BEFORE THE SECRETARY OF INTERIOR

PETITION TO LIST THE TUCSON SHOVEL-NOSED SNAKE (*CHIONACTIS ANNULATA KLAUBERI*) AS A THREATENED OR ENDANGERED SPECIES UNDER THE ENDANGERED SPECIES ACT

Photo Credit: Erik Enderson

September 24, 2020
CENTER FOR BIOLOGICAL DIVERSITY

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NOTICE OF PETITION

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Dear Secretary Bernhardt,

Pursuant to Section 4(b) of the Endangered Species Act (ESA), 16 U.S.C. § 1533(b); section 553(e) of the Administrative Procedure Act (APA), 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity and Noah Greenwald hereby petition the Secretary of the Interior, through the U.S. Fish and Wildlife Service ("FWS" or "Service"), to protect the Tucson Shovel-nosed Snake (*Chionactus annulata klauberi*) as a threatened or endangered species.

FWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on FWS. Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). FWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." *Id.*

The Center for Biological Diversity ("Center") is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has more than 1.7 million members and online activists throughout the United States. The Center and its members are concerned with the conservation of endangered species and the effective implementation of the Endangered Species Act.

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EXECUTIVE SUMMARY

The Tucson Shovel-nosed Snake (*Chionactus annulata klauberi*) is a small non-venomous snake that is uniquely adapted to "swim" and burrow in sandy soils. It is a habitat specialist that is restricted to portions of just three counties in Arizona: Pima, Pinal and Maricopa Counties. The Snake has already lost an estimated 39 percent of its historic habitat primarily to agriculture and urbanization. It continues to lose habitat to urbanization. The snake is also threatened by agriculture, roads, climate change and disease. Its vulnerability to these threats is further compounded by its limited range and low motility.

In response to a 2004 petition from the Center, FWS determined in 2010 that the snake warranted listing as a threatened or endangered species, finding that based on "the limited geographic distribution of this snake and the fact that its entire range lies within the path of future development," it is likely to become in danger of extinction within the foreseeable future (FWS 2010: 16058). Rather than provide protection, however, FWS found listing of the snake precluded by higher priority listings.

In 2014, FWS reversed course and denied protection to the snake, concluding the snake is a habitat generalist that has a range 274 percent greater than previously believed, with much of this expanded range safe from development. As demonstrated in this petition, these conclusions are based on an erroneous interpretation of a comprehensive genetics study of the shovel-nosed snake, an inaccurate habitat definition, and a poor assumption about land management in the snake's range. These conclusions are supported by the genetics study itself; a detailed letter from Dr. Phil Rosen, the leading expert on the snake's ecology; and a peer-reviewed modeling study of the snake's habitat.

Using an accurate range and habitat definition, there can be no question the Tucson Shovel-nosed Snake is severely threatened by the modification or curtailment of habitat or range and that existing regulatory mechanisms are inadequate to protect the snake and its habitat—two of the five factors under the Endangered Species Act for determining whether a species warrants listing as threatened or endangered. The snake is severely threatened by rapid urbanization in its range. Only 10.9 percent of the snake's remaining suitable habitat is afforded some form of legal protection from habitat conversion. Sixty percent of the snake's remaining habitat is vulnerable over approximately the next five decades. The snake also faces threats from disease and climate change providing further basis for its protection.

I. INTRODUCTION

As one of the most beautiful and interesting snakes of the upper Sonoran Desert, the Tucson Shovel-nosed Snake is an important component of Arizona's natural heritage. Uniquely adapted to literally swim through sandy soils using its spade-shaped snout, the Snake is dependent on very specific habitat requirements, including sandy soils found on level terrain of valley floors.

The Tucson Shovel-nosed Snake occurs in the northern Sonoran Desert and is found in less arid desert scrub than the closely related Colorado Desert Shovel-nosed Snake (*C. a. annulata*). It is

distinguished by dark black or brown maculations infused within the red secondary bands and likely mimics the Sonoran Coral Snake, with which it uniquely co-occurs (Rosen 2015).

Combined with a limited distribution, the narrow habitat requirements of the snake make it particularly vulnerable to habitat destruction from agriculture and urban sprawl. Unfortunately, the snake's historic range, portions of Pima, Pinal and Maricopa Counties, has been heavily altered by historic agriculture and is rapidly being squeezed by urban sprawl from both Phoenix and Tucson. The Tucson Shovel-nosed Snake needs the safety net of the Endangered Species Act to survive and continue to be a part of the unique biota of the upper Sonoran Desert.

II. NATURAL HISTORY

A. Description

Shovel-nosed snakes (genus *Chionactis*) are small colubrid snakes (250-425 mm total length) with a shovel-shaped snout and deeply inset lower jaw (Mahrdt et al. 2001a at 730.1). Four taxa are currently recognized: the Sonoran Shovel-nosed Snake (*C. palarostris*), Mojave Desert Shovel-nosed Snake (*C. occipitalis*) and two subspecies of the Sonoran Desert Shovel-nosed snake (*C. annulata)*: the Colorado Desert Shovel-nosed Snake (*C. a. annulata*) and the Tucson Shovel-nosed Snake (*C. a. klauberi*) (Wood et al. 2014 at 11).

Shovel-nosed Snakes have heads that are morphologically specialized for burrowing in the sandy soils they inhabit (Ernst and Ernst 2003 at 69). Their smooth scales, inset lower jaw, nasal valves and angular abdomen make these snakes uniquely adapted for swimming through the sand, wriggling through it rather than tunneling (Stebbins 2003 at 393). Their long, slender, slick bodies also appear to be adapted for high performance sand swimming (Sharpe et al. 2015 at 446).

The Tucson Shovel-nosed Snake has a cream colored, whitish or yellowish body with approximately 21 or more black or brown bands across the back that do not fully encircle the body and red secondary bands, also not encircling the body, that are suffused with dark pigment, giving them a black or brown appearance (Stebbins 2003 at 339 and 394). Males typically have fewer than 152 ventral scales and females typically have fewer than 160 ventral scales (Ernst and Ernst 2003 at 67, Stebbins 2003 at 394). Adults are 10-17 inches (25-42 cm) long and hatchlings are approximately four inches (AGFD 2010 at 1).

B. Taxonomy and Range

The Tucson Shovel-nosed Snake was recognized as a subspecies based primarily on the dark pigment of the red crossbands, as well as scale counts and other features (Klauber 1951 at 170, Cross 1979). The range of the subspecies was noted as most consistently observed in the "Tucson-Marana-Picacho-Florence-Junction area," but with a notable area of intergrade west of Phoenix, where snakes showed varying degrees of the maculation characteristic of the subspecies (Klauber 1951 at 170, Cross 1979 at 403, Mahrdt et al. 2001a). This area of intergrade has led to

considerable confusion about the boundary between the Tucson Shovel-nosed Snake and closely related Colorado Desert Shovel-nosed Snake (*C. a. annulata*) (USFWS 2014a at 56732).

To clarify the status of the Tucson Shovel-nosed Snake, as well as the taxonomy of Shovel-nosed Snakes overall, Wood et al. (2008) used mtDNA and reanalysis of morphological characters from museum specimens, finding evidence of two primary clades stemming from historical vicariance and environmental isolation, but a lack of concordance between genetic and morphological data and recognized subspecies.

FWS took these findings into consideration, as well as the opinion of six experts, when making the 2010 finding that the Tucson Shovel-nosed Snake was a valid subspecies that warranted listing, but that such listing was precluded, concluding:

> With regard to the taxonomy, we concluded that, because we received inconclusive expert opinion regarding the subspecies status of the Tucson Shovel-nosed Snake, as well as recommendations that further genetic study (nuclear DNA or microsatellites) is needed before this determination can be made, we regard the currently recognized taxonomic status and distribution of *C. o. klauberi* (Mahrdt *et al*. 2001, entire) as the best available science, with the understanding that as we acquired more information, the definition of this taxonomic entity (including its range) may change, and our finding may need to be revisited (75 FR 16050).

The status of the Tucson Shovel-nosed Snake was further clarified by Wood et al. (2014 at 1), who analyzed microsatellites and additional mtDNA finding that:

> Based on genetic and phenotypic evidence, we suggested that species-level diversity is underestimated in this group and we proposed that two species be recognized, Chionactis occipitalis and C. annulata. In addition, we recommend retention of two subspecific designations within C. annulata (C. a. annulata and C. a. klauberi) that reflect regional shifts in both genetic and phenotypic variation within the species.

In the species status assessment supporting the 2014 not warranted finding, FWS accepted this new information as clearly showing the Tucson Shovel-nosed Snake is a valid subspecies, but also to find that the subspecies has a greatly expanded range:

> Based upon this information, we consider the current estimated range of the Tucson Shovel-nosed Snake (*C. o. klauberi*) to include portions of Pima, Pinal, Maricopa, La Paz, Yuma, and Yavapai counties in Arizona… This range includes portions of the original purported *C. o. klauberi* X *annulata* intergrade zone, as well as portions of *C. o. annulata* and *C. o. annulata* X *occipitalis*, as recognized by Mahrdt *et al*. (2001, entire), and represents an increase of approximately 2,000,655 ha (4,943,728 ac) (274 percent) in our understanding of the overall range of the Tucson Shovel-nosed Snake.

Ultimately, FWS used this expanded range to justify not listing the Snake (FWS SSA 2014 at 13).

Dr. Phil Rosen, pre-eminent expert on the Tucson Shovel-nosed Snake, reviewed the finding and concluded FWS misinterpreted Wood et el. (2014) and wrongly included snakes that shared some genetic characteristics with *C. a. klauberi*, but do not have the phenotypic characteristics of the Tucson Shovel-nosed Snake (Rosen 2015). Dr. Rosen's letter is attached to this petition as an appendix.

The dispute centers on three samples from snakes found in eastern La Paz County near the California border that fall into a clade associated with the Sonoran Desert like the Tucson Shovel-nosed Snake, but were not found by Wood et al. (2014) to be part of *C. a. klauberi*. Instead, Wood et al. (2014 at 10) concluded:

> In the same way, haplotypes of *C. a. annulata* from west-central Arizona (clade E) formed a well-supported mtDNA clade, but could not be grouped with confidence to either the Colorado or Sonoran lineages. However, nuclear genotypes of these same samples were assigned to the genetic cluster containing the majority of all other *C. a. annulata* samples.

Wood et al. (2014 at 9) did expand the range of the Tucson Shovel-nosed Snake to include an intergrade zone, where snakes show phenotypic and genetic characteristics of both *C. o. annulata* and *C. o. klauberi*, but this area only stretches to western Maricopa County, stating "northwestern Maricopa county . . . corroborate[s] well with the inferred cluster boundaries."

In this petition, we request listing of *C. a. klauberia* and adopt the expanded range indicated by Wood et al. (2014), including portions of Pima, Pinal and Maricopa Counties (Figure 1). This range was used to model habitat for the Tucson Shovel-nosed Snake by Bradley and Rosen (*in press*) (Figure 1).

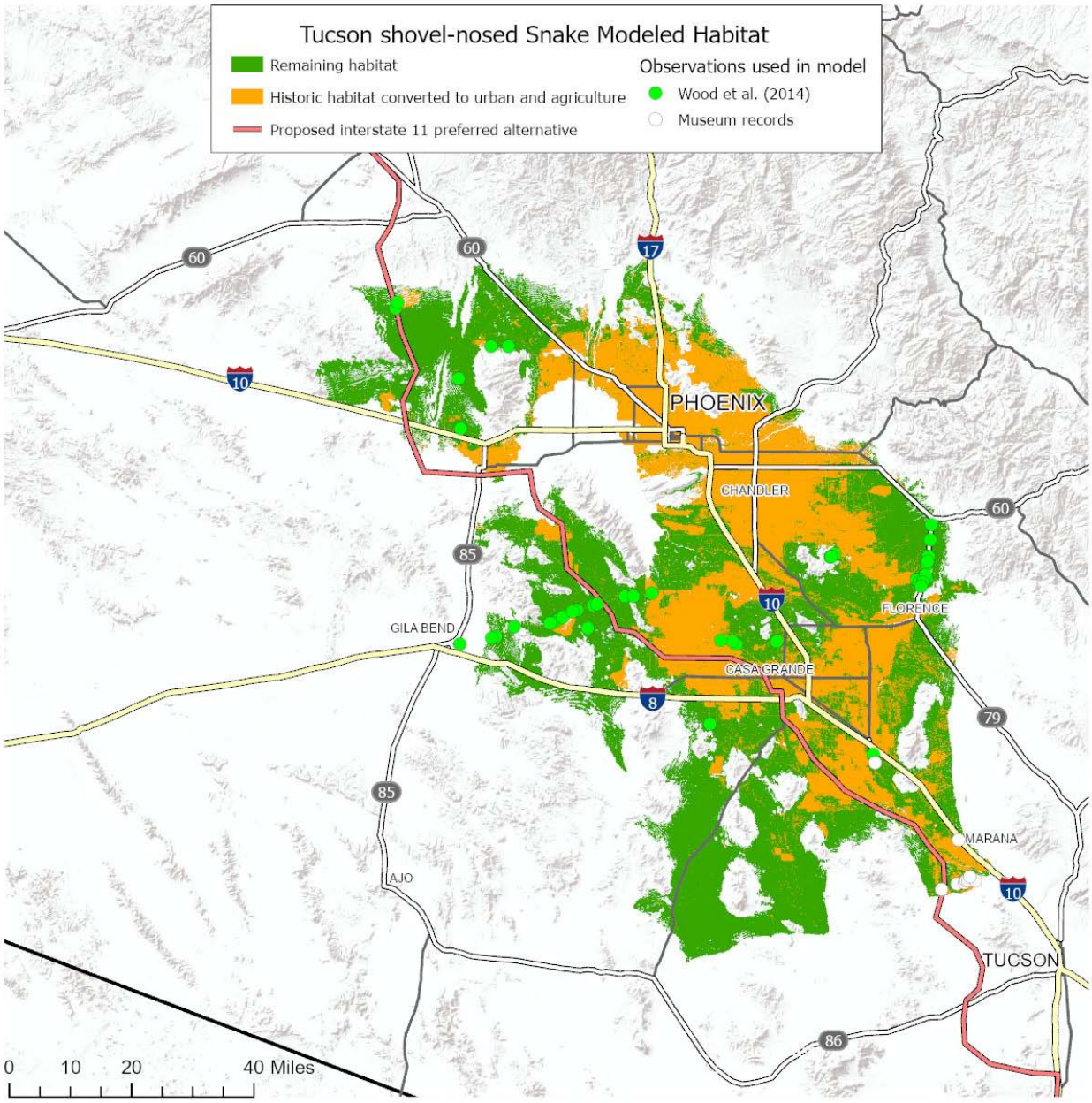

Figure 1. The range of the Tucson Shovel-nosed Snake modeled by Bradley and Rosen (*in press*) with verified locations and historic and current habitat.

C. Diet

The Tucson Shovel-nosed Snake feeds on scorpions, beetle larvae, spiders, centipedes, insects and buried moth pupae (Rosen et al. 1996 at 22-23, Glass 1972 at 445-47, Klauber 1951 at 194). The length of these invertebrates, found within the stomach of the Snake, typically range from four to 32 millimeters (Glass 1972 at 446). From these observations it also appears that hard-bodied prey, such as beetles, were not preferred (Glass 1972 at 446).

One aspect of the Tucson shovelnose snake's diet might be unique compared to other subspecies of Shovel-nosed Snake. The Tucson shovelnose snake relies heavily on scorpions (*Vejovis spinigeris*) for a significant portion of its diet, and Glass (1972 at 447) suggested the Snake may have developed a resistance to scorpion venom. The scorpion was most often seized by the base of the stinger. After the snake had a hold on the scorpion, on occasion it would back into the sand while holding the scorpion in its mouth. This aligned the scorpion properly to facilitate ingestion. After the scorpion was aligned, the snake would then begin to move the jaw opposite the side holding the stinger to begin to consume the prey. This was done in such a way that resulted in the scorpion being bent into a "U" shape. This would continue until the claws and stinger were all that remained to be consumed. At this point, both would be swallowed simultaneously (Norris and Kavanau 1966 at 661).

Aside from the consumption of scorpions, the Tucson Shovel-nosed Snake "subdued prey by one of two means: striking and grasping with the mouth, or looping the anterior third of the body in a single loop over the prey and pressing it against the substrate, then seizing the prey with the mouth" (Glass 1972 at 446).

A study by Rosen et al. (1996 at 22) found the stomachs of 7 of 7 *C. a. annulata* contained food remains, thus these snakes likely eat relatively frequently. This observation was further supported by the consumption of 5-8 crickets per week by each individual in a laboratory setting (Rosen et al. 1996 at 22). After a lapse in feeding of two to three weeks, the snakes begin to show marked decreases in weight (Rosen et al. 1996 at 22). From such high feeding demands it is predicted that these snakes would have to be actively feeding from at least April to October (Rosen et al. 1996 at 22), although they are rarely found crossing roads (the usual collecting/observation method) after early July.

D. Behavior

Shovel-nosed snakes exhibit a unique behavior described as "sand-swimming." The snake moves using a sideways swaying motion while it is either on or under the sand or loose soil (AGFD 2010 at 2, Stebbins 2003 at 393). In a study exploring the kinetics of locomotion of the shovel-nosed snake, Sharpe at al. (2015 at 446) found that the snake swims through sand by propagating traveling waves down the body, head to tail. During the day the snake will often rest under the sand surface below a creosote bush (*Larrea tridentate*). A study performed by Norris and Kavanau (1966 at 662) determined that the burrowing behavior of *Chionactis occipitalis* was dependent on the period of time since last activity and the temperature of the sand above it. During the winter months the snakes will hibernate in subsurface burrows. The Colorado Desert Shovel-Nosed snake has been found hibernating about three inches below the surface, near the top of south facing dunes (Shaw 1953 at 72). The burrows were approximately ten inches long and one and a half inches in diameter, with both ends of the burrow plugged with sand (Shaw 1953 at 72).

Although *Chionactus* species are very adept at burrowing and diving into loose sand, they will also attempt to escape by fleeing across the ground surface (Warren 1953 at 122), and their slender shape and strong musculature allows them to crawl fast, for a small snake. The Shovel-

nosed Snake has also been observed attempting to climb creosote bushes when it is disturbed (Warren 1953 at 123), and they frequently dive into pre-existing burrows if a threat appears.

The Tucson Shovel-nosed Snake typically rests during the day under cover, including shrubs and surface objects (AGFD 2010 at 2). During active periods the snake often forages for prey by stalking them from beneath the surface of sand or loose soil (AGFD 2010 at 2). They move above and below the surface at night and will flee from bright lights and other disturbances (AGFD 2010 at 2).

E. Reproduction

Due to the relatively obscure nature of the Tucson Shovel-nosed Snake, few studies have characterized the reproduction of this taxon. Other Shovel-nosed Snake species have been found to be oviparous (Ernst and Ernst 2003 at 70, NMDGF 2017 at 3) with a clutch of 2 to 4 eggs laid in the summer (Goldberg 1997 at 86), and there is no doubt that the Tucson Shovel-nosed Snake is similar. Shovel-nosed snakes generally reproduce from April to July and have clutch sizes of two to five eggs, and maybe as many as nine, that are laid in late spring and summer (AGFD 2010 at 2, Stebbins 2003 at 393). A study of the western shovel-nosed snake in California found a breeding period from approximately May-July, during which time reproductively active females have been found (Goldberg 1997 at 85). A lack of spermiogenic males and the occurrence of males with regressed testes during August-November likely indicate that breeding by *Chionactis occipitalis* does not continue into this period (Goldberg 1997 at 85). Only 25 percent of the females studied were found to be reproductively active during the breeding period, indicating that not all females of this species breed every year (Goldberg 1997 at 86).

In a study of *C. occipitalis* from the Mohawk Dunes, males have been shown to engage in combative behavior believed to be associated with their mating period (Goode and Schuett 1994). The male combat is thought to serve many different functions; however, "the one considered most important to male fitness is priority access to sexually active females" (Goode and Schuett 1994 at 115). In combatant males, there is evidence to suggest a relationship between large size, winning, and access to sexually active females (Goode and Schuett 1994 at 116). Since combat behavior in snakes is often coincident with mating, Goode and Schuett (1994 at 116) suggest that the mating season for these snakes is mid-spring.

F. Daily and Seasonal Activity

The daily activity of the Tucson shovelnose snake may vary depending on the time of year and the temperature. Although they are mostly nocturnal (Klauber 1951 at 187), Shovel-nosed Snakes have been observed to be active in the morning, "even on remarkably warm days" and just before sunset (Rosen et al. 1996 at 21). They exhibit intense periods of surface activity during the time from 1900 hr – 2100 hr. This maximal activity peak occurs during the twilight time to just after dark, starting at a time when observation is barely possible without artificial light (Rosen et al. 1996 at 21). They are most active in air temperatures between 70 and 90° F (21-32° C) (AGFD 2010 at 2, Klauber 1951 at 187). Activity seems to be highest after warm summer, or hot spring days, and with higher relative humidity (Rosen et al. 1996 at 21). Mahrdt

and Banta (1996 at 81) reported apparent mid-summer diurnal activity for the Colorado shovel-nosed snake (*C. o. annulata*) at a site in the Yuha basin characterized by creosote bush scrub.

Seasonally, the Western Shovel-nosed snake, and the subspecies Colorado Shovel-Nosed Snake, exhibit peaks in activity during May and June (Goldberg 1997 at 86). The Tucson Shovel-nosed Snake also displays a similar peak in activity, but collecting records suggest that the peak in activity might be slightly earlier in this subspecies, and demonstrate that activity ends more abruptly in late June-early July than is the case in subspecies found in lower, and more arid regions. These records show that peak activity begins in May, with decreasing activity in late June (Rosen 2003 at 16).

G. Habitat

The Tucson Shovel-nosed Snake is restricted to flat, valley bottoms with sand or sandy loam substrates in the Arizona Upland or Lower Colorado River Valley subdivisions of the Sonoran Desertscrub biotic community between 350-650 m in elevation (Rosen 2003 at 8, FWS 2014b at iii, Bradley and Rosen *in press* at 8).

In an effort to characterize the status of the Tucson Shovel-nosed Snake in the Avra Valley, an area where the species has experienced serious declines, Rosen (2003 at 9) surveyed historic localities (1900-2003) of the Snake based on museum specimen vouchers and characterized the habitat at these sites as productive desert or creosote flats with sandy loam soils with sparse gravel.

Bradley and Rosen (*in press* at 7) developed a habitat suitability model for the Tucson Shovel-nosed Snake that, based on 53 verified locations of the Snake, had "low (8.59 %) error" and found elevation to be the most important variable explaining variation in the characteristics of Snake locations. Annual precipitation, precipitation in the driest quarter, precipitation of the wettest month, and percent slope were also important in explaining variation in the data (Bradley and Rosen *in press* at 7). The model highlighted the Tucson Shovel-nosed Snake's association with elevated portions of the highly arid Lower Colorado River Valley portion of the Sonoran Desert (Bradley and Rosen *in press* at 9). Suitable habitat for the Tucson Shovel-nosed Snake is higher in elevation, less arid, less sparsely vegetated, and less sand-dominated than those largely occupied by the Colorado Desert shovel-nosed snake (*C. a. annulata*) (Bradley and Rosen *in press* at 9).

As further justification for denying the Tucson Shovel-nosed Snake protection, FWS (2014b at 56733) concluded:

> We assume that the presence of the appropriate habitat types (as described above) throughout the subspecies' range provides sufficient area and suitable habitat to support the subspecies. This is because the Tucson Shovel-nosed Snake appears to be a habitat generalist occurring within the relatively broad biotic community described above.

According to Rosen (2015 at 2), however, this is a "misinterpretation," as Shovel-nosed Snakes are "well-known habitat specialists, largely to entirely restricted to sand and sandy loam substrates and to valley floors and relatively level lower bajadas." As discussed in more detail below, the Snake's specific habitat requirements place it directly in the path of urban and agricultural development that is a serious threat to its survival.

III. STATUS OF THE TUCSON SHOVEL-NOSED SNAKE

Based on a combination of phenotypic and genetic characteristics, the Tucson Shovel-nosed Snake occurs in portions of three counties in south-central Arizona: Pima, Pinal, and Maricopa counties (Wood et al. 2014, Rosen 2015 and Bradley and Rosen 2018, Figure 1). Within its small range, the Snake has lost substantial habitat to urban and agricultural development, disappeared from portions of its range following habitat destruction and fragmentation, and faces immediate threat of further habitat loss (FWS 2014ab, Rosen 2003, Bradley and Rosen *in press*).

Using their model of probable Tucson Shovel-nosed Snake habitat, Bradley and Rosen (*in press*) estimated Tucson Shovel-nosed Snake habitat historically encompassed 1,255,946 ha (3,103,505 acres) and that of this habitat, 39 percent has been converted to urban development, roads, agriculture, or other uses (Figure 1). This habitat destruction has been driven by rapid urban expansion of Tucson and Phoenix, both of which have been and continue to be some of the fastest growing communities in the United States.

Concerns for the Tucson Shovel-nosed Snake first arose following surveys in 2003 in the Avra Valley, in which the Snake could not be located in multiple locations where it previously had been found (Rosen 2003). Rosen (2003 at 16) concludes:

> There can be no reasonable doubt that the Tucson Shovel-nosed Snake has severely declined in Avra Valley (including Marana) since the 1960's and 1970's. (1) There are no museum records since 1979; (2) University of Arizona herpetology personnel continued activity in Avra Valley during the 1980's; (3) we have worked Avra Valley intensively off and on since 1991; (4) our June 2003 survey was effective but yielded no shovel-nosed snakes; and (5) we have no reliable reports of observations of shovel-nosed snake in Avra Valley since 1979. All this evidence is consistent and conclusive. The question is whether the species is extinct in Avra Valley or not.

And more broadly that:

> The entire taxon, Chionactis occipitalis klauberi, as currently recognized, may be threatened.

Rosen (2003 at 2).

The loss of the Snake from the Avra Valley is concerning because, as noted by Rosen (2003 at 2 and 10), this area comprised "a significant portion of the known range of the Tucson Shovel-

nosed Snake," and the Snake was reasonably abundant and reliably found in this area in the 1970s, with up to two-three snakes being observed per night of road driving.

Later surveys have confirmed the absence of the Snake from Avra Valley with Rosen (2008 at 4) concluding:

> The findings strongly confirm the previous indications that the Tucson Shovel-nosed Snake has declined precipitously in Avra Valley… We cannot confirm the complete extirpation of the shovel-nosed snake in the Avra Valley based on these sample sizes, but it seems increasingly probable that it does not currently live in eastern Pima County.

It is also noteworthy that the Avra Valley is not the only place where the Snake has become rare, with Rosen (2003 at 3) concluding:

> [T]his taxon was known from the margin of the Arizona Upland, in places where it has been severely impacted by urban sprawl: Scottsdale region (probably extirpated by urban sprawl and agriculture), Florence region (uncommon, facing continued sprawl), Casa Grande region (severely impacted by agricultural development), and Avra Valley (also affected by agriculture and now, potentially, urban sprawl).

Various surveys were conducted for Tucson Shovel-nosed Snakes between 2008-2012, prior to the Snake being withdrawn from candidacy for listing, with the Service concluding:

> Based on these efforts, populations are persisting in areas dominated by creosote flats along State Route 79, north of Florence and south of Florence Junction; east of the San Tan Mountains; along State Route 349 between Maricopa and Casa Grande; south of Interstate 8 near the northern boundary of the Tohono O'odham Reservation; and in the vicinity of the Santa Cruz Flats near Eloy and Picacho. Additionally, one individual along Gilbert Road at the Salt River indicates that the Salt River and its floodplain may provide at least some appropriate habitat (Arizona Game and Fish Department 2011, unpublished data)(FWS 2012 at 5).

In sum, the Tucson Shovel-nosed Snake has lost substantial amounts of its habitat and disappeared from places where it was once common. In combination with massive future threats to its habitat, these facts make clear the Snake needs Endangered Species Act protections.

IV. THREATS

A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Historic and continued loss of habitat to agricultural and urban development threaten the Tucson Shovel-nosed Snake (AGFD 2010 at 3, Rosen 2003 and 2008, Bradley and Rosen *in press*). As the U.S. Fish and Wildlife Service itself acknowledged in 2014, habitat loss is the primary past, current, and future threat to the Tucson Shovel-nosed Snake (USFWS 2014 at 56736). The

Tucson Shovel-nosed Snake has already lost 39 percent of its historic habitat to agriculture and urban development, and is at immediate risk of losing more to these factors, as well as solar energy development, road construction and maintenance, wildfires, climate change, drought and others (USFWS 2014 at 56736, Bradley and Rosen, *in press* at 7). The following discussion provides additional detail to each of the threats to the Snake's habitat.

1. Urbanization

The Tucson Shovel-nosed Snake is particularly vulnerable to the rapid urbanization ongoing in its range, which is concentrated on valley floors comprising the predominant habitat of the snake (Rosen 2008). As Grimsley et al. (2018 at 413-14) explains "[t]he majority of development in the Sonoran Desert occurs, and is planned to occur, within the [Lower Colorado Valley] subdivision because of characteristics such as low elevation, level ground, and low density of vegetation." According to FWS (2010 at 16053), more than 20 percent of the Snake's range had already been converted to urban areas by 2001 and human population growth is only expected to continue. Using a more accurate depiction of the Snake's habitat and range, Bradley and Rosen (in press at Bradley personal communication) estimated 23 percent of the Snake's historic habitat has already been lost to urban development and more is slated for development.

Arizona has grown rapidly in recent decades, at a rate greater than the national average (AGFD 2017 at 4). This rapid urbanization is occurring in the area that comprises the core of the Tucson Shovel-nosed Snake's range. FWS (2010 at 16053) identified a "wide swath" known as "the Sun Corridor Megapolitan," stretching from the "international border in Nogales, through Tucson, Phoenix, and north past the Prescott area" as an area where massive population growth is expected to occur and concerningly, "encompasses the entire historical range" of the Snake.

Urban expansion of Phoenix is occurring at a rate of 1 km per year, with a substantial amount of corresponding development already underway, which will lead to additional infrastructure and habitat loss (Grimsley et al 2018 at 413). The City of Tucson grew from 25,503 hectares (63,758 acres) in 1980 to 58,048 hectares (145,119 acres) in 2004, with a corresponding population increase from 330,537 residents to 512,023 residents (City of Tucson, undated at 1). Pinal and Maricopa Counties more than doubled in population from 1980 to 2006 (ADOT 2010 at 10). Over the same period, 83 percent of Arizona's population growth occurred in Maricopa, Pima and Pinal counties, with the addition of 2.8 million people (ADOT 2010 at 10). Pinal County's population increased by 109.1 percent between 2000 and 2010, making it the second fastest-growing county in the US during this period (AGFD 2013 at 2). Maricopa County ranks fourth nationally in population and includes four municipalities that have ranked within the 10 fastest-growing cities in the U.S. (AGFD 2011).

Arizona's human population continued its pace of rapid growth throughout the past decade, growing by an additional 13.9 percent (886,428 people) between 2010 and 2019 (U.S. Census 2020). Pinal, Maricopa and Pima continued to lead the state in population size and growth, making up 92.7 percent (822,090 people) of the total growth in the state (U.S. Census 2020). Over this nine-year period, Pinal County's population grew by 23.2 percent, Maricopa County's by 17.5 percent and Pima County's by 6.8 percent (U.S. Census 2020).

This growth is expected to continue, with the human population of Arizona expected to more than double from almost 6 ½ million in 2010 to more than 14 million by 2050 (AGFD 2013 at 2). The population of Maricopa County, which is the largest county in Arizona and contains more than half the state's population, is also expected to double between 2010 and 2050 (AGFD 2011).

Rapid urbanization is an immediate threat to the survival of the Tucson Shovel-nosed Snake over a significant portion of its range, indeed most of its range, necessitating listing of the Snake under the Endangered Species Act.

2. Agriculture

According to the Service, "conversion of low desert valleys to farmland renders habitats unsuitable for the Tucson Shovel-nosed Snake" (FWS 2014a at 39). This is most clearly exemplified in the Avra Valley, where conversion to agriculture contributed to massive loss of habitat and disappearance of the snake. Rosen (2008 at 14) concluded:

> A reasonable synthetic hypothesis is that habitat destruction and fragmentation (conversion of level, valley floor habitat from Lower Colorado Valley Sonoran Desertscrub to agriculture, along with urban and suburban development and road mortality) has undermined the metapopulation dynamics of species that specialize in that natural habitat in the study region.

This statement applied to the Snake as well as several other Lower Colorado Valley species observed in the study. Rosen (2008 at 11) was able to find four Tucson Shovel-nosed Snakes north of the Avra Valley on the Santa Cruz Flats, but here too most habitat is gone:

> To the north, almost the entirety of this environment in the Santa Cruz Flats has been converted to irrigation agriculture, with no substantial intact habitat fragments remaining. The four Tucson Shovel-nosed Snake records we now have for this century in the study region are all from within 1 mile of the irrigation agriculture that has, apparently, occupied most the subspecies former habitat. This obviously increases concerns that this taxon's regional persistence is extremely tenuous, at best.

According to the Service, agriculture occupied roughly 10 percent of the Tucson Shovel-nosed Snake's range in 2001 (FWS 2014a at 38). As above, Bradley and Rosen (*in press*) used a more accurate range and habitat model and estimated just under 14 percent of the Snake's habitat has been converted to agriculture (Bradley personal communication). The acreage of agriculture has decreased some in recent years, but this is primarily because of conversion to urban development and thus provides little help to the Snake (FWS 2014a at 38). Overall, agriculture has been an important contributor to loss and fragmentation of the Snake's habitat, occurring in the valley flats that comprise the Snake's preferred habitat and provide another basis for listing the Snake as threatened or endangered.

3. Roads

According to the Fish and Wildlife Service (2010 at 16054), roads pose unique threats to the Tucson Shovel-nosed Snake, its prey base and the habitat where it occurs through: "(1) fragmentation, modification, and destruction of habitat; (2) increased genetic isolation; (3) alteration of movement patterns and behaviors; (4) facilitation of the spread of non-native species via human vectors; (5) increased recreational access and the likelihood of subsequent, decentralized urbanization; (6) interference with or inhibition of reproduction; and (7) population sinks through direct mortality."

Because snakes are thigmotherms that seek warm road surfaces (Sullivan 1981 at 246, Rosen and Lowe 1994 at 143), they are subject to high road mortality. Snakes are threatened both because they are relatively slow-moving animals presenting a large target as they crawl across roadways and because of their potential to rest on warm road surfaces (Rosen and Lowe 1994 at 143). Highways present an even higher threat as the likelihood of road mortality increases as traffic increases (Rosen and Lowe 1994 at 143). Four years of road cruising surveys on State Route 85 from Why to Lukeville in Pima County resulted in a large number of dead snakes both observed and estimated from highway mortality, despite being primarily in a national monument with only moderate traffic (Rosen and Lowe 1994 at 143). This study confirmed that road mortality has a substantial impact on snake populations (Rosen and Lowe 1994 at 143, 147).

Leavitt et al. (2013 at 4) found two Tucson Shovel-nosed Snake carcasses during road mortality surveys on the Arizona Army National Guard Florence Military Reservation (FMR) in Pinal County, Arizona in 2013. Both were detected on State Route 79, alongside habitat that was expected to be suitable for the snake based on habitat modelling within FMR (Leavitt et al. 2013 at 4).

The Tucson Shovel-nosed Snake's relative *Chionactis palarostris*, appears to be relatively strongly impacted by highway mortality, based on road cruising surveys conducted over four years along State Route 85, mostly within Organ Pipe Cactus National Monument (Rosen and Lowe 1994 at 143). Rosen and Lowe (1994 at 145) also found five dead *Chionactis occipitalis* over the four years of surveys. Based on species revisions in Wood et al (2014), Wood et al. (2008), and others, these individuals likely represent *Chionactis annulata annulata* or an intergrade between this species and *C. a. klauberi*.

Tucson Shovel-nosed Snakes are threatened not just by the construction of new roads and highways, but also by increasing traffic on existing roads and highways that is expected to result from Arizona's increasing human population. In addition, widening of roads and highways is often used in an attempt to manage increasing traffic on roadways, which will result in further habitat loss, fragmentation, and direct mortality of the Tucson Shovel-nosed Snake. Below are several examples of recently constructed or currently proposed new highway and highway widening projects that threaten the Tucson Shovel-nosed Snake and its habitat.

Loop 202 – South Mountain Freeway

Construction of the Arizona Department of Transportation's South Mountain Freeway (Loop 202) was nearing completion at the time this petition was prepared. This project is the largest in the state's history, adding 22 miles of eight lanes of freeway as a loop connecting Interstate 10 west of Phoenix to Interstate 10 southeast of Phoenix (FHA and ADOT 2014 at i). The new freeway is in the southwestern portion of the Phoenix metropolitan area in Maricopa County, Arizona.

The final environmental impact statement for the project found the project may affect the Tucson Shovel-nosed Snake and required preconstruction surveys (FHA and ADOT 2014 at xiv). Given the cryptic nature of the Tucson Shovel-nosed Snake, it seems unlikely that simply conducting preconstruction surveys for this species will be sufficient to mitigate any impacts and will do nothing about loss of habitat, fragmentation, and increased likelihood of road mortality.

Proposed Interstate 11 (I-11) Corridor from Nogales to Wickenburg, Arizona

The Tucson Shovel-nosed Snake's survival is threatened by a proposal to construct a new highway in the Snake's range. The proposed route would bisect some of the Snake's last intact habitat, leading to destruction and fragmentation of the Tucson Shovel-nosed Snake's habitat, as well as increased road mortality (Figure 2, Coalition for Sonoran Desert Protection 2019 at 8-9). Among other areas, the route will cut through the area between Gila Bend and Maricopa, within and adjacent to the Sonoran Desert National Monument, a reliable place to see the Tucson Shovel-nosed Snake with several individuals recorded along highway 238 (Coalition for Sonoran Desert Protection 2019 at 8). Construction of this new highway will also invariably lead to associated development with further impacts to the Snake's habitat (ADOT 2019 at ES-2).

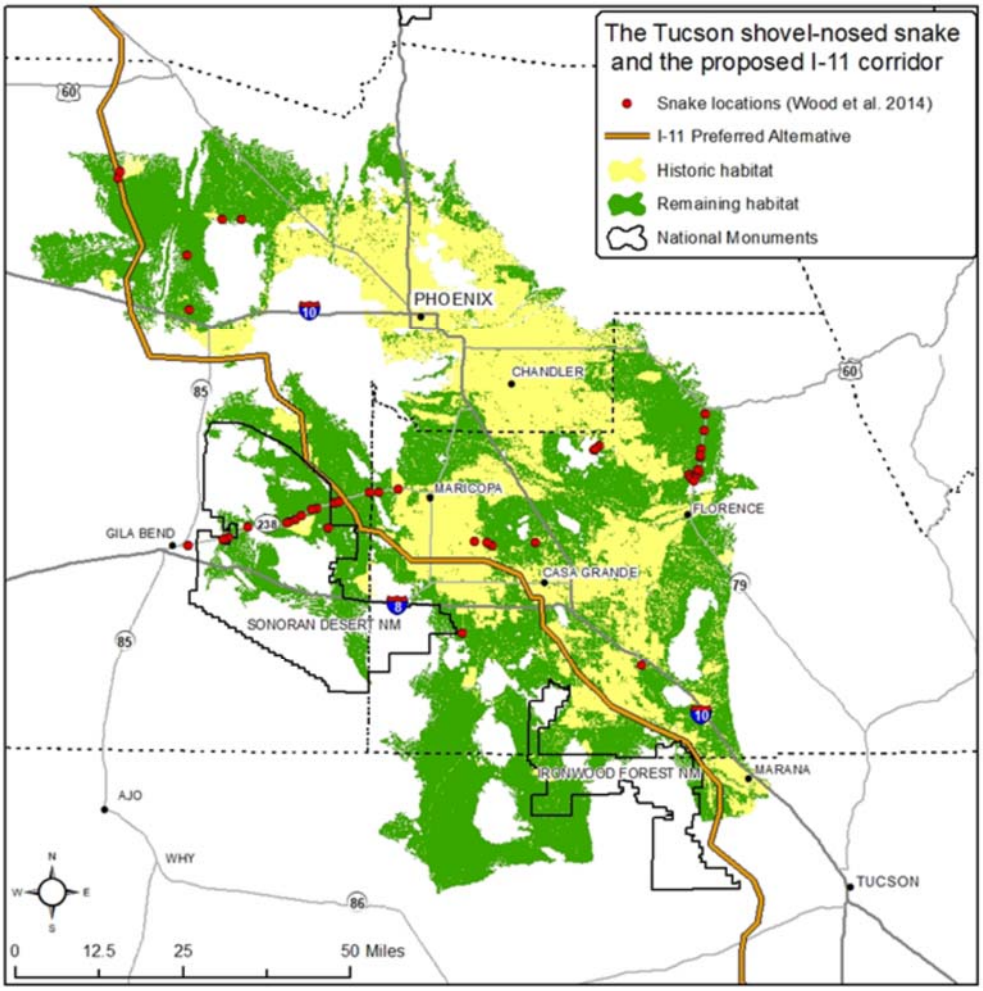

Figure 2. The Recommended Alternative route for I-11, bisecting through the historic and remaining habitat for the Tucson Shovel-nosed Snake (Coalition for Sonoran Desert Protection 2019 at 9).

B. Overutilization

While it is not believed that scientific and illegal commercial collecting of this species is widespread, this attractive species could experience some local population impacts from collection (Pima County 2016 at A-159). Although Arizona prohibits the commercial collection of reptiles, enforcement of this law is limited (Pima County 2016 at A-160).

C. Predation and Disease

While snakes are often considered to be top predators, there is evidence to suggest that this species is also the prey of several other animals, including larger snakes. Shovel-nosed snakes are preyed on by a variety of carnivores including snakes, foxes, coyotes, shrikes, and owls (Brennan and Holycross 2009 at 98). Klauber (1951 at 195) reported one *Chionatis* killed by a domestic cat and one eaten by a red racer. In a study examining the diet of the Colorado Desert Sidewinder, Shovel-nosed Snakes were found to be a food item, occurring in the stomachs of 1.2

percent of the snakes examined (Funk 1965 at 16). Mahrdt and Banta (1996 at 81) reported the first record of a passerine bird preying upon *C. occipitalis* (Colorado shovel-nosed snake), finding two adults impaled on an ocotillo plant approximately six feet above the ground, the apparent prey of a loggerhead shrike. The remains of Shovel-nosed Snakes have also been found in pellets regurgitated by the Great Horned Owl (Rosen, personal communication).

Since 2006, there has been a significant increase in reports of severe and fatal fungal snake infections in wild snakes in the United States (Lorch et al. 2016 at 2). This disease, known as snake fungal disease (SFD), is caused by the fungus *Ophidiomyces ophiodiicola* and has contributed to infection and death in many species of snake across the eastern United States (Clark et al. 2011; Allender et al. 2015; Lorch et al. 2016 at 2). It has also been linked to severe population declines in several species (Lorch et al. 2016 at 6). While scientists have demonstrated a growing interest in SFD, much remains to be learned about the disease and its conservation implications for snakes in the United States.

Snake fungal disease was recently documented for the first time in Arizona, and thus poses an additional threat to Tucson Shovel-nosed Snakes (Northern Arizona University 2019). Out of 60 snakes tested, one juvenile Narrow-headed Gartersnake and one adult Sonoran Kingsnake tested positive for SFD (Northern Arizona University 2019). This clearly indicates some degree of risk for the Tucson Shovel-nosed Snake and provides another basis for listing the species.

D. Inadequacy of Existing Regulatory Mechanisms

There can be no question the Tucson Shovel-nosed Snake faces clear threats to its survival. These threats are made worse by the overall lack of protection for the Snake's habitat. According to Bradley and Rosen (*in press* at 1), only 10.9 percent (207,669 acres) of the Tucson Shovel-nosed Snake's remaining suitable habitat is currently afforded legal protection from habitat conversion (Table 1).

Table 1. Remaining Suitable Habitat for the Tucson Shovel-nosed Snake by ownership from Bradley and Rosen (*in press*). Lands considered to be "protected" from habitat conversion included national parks, national monuments, military lands, and city, county and state parks (Bradley and Rosen *in press* at 7).

Remaining habitat by ownership	Acres	% of Currently Suitable Habitat
Tribal lands	549,580	28.8
Private	542,622	28.5
State Trust	457,345	24.0
BLM (national monuments)	185,418	9.7
BLM (other)	141,703	7.4
Military	16,352	0.9
Other	6,189	0.3
City or County Parks	3,863	0.2
National Parks	1,661	0.1
State Parks	375	0.0
Inadequately protected	**1,697,438**	**89.1**
Protected	**207,669**	**10.9**

1. State Lands

The Tucson Shovel-nosed Snake is considered a Species of Greatest Conservation Need (SGCN) in Arizona's State Wildlife Action Plan (AGFD 2012 at 219). However, this classification does not provide for any protections for the species. The State Wildlife Action Plan simply calls for surveys, monitoring, and research of the Tucson Shovel-nosed Snake, and does not provide for any conservation or recovery actions for the species (AGFD 2012 at 131).

According to Bradley and Rosen's (*in press*) habitat model, 24 percent of the Tucson Shovel-nosed Snake's remaining habitat occurs on Arizona state trust lands. Arizona currently has no regulations or programs to protect the Tucson Shovel-nosed Snake on their lands. The Federal Enabling Act for Arizona and the Arizona state constitution limit conservation on state lands by requiring that use of the lands maximize the economic value of state lands to benefit schools. The Arizona constitution, for example, states:

> Said lands shall not be sold or leased, in whole or in part, except to the highest and best bidder at a public auction . . . All lands, lease-holds, timber, and other products of land, before being offered, shall be appraised at their true value, and no sale or other disposal thereof shall be made for consideration less than the value so ascertained. (Arizona State Constitution, Article 10, Sections 3 and 4).

These restrictions are further explained in the mission of the Arizona State Land Department to "manage the State's Land Trust and to generate maximum revenues, through prudent planning decisions for the Beneficiaries. All land uses must compensate the Beneficiaries, and be

minimally invasive, a fact that distinguishes it from the way public land, such as parks or national forests, may be used."[1] Although the Arizona Legislature passed the Arizona Preserve Initiative in 1996 to encourage the preservation of open space around urban areas through the reclassification of State Trust Land for conservation purposes, portions of it have been discontinued due to lawsuit threats.[2] Citizen groups have also sought to achieve State Trust Land reforms to allow for conservation through ballot propositions but have so far been unsuccessful.[3]

2. County and City Protections

In 2016, Pima County finalized its Multi-Species Conservation Plan (MSCP) which includes protections for the Tucson Shovel-nosed Snake (Pima County 2016). This MSCP saw its origins in the Sonoran Desert Conservation Plan, a draft of which was released in 2004.

Pima County's MSCP permit area includes only 23,557 acres of remaining suitable habitat for the Tucson Shovel-nosed Snake (Bradley, personal communication 2020). Thus, any protections provided by the MSCP cover only 1.2 percent of the snake's remaining suitable habitat or 8.5 percent of the snake's remaining suitable habitat in Pima County. It is also unknown if there are any Tucson Shovel-nosed Snakes persisting in the covered area (Pima County 2016 at A-159). Thus, the impacts of protections under this conservation plan are of relatively low significance and do not sufficiently reduce the threat of extinction for the Tucson Shovel-nosed Snake to eliminate the need to list the snake under the ESA.

The Tucson Shovel-nosed Snake is being considered for inclusion as a covered species in a Habitat Conservation Planning process by the Town of Marana. The town issued a draft preliminary Habitat Conservation Plan (HCP) in 2004 and a draft HCP in March 2009 (CH2MHILL 2004, RECON 2009). Because this plan has not been finalized for such an extended period, it should not be considered in the context of a decision as to whether to list the Tucson Shovel-nosed Snake under the ESA, as its provisions, implementation, and effectiveness are all uncertain.[4]

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[1] https://land.az.gov/our-agency-mission/history-trust-land

[2] https://www.sonorandesert.org/learning-more/arizona-state-trust-land-reform/

[3] https://www.sonorandesert.org/learning-more/arizona-state-trust-land-reform/

[4] It is important to note that under the Endangered Species Act, when determining whether a species meets the requirements of a threatened or endangered species, the Fish and Wildlife Service is not to consider draft, planned, or future management actions, but instead only the current management and status of the species. In numerous cases, the U.S. Fish and Wildlife Service has been forced by judicial action to reverse decisions not to list species because they relied on promised management actions, including decisions over the Barton Spring's salamander, Queen Charlotte goshawk, jaguar, Alexander Archipelago wolf and coho salmon. This is not merely a legalistic technicality. There is a good reason for considering only current management and status. States, Federal agencies and private interests can easily promise to protect and recover species in order to avoid or delay a listing that they consider potentially controversial. Whether they fulfill the promises of the Plan and whether this fulfillment will result in

The Town of Marana only encompasses 2,175 acres of suitable habitat for the Tucson Shovel-nosed Snake (Bradley, personal communication 2020), or 0.28 percent of their total remaining suitable habitat. And there are no recent records of the snake in the area proposed to be covered under the draft HCP (RECON 2009 at 4.11-1). The HCP also acknowledges that "[t]he Town and vicinity represent a small and likely inconsequential portion" of the Tucson Shovel-nosed Snake's range (RECON 2009 at 4.11-3). Thus, even if the HCP is finalized and can avoid all impacts to the snake's suitable habitat, as unlikely as that is, it would not be sufficient to protect the snake from the threat of extinction. In addition, the draft HCP indicates that evaluation for federal listing was one of the reasons for its inclusion as a covered species (RECON 2009 at 4.11-2) so the town may decide to remove coverage for the snake if it is not listed under the ESA or being considered for protections.

The Tucson Shovel-nosed Snake is included as a covered species in a draft habitat conservation plan for the City of Tucson (City of Tucson 2006). This plan has been in draft form for more than a decade, but even if it were finalized, it provides little protection for the Snake. The plan acknowledges there are roughly 12,000 acres of suitable habitat in the planning area for the Snake in the Avra Valley and seeks to maintain this habitat. The plan, however, lacks specific and concrete protections and was never enacted.

3. Bureau of Land Management

According to Bradley and Rosen's (*in press*) habitat model, 17.1 percent of the Tucson Shovel-nosed Snake's remaining habitat occurs on Bureau of Land Management (BLM) lands, 9.7 percent of which is designated as national monuments and thus afforded protection. On other BLM lands, there currently are no regulations to protect the Tucson Shovel-nosed Snake.

Although the Tucson Shovel-nosed Snake was previously classified as a sensitive species by the Bureau of Land Management in Arizona, this classification was removed in 2017 (Bureau of Land Management 2017). Even if BLM adds this species back to its sensitive species list, this would not be sufficient to protect it as sensitive species designations afford little protection, requiring only that the impacts be considered but not preventing actions that would harm the snake. Thus, even when species are designated as sensitive species, BLM can conclude that individuals or populations of that species will be harmed or destroyed by an action, but still carry out that action. The primary threats on BLM lands include off-road vehicles, roads, livestock grazing, solar energy production facilities, and mine leasing.

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recovery of the snake can only be determined with time. For these reasons, the draft HCP for the Town of Marana is largely immaterial to determining whether the Tucson Shovel-nosed Snake merits listing under the Endangered Species Act.

4. Tribal Lands

According to Bradley and Rosen's (*in press*) habitat model, 28.8 percent of the Tucson Shovel-nosed Snake's remaining habitat occurs on tribal lands. Management of Tucson Shovel-nosed Snake habitat on tribal lands is uncertain. Potential threats on tribal lands include development, roads, off-road vehicles, livestock grazing, and solar energy production facilities.

E. Other Factors

Climate change, off-road vehicles, and invasive species are among the additional threats to the survival of the Tucson Shovel-nosed Snake. Each of these is discussed below.

1. Climate Change

Climate change is expected to affect amphibians and reptiles at the individual and population levels through a number of pathways, including shifts in phenology and range; habitat alterations including changes in hydrology, vegetation, and soil; changes in pathogen-host dynamics, predator-prey relationships and competitive interactions which can alter community structure; and interactions with other stressors such as UV-B radiation and contaminants, all of which can affect survival, growth, reproduction and dispersal capabilities (Corn 2005, Blaustein et al. 2010, Mitchell and Janzen 2010, Li et al. 2013 at 146, Wright et al 2015, Boyle et al. 2016, Levy et al. 2016, Ficetola 2016, Wang 2016).

FWS (2014b at 42) largely dismissed the threat of climate change speculating that since Shovel-nosed Snakes currently persist in areas that "experience less precipitation and higher temperatures and are characterized by simpler vegetation communities," the Tucson Shovel-nosed Snake "may be able to persist" if the climate becomes dryer and warmer. But according to Rosen (2015 at 4):

> This optimistic suggestion, however, is contradicted by our surveys in the Avra Valley. According to these and other surveys, the TSS occurs in the less arid transitional region of the Lower Colorado River Valley Sonoran Desert province. Under drought conditions, which are projected to worsen under climate change, surviving species may be those that more successfully utilize the less arid parts of the landscape, such as canyons and major arroyos. Given the rising temperatures and substantial drought episodes from the 1960s through 1970s when the TSS declined and disappeared from Avra Valley, it appears that drought, and thus climate change, may be a threat to the TSS."

Bradley and Rosen (in press at 10) provide further cause for concern, concluding:

> Although the relationship of recent regional climate change to range contraction of *C. a. klauberi* is unclear, climate acclimation via upward elevation range shifts would likely be blocked by anthropogenic land cover changes. *Chionactis annulata klauberi* may be significantly more threatened than foreseen by USFWS (2014), under both current and projected future climate and landscape regimes. As such, protection and restoration of

> sandy, saguaro-free, valley floor and lower bajada habitat in the northeastern Sonoran Desert of central Arizona may deserve higher priority than it is currently afforded.

Thus, the best available information indicates climate change is an additional threat to the Tucson Shovel-nosed Snake compounding threats from urbanization and other sources of habitat destruction.

2. Off-Road Vehicles

Off-road vehicles ("ORVs") pose a threat to the Tucson Shovel-nosed Snake both as a source of habitat destruction and mortality. FWS (2014b at ix) acknowledged this threat, but as with other threats wrote it off based on an incorrect interpretation of range. FWS (2012 at 8), using a range closer to that supported by the best available science and utilized in this petition, considered ORVs a serious threat, stating:

> Given the pervasive use of OHVs on the landscape, OHV-related mortalities are likely a threat to Tucson Shovel-nosed Snakes... In particular, the Gateway and Superstition Vistas Growth Area has been and continues to be impacted by OHV use, although the Arizona State Land Department is in the process of fencing off a part of this area for dust-abatement reasons (Windes 2009, pers. comm.).

Concern was also expressed by Rosen (2008 at 14), noting that the Snake "may also persist on State Lands between the Pima County line and Red Rock, near Pinal Air Park," but that "Off-road vehicle recreation is so intensive in this area that major ecological damage is occurring."

Given this evidence, ORVs must be considered another threat to the continued existence of the Tucson Shovel-nosed Snake.

3. Wildfire and Invasive Species

Wildfire and invasive grasses are a double whammy in the Sonoran Desert Ecosystem with FWS (2012 at 9) concluding:

> After disturbances such as fire, non-native grasses may exhibit dramatic population explosions, which hasten their effect on native vegetation communities. Additionally, with increased fire frequency, these population explosions may lead to a type-conversion of the vegetation community from desert scrub to grassland (Esque and Schwalbe 2002, pp. 175–176; Overpeck and Weiss 2005, p. 2075). Fires carried by the fine fuel loads created by non-native grasses often burn at extraordinarily high temperatures, which may result in soils becoming hydrophobic (water repelling), exacerbating sheet erosion, and contributing large amounts of sediment to receiving drainages and water bodies (Esque and Schwalbe 2002, pp. 177–178). Buffelgrass, in particular, is acknowledged as one of the most serious invasive weeds in the Sonoran Desert due to its ability to spread exponentially (Buffelgrass Working Group 2007, p. 2). It has the potential to invade much of southern and central Arizona, which can lead to recurring grassland fires and the

destruction of native desert vegetation (Buffelgrass Working Group 2007, p. 2). These changes can negatively affect the habitat and prey base of the Tucson Shovel-nosed Snake, although precisely how snake populations would respond is unknown.

Although the exact effects of conversion of Sonoran Desert vegetation to non-native invasive grass with concurrent changes in the fire regime on the Tucson Shovel-nosed Snake are unknown, the best available science suggests this is an additional threat to its survival.

V. REQUEST FOR CRITICAL HABITAT DESIGNATION

The Center for Biological Diversity formally requests the Service designate critical habitat for the Tucson Shovel-nosed Snake concurrently with listing, as required by the ESA (16 U.S.C. 1533(a)(3A)). Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protections; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. 16 U.S.C. § 1532(5).

Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that "classifying a species as endangered or threatened is only the first step in ensuring its survival. Of equal or more importance is the determination of the habitat necessary for that species' continued existence... If the protection of endangered and threatened species depends in large measure on the preservation of the species' habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat." H. Rep. No. 94-887 at 3 (1976).

Critical habitat is an effective and important component of the ESA, without which the Tucson Shovel-nosed Snake's chance for survival diminishes. The Center thus requests that the Service propose critical habitat for the snake concurrently with its proposed listing.

Critical habitat should include all existing habitat of the Tucson Shovel-nosed Snake and agricultural areas with potential for recovery and determined to be important to the survival and recovery of the species. Populations of the Tucson Shovel-nosed Snake are becoming more fragmented and isolated due to loss and degradation of habitat, and local extirpations. In order to conserve the species, populations must be able to expand and connect with other populations.

VI. CONCLUSION

The Tucson Shovel-nosed Snake is a beautiful and unique member of the fauna of the upper Sonoran Desert. Because of its dependence on sandy-loamy soils in flat valley bottoms, the Tucson Shovel-nosed Snake has experienced a severe and dramatic loss of its habitat with likely but poorly studied impacts on populations. Efforts are underway to conserve Sonoran Desert

habitats in portions of the Tucson Shovel-nosed Snake's range. These efforts, however, come too little and late. The Tucson Shovel-nosed Snake clearly merits listing as a threatened or endangered species under the Endangered Species Act.

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