Least Shrew (*Cryptotis parvus*)

Recovery Plan

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Photo courtesy Kory G. Roberts

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1.0 INTRODUCTION

This recovery plan for Least Shrew (*Cryptotis parvus*) was developed under the authority of the New Mexico Wildlife Conservation Act (WCA). The New Mexico Department of Game and Fish (NMDGF) is directed under the WCA to develop recovery plans for species listed as threatened or endangered by the State [17-2-40.1 NMSA 1978]. To the extent practicable, each recovery plan is developed to achieve the following objectives:

- restoration and maintenance of viable populations of the listed species and its habitat to the extent that the species may eventually be downlisted
- avoidance or mitigation of adverse social or economic impacts resulting from recovery actions (if indicated)
- identification of social or economic benefits and opportunities of recovery actions (if indicated)
- use of existing resources and funding to implement the overall plan

To engage the public in the recovery planning process, public information meetings were held on 18 December 2019 in Roswell, New Mexico, and 19 December 2019 in Clovis, New Mexico. Additionally, Dr. Andrew Hope, a mammalogist and molecular ecologist at Kansas State University, and Dr. Jennifer Frey, a mammalogist at New Mexico State University, advised on portions of plan development.

1.1 Executive Summary

This recovery plan for Least Shrew (*Cryptotis parvus*) is developed under the authority of the New Mexico Wildlife Conservation Act (WCA). Recovery plans as mandated under the WCA are long-term conservation and management strategies that are intended to restore and maintain viable populations of the species and its habitat. *Cryptotis parvus* was not known to occur in New Mexico until 1981 and was listed as threatened in 1985, at which time only three occupied sites had been identified. Subsequent reconnaissance surveys have revealed several additional populations in both the prairie grasslands of the northeastern portion of the state and in the Pecos River Valley. The goal of this recovery plan is to ensure the long-term persistence of robust, representative, and secure

populations of Least Shrew in New Mexico's High Plains and Pecos River Valley such that they no longer require protection under the Wildlife Conservation Act.

1.2 Recommended Citation

New Mexico Department of Game and Fish. 2021. Least Shrew (*Cryptotis parvus*) Recovery Plan. New Mexico Department of Game and Fish, Wildlife Management Division, Santa Fe, New Mexico. 27 pp.

1.3 Additional Copies

Additional copies of the Least Shrew Recovery Plan may be obtained from:

Terrestrial Recovery Coordinator
New Mexico Department of Game and Fish
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2.0 BACKGROUND AND NATURAL HISTORY

2.1 Taxonomy and Systematics

Although often mistaken for mice, shrews are only distantly related to rodents (Order Rodentia). All shrews were formerly classified either in the Order Insectivora (e.g., Hall 1981), which included a diverse group of unspecialized insectivorous mammals, or in the Order Soricomorpha (e.g., Hutterer 2005), which included three families of shrews as well as moles and solenodons. However, a recent revision of the taxonomy of these animals using genetic data regrouped the shrews in the Order Eulipotyphla, which includes shrews, moles, solenodons, and hedgehogs (Carraway 2007). Within this order, all shrews are placed in the Family Soricidae.

The shrew genus *Cryptotis* comprises a New World group of approximately 30 species, of which only *C. parvus*[1] occurs north of Mexico (Hutterer 2005)[2]. *C. parvus* was originally described by Say (1823) as *Sorex parvus* from a specimen collected at the "Engineer Cantonment" (a temporary winter camp for military and scientific expeditions in the early 1800s), located along the Missouri River in what is now the vicinity of Fort Calhoun, Washington County, Nebraska. The species was subsequently reassigned to the genus *Blarina*, and then to *Cryptotis* (Whitaker 1974; Hall 1981).

Multiple subspecies of *C. parvus* have historically been recognized (Choate 1970, Whitaker 1974), many of which are no longer considered valid or are now recognized as separate species (Hutterer 2005; Carraway 2007, Hutchinson 2010, Woodman 2018). Based on a recent analysis of mitochondrial data, all Least Shrew populations in New Mexico belong to the subspecies *C. p. parvus* (Andrew Hope, pers. comm.).

C. parvus is usually assigned the common name Least Shrew (e.g., Frey 2004), although Hutterer (2005) used the name North American Least Shrew to distinguish *C. parvus* from other species of *Cryptotis* that occur in Mexico and Central America. Other

[1] Known as to as *C. parva* until Woodman (2018) recommended that the specific epithet for this species be emended to its correct Latin noun gender and spelled *parvus*, rather than *parva*.
[2] Hutchinson (2010) and Woodman (2018) suggested that *C. p. floridana* and *C. p. berlandieri*, respectively, should be considered full species. Corroborative analyses are needed in both cases, however.

common names that have been applied to the species include Small Short-tailed Shrew, Little Short-tailed Shrew, and Bee Shrew (Whitaker 1999).

2.2 Description

Males and females of this small shrew species are comparable in size and appearance. Adults measure about 95 mm in total length (body and tail combined), and have a body mass of about 5 grams (excluding pregnant females; Kaufman and Kaufman 2011). They have very short tails that are less than 45 percent of the head and body length combined, and never more than twice as long as the hind foot (Whitaker 1999; Schmidly and Bradley 2016). As suggested by the genus name *Cryptotis* ("hidden ear"), the ears are very small and typically hidden within the fur. In addition, the eyes are very small. Fur color ranges from brownish to grayish, depending on subspecies and time of year, with grayish color being more common in winter (Whitaker 1999). Choate (1970) described the fur pattern as agouti, in which each hair displays alternating bands of light and dark pigmentation.

2.3 Food Habits

The Least Shrew is an opportunistic predator of small invertebrates. Insect larvae, slugs, snails, spiders, grasshoppers, crickets, and other arthropods have been reported in the diet (Whitaker 1999). Food items that are not eaten at the time of capture may be stored in the shrew's burrow for later consumption (Whitaker 1999). Least Shrews held in captivity have been reported to eat more than their own body mass within a 24 hour period.

2.4 Behavior and Social Organization

The small size and foraging behavior of Least Shrews often makes them difficult to detect in the wild. All shrews are highly active and fast-moving when foraging on the surface, but may also tunnel in leaf litter and loose soil in search of food (Schmidly and Bradley 2016). They travel alongside logs and other surface objects, and often construct runways or use those created by other small mammals to move through dense herbaceous vegetation. Least Shrews can be active at any hour of the day, but are most active on the surface at night. They can be vocal, producing a variety of faint calls that are audible to the human ear.

Least Shrews construct nests of grasses or leaves, which are hidden in dense vegetation, beneath a bush or log, or in a burrow constructed by the shrew or another animal. In Texas, Least Shrews sometimes construct shallow burrow systems with chambers that may be used both for sheltering and for rearing young (Schmidly and Bradley 2016). Although shrews are typically solitary and intolerant of one another outside of the breeding season, the Least Shrew appears to be more social than other species. Whitaker (1999) noted that there are multiple records of several individuals of the Least Shrew occupying the same nest. Other records of group nesting behavior include two different nests in Texas that held 12 and $\geq$ 31 individuals, respectively, and a nest in Virginia that had 25 (McCarley 1959; Whitaker 1999). McCarley (1959) hypothesized that the behavior might function as a heat conservation measure.

2.5 Reproductive Phenology and Biology

In the northern part of its range, the Least Shrew produces young from March to November, whereas in the South it may breed year round. Least Shrews collected in Texas during the winter have been found to be in reproductive condition (Schmidly and Bradley 2016). Litters typically consist of 2-7 young, born after a gestation period of 21-23 days (Whitaker 1999). Newborn Least Shrews are only about 22 mm long. The combined mass of 6 neonates from a litter in Virginia was approximately 2 grams (Whitaker 1999).

2.6 Population Ecology

Little is known about *C. parvus* population ecology and dynamics, in part due to difficulty in reliably trapping this species[3] (Hamilton 1944, Whitaker 1974), and also to logistical constraints in the ability to sample a sufficiently large area to incorporate meaningful demographic and ecological events (e.g., Buckner 1966). Trapping success also can fluctuate widely from year to year, which may reflect cyclic or boom/bust dynamics typical of many small mammal species (Krebs 2009). For example, in four consecutive autumns of trapping small mammals on permanent study plots near

[3] Shrews do not typically respond to bait, and therefore are not readily attracted to standard live-traps or snap-traps. They are most consistently captured in pitfall traps placed such that a shrew accidentally falls into the trap in the course of its daily routine. Because shrew population density and trap placement affect probability of capture, there is an element of haphazardness in relation to capture success.

Lawrence, Kansas, numbers of Least Shrews captured each year varied from 2 to 184 (Rose 1989). Similar results for Least Shrew capture rates have been reported by other researchers (Andrews 1974, Kaufman and Kaufman 2011). Whether these apparent fluctuations in numbers occur at landscape scales, are highly localized, or are mere sampling effects is unknown.

2.7 Predators

In many parts of its geographic range, Least Shrews are commonly preyed upon by owls, especially Barn Owls, as evidenced by the frequent presence of their skulls and skeletal remains in regurgitated pellets (Whitaker 1974; Wright et al. 2016). For example, Least Shrew skulls (n = 141) comprised 41% of the prey remains identified in Barn Owl pellets at a study site in Texas (Whitaker 1999). As noted by researchers in Kansas, "it has long been recognized that owls are better collectors of Least Shrews than are mammologists" (Kaufman and Kaufman 2011). Other predators that are known or likely to prey on Least Shrews include hawks, carnivorous mammals, and snakes (Whitaker 1999). Although no study of predation has been conducted in New Mexico, it is likely that owls, hawks, Long-tailed Weasel, and snakes readily prey on the species. Domestic animals apparently also account for some predation in New Mexico; the first specimens acquired at Tucumcari and at Bitter Lake National Wildlife Refuge were killed by housecats (Hoditschek et al. 1985; Shuster 1989), and three specimens from Curry and Roosevelt counties were brought in to their owners by dogs (NMDGF, unpubl. data).

2.8 Habitat Requirements

Whitaker (1999) described the habitat of the Least Shrew as: (1) grassy, weedy, and brushy fields in the northern part of its range; (2) marshes on the East Coast; and (3) a wide range of habitats, including wooded areas, in the South.

In the southern Great Plains, Least Shrew presence has been documented in a broad array of vegetation types, with various grassland communities predominating in researchers' descriptions of habitat conditions at capture sites (Table 1). Schmidly and Bradley (2016:102) described the habitat in Texas as "grasslands, where it utilizes the surface runways of cotton rats (*Sigmodon* spp.) and other grassland rodents"; they noted that the species "seldom occurs in forests, but occasional individuals have been found under logs

and leaf litter in moist, forested areas." In Colorado, it is known to occur in shortgrass prairie, old field communities, marshy areas, and riparian woodlands; generally, these sites are grassy, weedy, or brushy and are sometimes quite dry (Armstrong et al. 2011).

Table 1. Habitat types occupied (capture sites) by Least Shrews (*Cryptotis parvus*) in the southern Great Plains.

Habitat Type (per reference)	State	Reference
Tallgrass prairie	Kansas	Kaufman et al. 1989; Clark et al. 1995
Mixed grass prairie	Kansas	Kaufman & Kaufman 2008
Sandsage prairie	Kansas	Choate & Reed 1988
Leaf litter in wooded areas	Kansas	Pitts et al. 1987
Pastures	Kansas	Rose 1989
Agricultural fields	Kansas	Kaufman et al. 2000
Abandoned old fields & pastures	Kansas	Swihart & Slade 1990
Managed habitats on interstate highway interchanges	Kansas	Hopton & Choate 2002
Riparian habitat	Colorado	Moulton et al. 1981
Shortgrass prairie, old fields, marshy areas, riparian woodlands	Colorado	Armstrong et al. 2011
Tallgrass prairie	Oklahoma	Payne & Caire 1999
Grassy upland prairie	Oklahoma	Clark et al. 1998
Open grassy areas	Oklahoma	Stancampiano & Schnell 2004
Old fields & disturbed sites	Oklahoma	Payne & Caire 1999
Upland deciduous forest	Oklahoma	Schnell et al. 1980
Grasslands; seldom in forests	Texas	Schmidly & Bradley 2016

In New Mexico, the Least Shrew has most predictably been found in association with dense herbaceous vegetation and moist soil conditions, which may in part reflect the considerably greater trapping effort in mesic and hydric habitats. Alternatively, an apparent preferred association with relatively mesic conditions may be due to higher aridity at the southwestern limit of the species' range. In summarizing generalized habitat characteristics from Least Shrew trapping surveys in New Mexico, Frey (2005) stated that most occupied localities were within or adjacent to "native emergent wetland communities, especially inland saltgrass meadows and marshes dominated by cattail, sedges, rushes, bulrush, and various wetland grasses. However, *C. parva* was also captured in close association with non-native species such as Bermuda grass, Johnson grass, and kochia. Further, *C. parva* infrequently occurred at low relative abundance in alkali sacaton dominated communities that lacked associated wetland plants." In a

limited trapping survey at Kiowa National Grassland (Union County, NM) in 2019, Least Shrews were captured at two wetland sites, one lightly-wooded dry riparian site, and one xeric site in shallow swale in upland prairie (NMDGF, unpubl. data). Habitat affinities of this species in New Mexico require further study.

2.9 Distribution

2.9.1 North America

The Least Shrew is found in eastern North America from the Great Lakes region (southern Ontario, Michigan, New York) south through the eastern United States to Florida and the Gulf Coast states (Whitaker 1974; Hall 1981). It also occurs in Mexico, from Coahuila west to Nayarit and south through Chiapas (Carraway 2007). The elevational range of the species extends from sea level to 2750 m (Carraway 2007). New Mexico is at the southwestern edge of the species' range.

A number of relatively recent records from the western extent of the species' range have been reported, including from Kansas (Choate and Reed 1988), Oklahoma (Dreier et al. 2015), Nebraska (Geluso et al. 2004), Colorado (Choate and Reed 1988; Siemers et al. 2006), Texas (Jones et al. 1993, Choate 1997, Wright et al. 2016), and New Mexico (Hoditschek et al. 1985; Owen and Hamilton 1986). These newer records typically have been interpreted as representing recent westward range expansions from previously known populations on the Great Plains. However, in at least some cases, such records might simply represent discoveries of previously unknown populations in areas that had not been well-surveyed, or where Least Shrew might have been present for long periods but at low densities that eluded detection.

2.9.2 New Mexico

In their review of the mammal fauna of New Mexico, Findley et al. (1975) did not report this species from the state. The first published documentation of Least Shrew in New Mexico was in 1981, when a population was discovered at Tucumcari, Quay County (Hoditschek et al. 1985; but see caveat under *Eddy County* below). Since then additional populations have been reported from scattered sites on the High Plains of northeastern New Mexico and in the Pecos River Valley (Hafner and Shuster 1996; Frey 2005,

NMDGF unpubl. data). Records of Least Shrew occurrence in New Mexico are summarized by region and county below**,** and in Figure 1.

High Plains:

Use of the term High Plains in this document refers to the largely continuous grassland ecosystems associated with the Canadian River and other east flowing tributaries to the Arkansas River, and with the Llano Estacado at the southern extent of the plains (Figure 1). The area so-defined includes portions of both the High Plains and Tablelands Type III Ecoregions (NMDGF 2016), but the habitats potentially suitable for Least Shrew occupation in both Ecoregions are essentially identical.

Union County.—[Map Pins # 1-5] A single specimen was collected in a pitfall trap in November 2017 from Clayton Lake State Park along Seneca Creek, immediately below Clayton Lake Dam (NMDGF, unpubl. data). Least Shrews were also documented in September 2019 at four trapping sites between the City of Clayton and Corrumpa Creek, on Kiowa National Grassland (NMDGF, unpubl. data).

Quay County.—[Map Pins # 6-11] Least Shrews were detected in and near Tucumcari in the early 1980s. Specimens were procured from Tucumcari Lake Wildlife Management Area, within the town of Tucumcari, and at a third site south-southeast of Tucumcari (Hoditschek 1985). In 2005, Frey (2005) surveyed for this species at locations reported by Hoditschek et al. (1985) and at additional sites within the Tucumcari Basin, and found the species to be rather widespread in the area, although Shuster (1988) failed to document occurrence of Least Shrews at a trapping site 5 km downstream from the Conchas Lake dam on the Canadian River. A Least Shrew was trapped at Tucumcari Lake in September 2017, indicating its persistence at this site (NMDGF, unpubl. data).

Curry County.—[Map Pin # 12] A single dead specimen was collected at a private residence approximately 6 miles south of Texico in the southeast corner of the county in January 2018, and a second dead specimen was collected at this site in 2019 (NMDGF, unpubl. data). These records are within an area of extensive agricultural development on the Llano Estacado, and most of the surrounding farmland is intensively irrigated.

Considerable quantities of water escape from the irrigated fields to roadside ditches that support dense emergent and other herbaceous vegetation that likely harbor Least Shrews.

Roosevelt County.—[Map Pins # 13-15] The species was discovered in 1982 at Salt Lake on the Grulla National Wildlife Refuge near the town of Arch (Owen and Hamilton 1986). Subsequent surveys at Salt Lake by Shuster (1988, 1989) and Frey (2005) indicated the persistence of a population at this playa lake. Additionally, a single dead specimen was collected in 2019 at a private residence near Portales in a largely irrigated agricultural landscape.

Colfax County.—[Map Pins # 16-18] Surveys conducted by NMDGF in 2020 revealed the presence of Least Shrews at Laguna Madre/Stubblefield Reservoir, Springer Lake Wildlife Area, and at Sauz Creek on Kiowa National Grassland.

Mora County.—[Map Pin # 19] A single Least Shrew was captured in emergent vegetation associated with a spring on Wagon Mound Lake Wildlife Management Area in July 2020.

Harding County.—[No captures] No least shrews were captured in three nights of trapping in September, 2020, at an isolated wetland site on Kiowa National Grassland, 4.5 km southwest of Mills. One Desert Shrew (*Notiosorex crawfordi*) was captured at this location.

San Miguel County.—[No captures] No Least Shrews were captured at McAllister Lake Wildlife Management Area during four nights of trapping in July 2020.

Pecos River Valley:

Guadalupe County.—[Map Pin # 20] Four Least Shrews were captured in one night of trapping adjacent to a wetland site at Rock Lake Fish Hatchery, Santa Rosa, in October 2018 (NMDGF, unpubl. data).

DeBaca County.—[Map Pin # 21] Seven Least Shrews were captured in three nights of trapping at a wetland site at Bosque Redondo Park, Fort Sumner, in September 2019 (NMDGF, unpubl. data).

Chaves County.—[Map Pins # 22-34] The species was discovered at Bitter Lake National Wildlife Refuge near Roswell in 1985 when a housecat captured a specimen near the refuge headquarters (Hafner and Shuster 1996; Frey 2005). Subsequent surveys on the refuge indicate that the species is relatively widespread in the area (Frey 2005). Least Shrew populations were also documented in 2005 at Bottomless Lakes State Park and on the Bureau of Land Management Overflow Wetlands adjacent to Bottomless Lakes (Frey 2005). In 2018, Least Shrew occurrence was also documented in association with wetlands at the Southwestern Native Aquatic Resources and Recovery Center, Dexter (NMDGF, unpubl. data). This site, at present, constitutes the southern extent of the known occupied range of *C. parvus* in the Pecos River watershed.

Eddy County.—A previously unreported museum specimen of Least Shrew was recently discovered in the mammal research collection at the University of Colorado-Boulder (UCM 10974). This specimen, from 10.4 miles SSE of Artesia, was collected in a snap-trap during small mammal surveys on 10 June 1961, and thus represents the earliest record from New Mexico (T.G. Minton, pers. comm; E.M. Braker, UCM, pers. comm.). The river bottom and floodplain area from which this shrew was taken is now highly degraded, and it is doubtful that *C. parvus* has inhabited this site in recent decades.

More recent surveys for Least Shrew in remnant potential habitat areas in Eddy County have been unsuccessful. Shuster (1988, 1989) conducted trapping surveys for this species near the confluence of the Pecos and Black rivers in the 1980s but failed to detect it. Other unsuccessful trapping surveys directed at Least Shrew were conducted in 2017-2018 in moist-soil areas at the Huey Wildlife Management Area and at the downstream extent of the former Lake McMillan, both near Artesia (NMDGF, unpubl. data). Intensive trapping at six sites in the upper watershed of the Black River in October 2018 and again at the BLM Black River Recreation Area in September 2020 also failed to detect the species (NMDGF, unpubl. data). Whereas there are extensive habitat areas at the BLM site in the upper Black River watershed that appear to be highly suitable for occupation by *C. parvus*, the Pecos River mainstem and its associated floodplains are highly degraded through virtually all of Eddy County south of Artesia, and it seems likely that Least Shrews may be entirely absent most or all of this county. The most suitable habitat remaining on the Pecos River proper is at the Huey WMA. Recent wetland and

riparian restoration efforts there may benefit the species if this site is within dispersal distance of an extant population.

3.0 HABITAT AND POPULATION ASSESSMENT

3.1 Current Status Summary

The species apparently had a more extensive range in New Mexico during the Pleistocene when more mesic conditions occurred across much of the state (Hafner and Shuster 1996). Fossil records of the Least Shrew are available from two paleontological sites: Dry Cave near Carlsbad, Eddy County, and Howells Ridge Cave in the Little Hatchet Mountains, Hidalgo County (Harris et al. 1973). The Hidalgo County fossil site is far outside of the current known range of the species and the Eddy County site currently lacks suitable habitat for the species.

Based on morphology and a genetic assessment using allozyme loci, Hafner and Shuster (1996) discussed the possibility that populations in the Pecos River Valley, which they assigned to the subspecies *C. p. berlandieri*, may be Pleistocene relicts, whereas populations on the High Plains, assigned to *C. p. parvus*, are possibly of more recent origin in the state, perhaps the result of westward dispersal facilitated by agricultural development in the region and three decades of predominately cooler and wetter climatic conditions beginning in the mid-1960s (Frey 1992, Hafner and Shuster 2005). Preliminary results of an ongoing genetic/genomic assessment at Kansas State University, however, indicate that all Least Shrew populations in New Mexico are likely assignable to *C. p. parvus*, and that populations inhabiting Chaves County (Pecos River Valley), while not *C. p. berlandieri*, appear to be derived from a different founding source than those of the High Plains (Andrew Hope, pers. comm.).

At the time of state listing as threatened in 1985, Least Shrews were known from only three locations and five specimens in New Mexico. Prior to the listing decision, no trapping surveys had been done to further elucidate the species' distribution in the state or to establish a more robust understanding of the status of local populations in the vicinity of the initial specimen collection sites. Subsequently, trapping efforts by Shuster (1989, 1996) and Frey (2005) provided additional information on populations at the previously

known sites, indicating that at the very least that *C. parvus* was well-distributed in the Tucumcari Basin as well as within and adjacent to wetlands associated with the Bitter Lake/Bottomless Lakes/BLM Overflow Wetlands complex. NMDGF undertook additional trapping surveys (2017 to the present) with the goal of expanding our understanding of the current range of Least Shrew on the High Plains and in the Pecos River Valley. Preliminary results of these surveys in conjunction with recent specimens obtained adventitiously from the Llano Estacado (Curry and Roosevelt counties) indicate that *C. parvus* is substantially more widespread than previously thought. Results from the High Plains and Pecos River Valley are discussed below.

High Plains:

Based on results of surveys conducted to date, in combination with recent occurrence records from adjacent states, we believe that Least Shrew populations likely are widely distributed across the High Plains from at least Grulla National Wildlife Refuge north to the Colorado border, and westward to near the foothills of the Sangre de Cristo Mountains (Figure 1). Further, it appears likely that the species may not be strictly associated with streams, irrigated farmland, playas, and wetland/mesic habitat conditions on the High Plains. Findings from more xeric sites on Kiowa National Grassland in conjunction with published literature from Kansas, Colorado, Oklahoma, and Texas (see Table 1) may indicate that dense ground cover alone may sometimes be indicative of Least Shrew presence irrespective of local soil moisture conditions. Additional trapping surveys at prairie sites dominated by buffalo-grass and structurally similar graminoids is warranted. Also warranted are additional surveys aimed at exploring occupation of the current (unsurveyed) gap in distribution through the central portion of New Mexico's High Plains (Figure 1).

Pecos River Valley:

Habitat affinities of *C. parvus* in the Pecos River watershed may be somewhat different from those of the High Plains, which possibly reflects the fact that Least Shrews in that ecoregion appear to be of different origin. To date, with a single exception, all sites where the species has been documented in the Pecos River Valley are remnant ciénegas (i.e., persistent ancient wetlands) (Cole and Cole 2015). Least Shrew capture sites at

Santa Rosa, Bitter lake National Wildlife Refuge, Bottomless Lakes State Park, BLM Overflow Wetlands, and Dexter are all associated with functioning remnant ciénegas (Sivinski and Tone 2011). The sole exception among Pecos River shrew capture sites is Bosque Redondo, Fort Sumner, where the trapping site is at a well-developed permanent wetland in an old oxbow river channel that is not dissimilar in character to the occupied ciénegas elsewhere in the valley.

3.2 Threats

Throughout most of its North American range, the Least Shrew is apparently common and is not of conservation concern. However, in the more arid western part of its range, the species might be more limited in distribution due to the lower availability of suitable habitat or climatic extremes, and thus more prone to local extirpation. The listing of Least Shrew in 1985 as State Threatened in New Mexico was predicated on its limited and rather fragmented distribution in the state (at that time), presumed small population sizes, and its apparent dependence on mesic habitats that are prone to loss or degradation from water diversion, agriculture, overgrazing, and drought (Jones and Schmitt 1997; NMDGF 2016, 2018).

With our current improved understanding of distribution and habitat use in the state, it is not clear that the threats identified at the time of listing are now of particular concern. There are large, relatively secure conservation areas that support populations of Least Shrews, including several DGF Wildlife Management Areas, Grulla NWR, Clayton Lake State Park, Bitter Lake NWR, Bottomless Lakes State Park, BLM Overflow Wetlands, Dexter Hatchery NWR, and Rock Lake Fish Hatchery and adjacent Rock Lake conservation easement. Moreover, Bitter Lake National Wildlife Refuge and Bottomless Lakes State Park were collectively designated (*Roswell Artesian Wetlands*) as wetlands of international importance in 2010 under the Ramsar Convention, and the BLM has designated its Overflow Wetlands as an Area of Critical Environmental Concern, managed by the agency for biological and scenic values (BLM 2003). NMDGF's plans for significant wetland habitat rehabilitation at Tucumcari Lake WMA will likely enhance existing habitat and/or create new, and perhaps more stable, habitat conditions for Least Shrew. Finally, Least Shrew populations on the High Plains of New Mexico

are contiguous with known or presumed occupied habitat in Colorado, Oklahoma and Texas.

4.0 ECONOMIC AND SOCIAL IMPACTS

No adverse economic or social impacts related to conservation or management of Least Shrews are anticipated in association with recovery planning. Any proposed recovery activities will be focused on state (NMDGF) and federal lands (BLM, U.S. Forest Service, U.S. Fish & Wildlife Service).

Under the provisions of the Wildlife Conservation Act, NMDGF does not have authority on lands it does not own to prevent habitat-altering activities that might have an adverse effect on state-listed species, or to require activities that would benefit the species. Potential actions proposed to achieve recovery of Least Shrew would have to be coordinated with all stakeholders, including federal land management agencies, and any actions that would be carried out on private lands would require voluntary cooperation of the landowner or land manager.

5.0 RECOVERY AND CONSERVATION STRATEGY

The Least Shrew was state-listed as threatened in 1985 based on what at the time was thought to be a highly limited and disjunct distribution. Subsequent reconnaissance trapping surveys indicate that *C. parvus* is substantially more widespread than previously thought, occurring throughout several portions of New Mexico's High Plains and the Pecos River Valley, with the species' occupied range also extending more or less continuously northward and eastward in adjoining states.

Species recovery is often based on restoring a species to a percentage of its historic range. However, Least Shrew occurrence was not documented in New Mexico prior to 1981, and little has been learned about its distribution until recently. In the absence of historical information, we focus this recovery plan on ensuring long-term persistence of the species in representative core recovery areas in both the High Plains and Pecos River Valley regions.

Recovery Goal:

To ensure the long-term persistence of robust, representative, and secure populations of Least Shrew in New Mexico's High Plains and Pecos River Valley such that they no longer require protection under the Wildlife Conservation Act and may be delisted.

Recovery Objective:

To obtain sufficient data and related documentation on *C. parvus* distribution, taxonomy, habitat affinities, and habitat security to allow for an objective assessment of the species' current conservation status, its prospects for long-term persistence, and its potential for near-term delisting.

Recovery Criteria:

Least Shrew may be removed from the New Mexico list of threatened and endangered species when it can be demonstrated that conditions for ensuring habitat and population representation, redundancy, and resilience have been met in both the High Plains and Pecos River Valley regions of the state, as follows:

1. In each of the High Plains and Pecos River Valley regions, identify a minimum of four core recovery areas in representative habitat types occupied by Least Shrews in that region.

2. Each core recovery area must comprise at least four separate habitat patches in which Least Shrew presence has been confirmed. The localities must be distributed such that there is high potential for overall population resilience within the core recovery area in the face of local perturbations and disturbances. This may include potential for dispersal between some of the localities, and differing habitat features among localities. The spatial configuration of the occupied localities within each core area will ultimately depend on site-specific habitat characteristics.

3. Each core recovery area must contain at least one occupied habitat patch on property that is conserved and/or managed for wetland or wildlife values (e.g., Wildlife Management Area, National Wildlife Refuge, Area of Critical Environmental Concern, etc.) to help ensure Least Shrew habitat and population protection into the future.

Recovery Tasks:

Specific recovery tasks will focus on achieving greater taxonomic clarity and gathering additional data on distribution, habitat affinities, and habitat security to identify core recovery areas in each region that are sufficiently extensive to support viable, redundant populations of Least Shrews into the future.

1. Better define aspects of the distribution of *C. parvus* in New Mexico.

1.1. Conduct additional reconnaissance trapping surveys in the central and western portions of the High Plains.

1.2. Continue to define upstream and downstream limits to Least Shrew distribution on the Pecos River.

2. Resolve outstanding questions concerning the taxonomic status and evolutionary history of *C. parvus* in New Mexico, particularly with reference to whether populations in Chaves County (Pecos River Valley) are sufficiently distinct genetically to be considered an Evolutionarily Significant Unit, and whether *C. parvus* occurrence on the High Plains is in fact due to recent westward expansion of the species' range.

2.1. Sequence and analyze genomic data to assess the taxonomic status of apparently disjunct populations of Least Shrew in New Mexico.

2.2. Assess the genetic demographic histories of independent populations, including, as feasible, estimates of genetic diversity, gene flow, and population trends.

3. Develop a better understanding of broad-scale habitat affinities of *C. parvus* in both occupied regions of New Mexico.

3.1. Establish the extent to which *C. parvus* is confined to sites with mesic and hydric soil conditions. To help address this, additional trapping surveys should be conducted in more xeric sites with structurally dense herbaceous vegetation.

3.2. Conduct trapping surveys at off-river springs (Milford et al. 2001) and associated habitats in Chaves County.

3.3. Conduct trapping surveys in irrigated agricultural lands of the Llano Estacado to verify Least Shrew use of these habitats (currently surmised from specimens collected by dogs).

4. Assess projected habitat availability and security across the Least Shrew's range in New Mexico.

4.1. Habitat availability and pervasive threats to future habitat availability should be assessed across the shrew's range to ensure that a sufficient number of populations of *C. parvus* in New Mexico are free from foreseeable pervasive threats to future survival, as indicated by habitat characteristics, land ownership, management practices, and projected future habitat security.

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7.0 APPROVALS

_____ _____

Stewart Liley, Wildlife Management Division Chief Date
New Mexico Department of Game and Fish

_____ _____

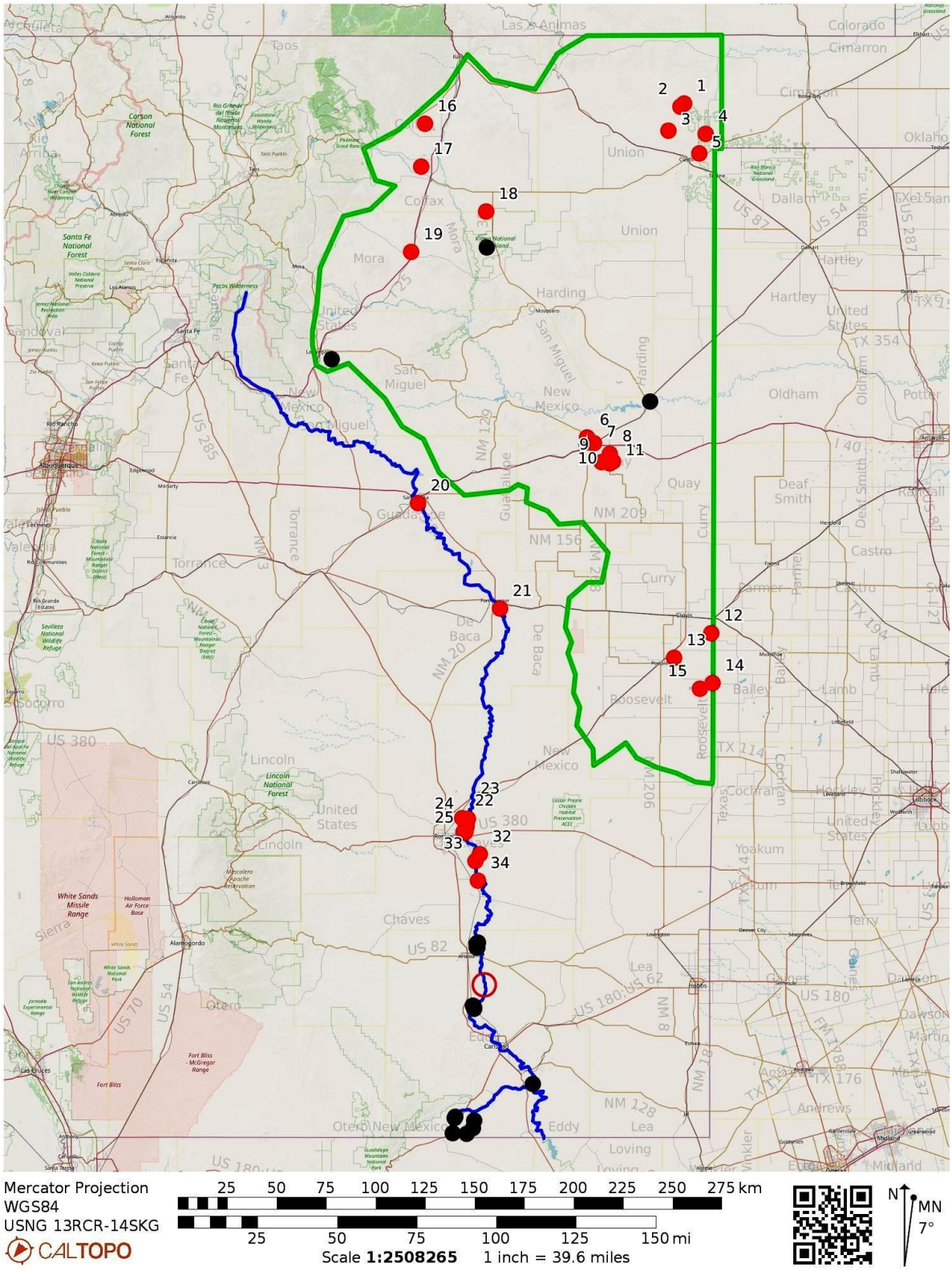
Michael Sloane, Director Date
New Mexico Department of Game and Fish

_____ _____

Sharon Salazar Hickey, Chair Date
New Mexico State Game Commission

8.0 FIGURES

Figure 1. *C. parvus* distribution in New Mexico as currently revealed by ongoing trapping surveys. The numbered red dots are documented Least Shrew occurrence locations that correspond to the localities discussed in the text (Section 2.9.2). Black dots are trapping sites at which no shrews were captured. The open red circle is the location of the 1961 capture record in Eddy County, now in a highly unsuitable habitat condition. The blue line is the Pecos River. The green polygon encompasses shortgrass prairie habitats of the High Plains and adjacent (to west) Tablelands ecoregions. In the text of this recovery plan, use of the term "High Plains" refers collectively to both ecoregions. There are no *C. parvus* records either due south of this polygon in New Mexico or to the southeast in Texas.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