of "Good" as defined in the SSA (addresses Factors C and E);

(2) Habitat quality and quantity on the population sites from Criterion 1, located throughout the species' range, is sufficient to support the long-term survival of Louisiana pinesnake in its natural environment (i.e., Habitat Quality and Connectivity ranks as "Good" or better for many sites, and the majority of EOHAs rank as "Large" as defined in the SSA) (addresses Factors A and E).

Justification for Recovery Criteria

As described in section 4(a)(1) of the Act, the Service may list a species based on any of the following five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; (E) other natural or human-made factors affecting its continued existence. The proposed recovery criteria reflect the best available information on the Louisiana pinesnake. They address the five factors in the Act, including those identified in the final listing rule for the Louisiana pinesnake (83 FR 14958).

The SSA (Service 2023) and listing rule (83 FR 14958) emphasized that the Louisiana pinesnake is threatened because of habitat loss but possibly even more so because of its small, isolated, genetically compromised populations. LPS were known to exist in seven populations. Six of these are natural populations, and the seventh was an introduced population founded from individuals produced from the captive propagation program (Catahoula site). Based on trapping success and occurrence records as of the 2023 5-year review, 3 of the 6 naturally occurring populations are possible extirpated. Because we don't know with certainty why some populations don't seem to increase in abundance even with good habitat management, redundancy is especially important. Regarding adaptive capacity, spreading populations over the range is beneficial because there may be ecological niches of which we may not be aware. We will be adding more genetic diversity to the wild populations through reintroductions and augmentations, giving the species additional material to work with in adapting to potentially diverse environmental situations. The reintroduction population was also considered stable at that time, but possibly only because it was being enriched with captive-bred snakes on a regular basis. To recover the species, multiple populations with proven stability without artificial enrichment are necessary.

Actions Needed:

Recovery actions identified in the table below are those that, based on the best available science, we believe are necessary to accomplish the recovery of the Louisiana pinesnake. We have included a priority number and estimated cost to complete each action.

	Recovery Action	**Estimated Cost**	**Priority ***
1	Protect and manage Louisiana pinesnake habitat on public and private land in the following priority if possible: (1) currently occupied or designated critical habitat, (2) strategically located near existing populations and currently suitable but unoccupied, (3) strategically located near existing populations and currently unsuitable, but potentially suitable if beneficial management applied	$6M	1

2	Support and expand a genetically diverse captive population which should include ongoing genetic contributions from wild individuals and be large enough to supply enough individuals for reintroduction to create new populations, and augment populations for the Louisiana pinesnake according to the USFWS Controlled Propagation and Reintroduction Plan	$2.45M	1
3	Conduct or fund research to aid recovery efforts for the Louisiana pinesnake and apply adaptive management where appropriate	$510K	2
4	Continue, refine, and expand a monitoring (presence, abundance, condition, health, etc.) protocol for the Louisiana pinesnake and its habitat	$1.56M	2
5	Expand public outreach and education efforts for youth, hunters, and outdoors enthusiasts about the importance of Louisiana pinesnake conservation and the partnerships involved with recovery	$1,500	3
6	Identify potential interpopulation habitat corridor locations and secure agreements to protect and restore suitable habitat in those areas	$5,000	3
	Total Estimated Cost	$10.83M	

* Recovery actions are assigned numerical priorities to highlight the relative contribution they may make toward species recovery (48 FR 43098):

Priority 1: an action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species.

	Action						
Years	**1 Habitat**	**2 Reintroduction**	**3 Research**	**4 Monitoring**	**5 Outreach**	**6 Corridor**	**Cost/Year**
1-5	500K	250K	100K	300K	1,500	0	**1.15M**
6-10	500K	250K	100K	300K	0	5,000	**1.15M**
11-15	500K	250K	100K	100K	0	0	**950K**
16-20	500K	250K	100K	100K	0	0	**950K**
21-25	500K	250K	20K	100K	0	0	**870K**
26-30	500K	250K	10K	100K	0	0	**860K**
31-35	500K	250K	20K	100K	0	0	**870K**
36-40	500K	250K	10K	100K	0	0	**860K**
41-45	500K	250K	20K	100K	0	0	**870K**
46-50	500K	100K	10K	100K	0	0	**860K**
51-55	500K	100K	20K	100K	0	0	**870K**
56-57	500K	0	0	60K	0	0	**560K**
Cost/Action	**6M**	**2.45M**	**510K**	**1.56M**	**1,500**	**5,000**	**Total Program Cost**
							10.83M

Estimated Cost of Delisting: The estimated costs associated with implementing recovery actions for delisting are $10,826,500. Cost estimates reflect costs for specific actions needed to achieve Louisiana pinesnake recovery. Some costs for recovery actions are not determinable at this time; therefore, the total cost for recovery will be higher than this estimate.

Estimated Date of Recovery: The estimated date of recovery is 2075. The management needs and threats for this species are well documented and understood. It was for these reasons that recovery potential was categorized as "high.". However, it will take time to protect and restore habitat to maintain the current populations due to its low reproductive rate and the need to establish new populations. As we learn more about this species and its threats, and recovery

actions are implemented and funded with close cooperation of all partners, we will carefully monitor and assess progress toward recovery to ensure we are on track with our estimated time for delisting.

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