

**Petition to list the Mexican Garter  
Snake, *Thamnophis eques megalops*,  
as an endangered or threatened  
species under the  
Endangered Species Act**

**Center for Biological Diversity  
Petitioner  
December 2003**



December 15, 2003

Ms. Gale Norton  
Secretary of the Interior  
Office of the Secretary  
Department of the Interior  
18th and "C" Street, N.W.  
Washington, D.C. 20240

CC: Dale Hall  
Head of Southwest Region  
US Fish and Wildlife Service  
500 Gold Ave. SW  
Albuquerque, NM 87102

Ms. Norton,

The Center for Biological Diversity hereby formally petitions to list the Mexican Garter Snake (*Thamnophis eques megalops*) as threatened or endangered pursuant to the Endangered Species Act, 16 U.S.C. 1531 et seq. (ESA). This petition is filed under 5 U.S.C. 553(e) and 50 CFR 424.14 (1990), which grants interested parties the right to petition for issue of a rule from the Assistant Secretary of the Interior.

The petitioner also requests that Critical Habitat be designated concurrent with the listing, as required by 16 U.S.C. 1533(b)(6)(C) and 50 CFR 424.12, and pursuant to the Administrative Procedures Act (5 U.S.C. 553).

The grounds for this petition are documented population declines, decreased range, and local extirpations of the Mexican garter snake. Petitioners believe the Mexican garter snake warrants endangered or threatened status on the ESA based on its current population status and significant threats. Threats throughout its range include: loss of wetlands, urbanization, habitat alteration, pollution, livestock grazing, loss of native prey species, and exotic species predation.

The USFWS has three options for listing the Mexican garter snake under the ESA: (1) listing the U.S. population as a Distinct Population Segment (DPS); (2) listing the species throughout its range in the U.S. and Mexico based on its rangewide status; or (3) listing the species throughout its range in the U.S. and Mexico based on its U.S. status, which qualifies as a significant portion of the species range. Listing under the Endangered Species Act with designation of Critical Habitat is necessary to ensure the conservation of the Mexican garter snake. Current regulatory mechanisms and conservation designations have been inadequate to mitigate the decline of the species.

**Petitioners:**

**Center for Biological Diversity** is a conservation organization dedicated to preserving all native wild plants and animals, communities, and naturally functioning ecosystems in the Northern Hemisphere.

## **Table of Contents**

<b>I. EXECUTIVE SUMMARY .....</b>	<b>5</b>
<b>II. INTRODUCTION.....</b>	<b>7</b>
<b>III. NATURAL HISTORY .....</b>	<b>7</b>
A. TAXONOMY .....	7
B. SPECIES DESCRIPTION.....	8
C. FEEDING .....	9
D. REPRODUCTION.....	10
E. NATURAL MORTALITY AND DEFENSE .....	10
F. SEASONAL ACTIVITY.....	11
G. HABITAT DESCRIPTION AND REQUIREMENTS .....	11
1. <i>Habitat Description</i> .....	11
2. <i>Habitat Requirements</i> .....	12
i. Permanent water.....	12
ii. Vegetative cover .....	12
iii. Native prey species.....	13
H. DISTRIBUTION .....	13
1. <i>Arizona</i> .....	13
2. <i>New Mexico</i> .....	16
<b>IV. THE MEXICAN GARTER SNAKE IS A LISTABLE ENTITY UNDER THE ESA.....</b>	<b>16</b>
A. DISTINCT VERTEBRATE POPULATION SEGMENT .....	17
1. <i>Discreetness</i> .....	17
2. <i>Significance</i> .....	18
i. Loss of the Mexican garter snake in Arizona and New Mexico would create a significant gap in the species range.....	19
ii. The Mexican garter snake in the U.S. likely has different genetic characteristics than Mexican populations.....	19
iii. The Mexican garter snake is an indicator species for..... southwest riparian ecosystems .....	20
B. ENDANGERED OR THREATENED IN A SIGNIFICANT PORTION OF ITS RANGE OR THROUGHOUT ITS ENTIRE RANGE. ....	20
<b>V. CONSERVATION STATUS .....</b>	<b>21</b>
A. CURRENT STATUS .....	21
B. LISTING HISTORY AND DEFINITIONS OF CURRENT CONSERVATION STATUS .....	22
1. <i>Federal</i> .....	22
2. <i>Arizona</i> .....	22
3. <i>New Mexico</i> .....	22
4. <i>Mexico</i> .....	23
5. <i>Heritage Status</i> .....	23

<b>VI. POPULATION STATUS .....</b>	<b>23</b>
A. STATUS OF POPULATIONS IN ARIZONA .....	23
1. <i>San Bernardino National Wildlife Refuge</i> .....	24
2. <i>Finley Tank</i> .....	24
3. <i>Scotia Canyon</i> .....	25
4. <i>Lower San Raphael Valley</i> .....	26
5. <i>Arivaca Ciénega</i> .....	26
6. <i>Babocomari Ciénega</i> .....	26
7. <i>Ciénega Creek at Empire-Ciénega Ranch</i> .....	26
8. <i>Lower Ciénega Creek at Ciénega Creek County Preserve</i> .....	27
B. STATUS OF POPULATIONS IN NEW MEXICO .....	27
C. EXTIRPATED POPULATIONS AND DECREASED RANGE.....	27
D. POPULATION NUMBERS .....	27
E. STATUS IN MEXICO .....	28
F. POPULATION VIABILITY .....	28
<b>VIII. THE MEXICAN GARTER SNAKE IS ENDANGERED UNDER THE ESA</b> <b>.....</b>	<b>28</b>
A. DESTRUCTION, MODIFICATION, OR CURTAILMENT OF ITS HABITAT OR RANGE.....	29
1. <i>Destruction and Loss of Wetlands</i> .....	29
2. <i>Livestock grazing</i> .....	30
3. <i>Decline in the food base of the Mexican garter snake: Loss of native prey species</i> .....	31
B. OVERUTILIZATION FOR COMMERCIAL, RECREATIONAL, SCIENTIFIC, OR .....	32
EDUCATIONAL PURPOSES.....	32
C. DISEASE AND PREDATION.....	33
D. INADEQUACY OF EXISTING REGULATORY MECHANISMS .....	34
E. OTHER NATURAL OR ANTHROPOGENIC (HUMAN-CAUSED) FACTORS .....	35
<b>IX. RECOMMENDATIONS FOR RECOVERY PLAN .....</b>	<b>35</b>
<b>X. REQUEST FOR CRITICAL HABITAT DESIGNATION.....</b>	<b>37</b>
<b>XI. CONCLUSION.....</b>	<b>38</b>
<b>XII. REFERENCES.....</b>	<b>39</b>
<b>XIII. UNPUBLISHED SOURCES.....</b>	<b>42</b>

**LIST OF FIGURES**

FIGURE 1: <i>THAMNOPHIS EQUES MEGALOPS</i> , FROM GRANT COUNTY (DEGENHARDT ET AL. 1996, PLATE 108).....	9
FIGURE 2: DISTRIBUTION OF <i>THAMNOPHIS EQUES</i> AND ITS SUBSPECIES: (1) <i>T. E. EQUES</i> ; (2) <i>T. E. MEGALOPS</i> ; (3) <i>T. E. VIRGATENUIS</i> . (ROSSMAN 1996).....	14
FIGURE 3: DISTRIBUTION OF MEXICAN GARTER SNAKES IN THE U.S. (ROSEN 2003) .....	15
FIGURE 4: MEXICAN GARTER SNAKE POPULATION AT FINLEY TANK, AZ, ROSEN ET AL. 2001 .....	25

## I. EXECUTIVE SUMMARY

The Mexican garter snake, *Thamnophis eques megalops* (*T. e. megalops*), is an aquatic garter snake found in Arizona, New Mexico, and Mexico. *T. e. megalops* is a subspecies of *T. eques* first documented by R. Kennicott in 1860. The species is an olive-brown color with three bright lateral stripes. Habitat requirements include: permanent water, vegetative cover, and native prey species.

*Thamnophis eques megalops* qualifies as a Distinct Vertebrate Population Segment (DPS) under the Endangered Species Act. The U.S./Mexico international border creates a discreet population with international differences in regulatory mechanisms, quality of information, habitat occupied, and types of threat. The Mexican garter snake in the U.S. is significant because (1) their loss would create a significant gap in the species distribution, including the entire distribution of the species in the U.S. (2) the U.S. populations are likely genetically distinct (3) the Mexican garter snake is an indicator species for the health of southwest riparian ecosystems.

The USFWS may also list the Mexican garter snake as Endangered or Threatened throughout its entire range.

*T. e. megalops* ranges from central and southern Arizona, to southwestern New Mexico, and into Mexico in the states of Sonora, Chihuahua, Durango, Guanajuato, Hidalgo, and San Luis Potosi. Exact population numbers are unknown, but population decline is documented in New Mexico and Arizona. Populations of Mexican garter snakes have been extirpated from Tucson, Phoenix, along the Colorado River, Lower Santa Cruz River, Salt River, Gila River, San Pedro Valley, and along the Gila River and Duck Creek in New Mexico.

Current threats to the Mexican garter snake include: (1) destruction, modification, and curtailment of its habitat and range, (2) illegal collection or intentional take, (3) predation from non-native species, (4) inadequacy of existing regulatory mechanisms, and (5) competition with Checkered garter snakes.

The destruction, modification, and curtailment of its habitat and range are caused by urbanization, loss of wetlands, loss of native prey species, livestock grazing, and climate change. Development of the southwest has caused a significant loss of wetlands and riparian areas and degraded suitable habitat. Ciénegas, the ideal habitat for *T. e. megalops* in Arizona, are known to be in decline. Climate change and drought are negatively affecting the riparian habitat of the Mexican garter snake. The Mexican garter snake is particularly sensitive to the modification of habitat from livestock grazing and the loss of native prey species.

Non-native bullfrogs are known to prey on the Mexican garter snake and extirpate local populations. In addition, the bullfrog is a predator to the Mexican garter snake's native prey. Bullfrogs have been known to prey on and extirpate leopard frogs, one of the

Mexican garter snake's key food sources. The Mexican garter snake is particularly sensitive to the loss of native prey species.

Currently, the Mexican garter snake receives no federal protection. In New Mexico, the species is listed as Endangered and in Arizona, the Mexican garter snake is listed as a "Species of Special Concern." It is listed as "vulnerable to extirpation or extinction" in the Natural Heritage Database. However, these listings are inconsequential as neither state has produced any conservation programs or recovery plans or taken substantial action to protect the species' habitat. The Mexican garter snake is co-existent with other species listed on the ESA, yet this co-occurrence has not halted decline.

Additional conservation measures are recommended by the Center for Biological Diversity to insure recovery of the Mexican garter snake. These measures include: (1) increase surveys of the Mexican garter snake to accurately determine population status and distribution, (2) eliminate non-native predators including bullfrogs and predatory fish, (3) fence wetlands with existing Mexican garter snake populations to sustain and propagate for reintroduction, (4) protect and conserve the species' food base including native leopard frogs and native fish, (5) manage lands to preserve vegetative cover and manage perennial flows for lakes, rivers, streams, and ciénegas in current and historical habitat, (6) create an international agreement with Mexico to protect and conserve *T. e. megalops*.

Petitioners request critical habitat designation concurrent with ESA listing. Critical habitat should be connected vegetated riparian areas that include floodplains and watersheds in current and historic habitat of the Mexican garter snake.

## II. Introduction

Riparian areas in the Southwest are a refuge for humans and wildlife alike. The rivers, streams, headwaters, and marshes provide a dynamic element to the desert landscape that serves as a breeding ground for biological diversity. With such a small fraction of the southwest's land as wetlands, it is evident that these areas must receive vigorous management and protection. The wetlands of the southwest are quickly diminishing. In Arizona and New Mexico, nearly 90% of presettlement riparian wetlands have been lost (George 1996). Loss of riparian areas and loss of biodiversity go hand in hand in the arid Southwest.

Native obligate riparian species are clearly threatened throughout their distribution in the southwest. Riparian species are the first species to disappear from disturbances in the riparian community. Although not systematically recorded, local extinctions of obligate riparian reptile species are known to have occurred in Arizona over the last 20 years (Lowe 1985).

The Mexican garter snake is considered a native obligate riparian species with a threatened population. In the 1960's the species was extirpated from the Rillito floodplain in Tucson (Lowe 1985). Since then, surveys have shown the species to have disappeared from other historic habitat. Jeffrey Howland (2000), a biologist with the U.S. Fish and Wildlife Service affirmed, "Mexican garter snakes are a strong candidate to become the first species lost from Arizona's rich reptile fauna"

Rosen, Wallace, and Schwalbe (2001) clearly demonstrated population decline of the Mexican garter snake in southern Arizona. They asserted the decline in Mexican garter snakes is "intimately linked" to two other acute declines: (1) the collapse of native ranid frogs and native fishes and (2) the quality of lowland perennial waters in the Southwest. For these reasons, their principal recommendation was that *Thamnophis eques megalops* be listed as a Threatened Species under the ESA.

This petition will relate the natural history of the Mexican garter snake including its habitat requirements and distribution. We will go on to substantiate the species is eligible for listing pursuant to the ESA and recount its current conservation status and listing history. Then we will cite scientific literature in describing the population status and threats to the species to verify the species is endangered. Finally we will recommend additional conservation measures to effectively conserve the Mexican garter snake.

## III. NATURAL HISTORY

### A. Taxonomy

The Mexican Garter Snake is a subspecies of *Thamnophis eques*. Its complete taxonomic classification can be found in Table 1. The genus *Thamnophis*, includes all garter snakes, a common snake with 30 recognized species from southern Canada to Costa Rica

(Howland 2000). Five species of garter snakes reside in Arizona, and all depend on aquatic habitats (Howland 2000).

**Table 1: Taxonomic classification of the Mexican garter snake**

<b>Kingdom</b>	<b>Phylum</b>	<b>Class</b>	<b>Order</b>	<b>Family</b>	<b>Genus</b>	<b>Species</b>	<b>Subspecies</b>
Animalia	Chordata	Reptilia	Squamata	Colubridae	Thamnophis	eques	megalops

*Thamnophis eques* was first documented by Reuss in 1834, and *T. e. megalops* was first documented by R. Kennicott in 1860 (AGFD 2001). The type locality of *T. e. megalops* is Tucson, AZ (AGFD 2001), however the species is currently extirpated from this area.

Various scientific names were used for the Mexican Garter Snake until the nomenclature stabilized in 1951. Early literature on the species can be found under *Eutaenia megalops*, *T. subcarinatus megalops*, or *T. macrostemma megalops* (Degenhardt et al. 1996). Other common names are Arizona garter snake, Emory’s garter snake, and Arizona ribbon snake. There are three officially recognized subspecies of *Thamnophis eques*: *T. e. eques*, *T. e. virgateniatus*, and *T. e. megalops*. *T. e. megalops* is the only subspecies found in Arizona and New Mexico. The other two subspecies are found only in Mexico. (Rosen and Schwalbe 1988) Recently, seven new subspecies of *T. eques* have been described by Conant (2003). All seven new subspecies are found in the Lakes of Mexico’s Transvolcanic Belt. The isolation of the volcanic lakes has allowed the species to evolve separately.

## **B. Species Description**

The Mexican garter snake is a medium sized garter snake with a maximum length of one meter. It ranges in color from olive to olive-brown to olive-gray. Three stripes run the length of the body with a yellow stripe down the back that darkens toward the tail. The lateral stripes distinguish *T. eques* from other garter snakes because a portion of the lateral stripe is found on the fourth scale row. Paired black spots extend along the dosolateral fields. A light-colored crescent extends behind the corners of the mouth. (Rosen and Schwalbe 1988)





Figure 1: *Thamnophis eques megalops*, from Grant County (Degenhardt et al.. 1996, Plate 108)

### C. Feeding

The Mexican garter snake is classified as a terrestrial-aquatic generalist because across its geographic range it feeds mainly on the air/water interface taking both aquatic and terrestrial prey (Drummond and Marcias Garcia 1989). Mexican garter snakes have a varied diet consisting of mostly frogs, tadpoles, and fish, supplemented by lizards and mice. Species of greatest importance in their diet are leopard frogs (*Rana chiricahuensis* and *R. yavapaiensis*), Gila and roundtail chub (*Gila robusta* and *G. intermedia*), Woodhouse toad (*Bufo woodhousei*), and Gila topminnow (*Poeciliopsis occidentalis*). (Rosen and Schwalbe 1988)

*T. e. megalops* in Scotia Canyon, Arizona had a diet of larval and adult bullfrogs, larval tiger salamanders, mountain treefrogs, and earthworms (Holm and Lowe 1995). At a study site in the northern Mexican Plateau, *T. eques* were recorded eating mainly frogs along with tadpoles and terrestrial prey (Drummond and Marcias Garcia 1989).

*Thamnophis eques* studied in Toluca, Mexico were found to have eaten larvae, *Hyla* sp., earthworms, mice, and slugs (Manjarrez 1988). Drummond and Marcias Garcia (1989) found *T. eques* are locally specialized in feeding on only 2 or 3 prey taxa.

The Mexican garter snake forages in water and on land for its prey. Foraging is often done in vegetative cover like aquatic grasses, spikerushes, seep willow, sacaton, and deergrass. *T. e. megalops* has been observed eating fish trapped in drying pools. (Rosen and Schwalbe 1988) *T. eques* searches for prey on the water surface. Substantial foraging time is spent “cruising” along the shore, and an attack may include a sudden lunge across the surface toward prey. (Drummond and Marcias Garcia 1989)

Native prey species are of particular importance to *T. e. megalops*. Rosen and Schwalbe (1988) stated,

In general, we consistently observed that substantial populations of Mexican garter snakes only occur where anurans and prey fish are also plentiful. In areas where such prey are scarce due to introduced predators or other causes, few garter snakes were seen. Native prey species seem to play a larger role in the ecology of *Thamnophis eques* than for the other striped Arizona species, the black-necked (*T. cyrtopsis*), the wandering (*T. elegans vagrans*) or the checkered (*T. marcianus*) (p.20).

Native prey species for the Mexican garter snake are declining and becoming increasingly rare. Chiricahua leopard frogs and Gila topminnow are listed on the ESA. The disappearance of leopard frogs is documented in various habitat localities of the Mexican garter snake. The Gila chub is proposed for ESA listing and the roundtail chub is under petition for listing. The loss of native prey species and its effects on the Mexican garter snake is discussed in more detail in section VI-A.

#### **D. Reproduction**

Like all garter snakes, *T. eques* is viviparous, giving birth to live young instead of laying eggs (Howland 2000). Males breed in fall and early spring, and females store the sperm until ovulation in late March or early April (Howland 1991). Young are born sometime in early June to early July (Rosen and Schwalbe 1998). On average about half of the females in a population will give birth each year to 10-20 young (Howland 1991). Males mature in 2 years while females reach maturity in 2 to 3 years and females will grow larger than males. (Rosen and Schwalbe 1988)

#### **E. Natural Mortality and Defense**

The Mexican garter snake is considered long-lived, surviving at least 10 years in the wild (Rosen and Schwalbe 1996). Natural mortality occurs from native predators like red-tailed hawks, kestrels, kingsnakes, whipsnakes, owls, accipiters, buteos, herons, skunks, raccoons, and coyotes. In addition, non-native bullfrogs and predatory fish are causing significant mortality to Mexican garter snakes. (Rosen and Schwalbe 1988)

*T. eques* seeks shelter in thick streamside vegetation. *T. eques* prefers to be more secretive than other garter snakes and remain hidden in vegetation instead of basking in the open (Painter 2000). If threatened, the snake will flatten its head and strike repeatedly (Degenhardt et al. 1996). *T. eques* is not venomous but will bite and emit a foul musk when disturbed. Their tail breaks easily if attacked by a predator. This defense mechanism allows for escape, but the tail does not regenerate (Howland 1991). Evidence of this defense was seen in a study by Rosen and Schwalbe (1995) on the effects bullfrogs had on Mexican garter snakes. All the older snakes that had survived bullfrog predation had damaged tails. An infected tail from bullfrog predation may lead to mortality of Mexican garter snakes (see Section VIII-C).

## **F. Seasonal Activity**

The activity of the Mexican garter snake can be related to temperature as seen in a study by Javier Manjarrez (1998). The study was conducted in Mexico, northwest of Toluca City in grassland habitat. *T. eques* had two seasonal peaks of activity, from September to October and April to June. *T. eques* was earliest observed on March 6<sup>th</sup> and last seen November 25<sup>th</sup>. Manjarrez also found a correlation between monthly temperature and births.

Holm and Lowe (1995) found the primary limit to activity was ambient temperature. Mexican garter snakes were active from 14.8-27.8°C air temperature, 19.0-31.5°C surface temperature, and 22.1-22.5°C water temperature. They are active diurnally and nocturnally and forage whenever prey is available.

## **G. Habitat Description and Requirements**

### **1. Habitat Description**

Habitat is found between 1739 and 6152 feet (530-1875m) in elevation, but most frequently between 3000 and 5000 ft (914 - 1524 m). Formerly, the Mexican garter snake was found as low as 174 ft near Yuma. There are three general habitat types in Arizona: source area ponds and ciénegas, lowland river riparian forests and woodlands, and upland stream gallery forests (Rosen and Schwalbe 1988).

Source area wetlands, such as ciénegas, ciénega-streams, and stock tanks, are the most important habitat type in Arizona. In source-area wetlands like ciénegas, vegetation consists of knot grass (*Paspalum distichum*), spikerush (*Eleocharis*), bulrush (*Scirpus*), and cattail (*Typha*). Bank vegetation includes deergrass (*Muhlenbergia*), sacaton (*Sporobolus*), Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and velvet mesquite (*Prosopis velutina*) (Rosen and Schwalbe 1988).

Habitat can be found in the shallow waters, banks, and riparian vegetation of large river riparian woodlands and forests. Mexican garter snake populations are found in association with cottonwood, willow, seep willow, mesquite, and a variety of grasses. Mexican garter snake populations may be abundant in these habitats. Historically, populations were found in this habitat type in the Phoenix area along the Colorado River, downstream of Nogales on the Santa Cruz, and in Tucson (Rosen and Schwalbe 1988).

Potential habitat is also found in streamside gallery forests located on the margins of intermediate sized streams at high elevations. Forests are deciduous and Mixed Broadleaf Woodlands (Rosen and Schwalbe 1988).

Source area wetlands are important habitat for the Mexican garter snakes in New Mexico. Most habitat in New Mexico is around shallow stock tanks with abundant vegetation including grasses, willows, and cattails (Painter 2000). Two exceptions are a species

observation in a shallow section of the Gila River and an observation at a meandering tributary of the Gila (Degenhardt 1996).

The habitat in Mexico for *T. e. megalops* cannot be fully determined until the subspecies' habitat has been distinguished from other subspecies of *T. eques*. However, a description can be given based on habitat of *T. eques*. *T. eques* is found around permanent water sources including ponds, lakes, streams, and rivers. *T. eques* has been studied in ponds surrounded by grasslands and dense vegetation (Manjarrez 1998, Drummond and Macias Garcia 1989) The species is found in river systems that course through desert or mesquite grasslands, gallery forests of willow and cottonwood, and pine-oak forests (Conant 1963). Species are also found in both large and small isolated volcanic lakes (Conant 2003).

## **2. Habitat Requirements**

All populations of the Mexican garter snake require the following for suitable habitat: permanent water, vegetative cover, and native prey species.

Because vegetative cover is a key requirement of Mexican garter snake habitat, stock tanks are inadequate habitat for the Mexican garter snake. Livestock use around stock ponds leads to the removal of vegetative cover. Stock tanks can be an unstable water source because they are prone to draining, siltation, desiccation, and flooding. Stock tanks are also prone to non-native species introduction and fail to provide habitat connectivity (Painter 2000).

### ***i. Permanent water***

Being an aquatic species, the Mexican garter snake requires a permanent water source. Mexican garter snakes are linked to shallow slow-moving or impounded waters (Howland 1991), and occur in lakes, large streams, rivers, springs and headwaters (Rosen and Schwalbe 1988). Mexican garter snakes rarely venture 15 meters from permanent water with lush vegetation, although overland migration is possible (Rosen and Schwalbe 1988).

### ***ii. Vegetative cover***

Riparian vegetation is essential to the Mexican garter snake for foraging and cover. Vegetation and organic material provides favorable conditions for native prey and increased area for foraging. The Mexican garter snake forages along the water/land interface for native leopard frogs, the most important prey in its diet. *T. e. megalops* has been known to abandon habitat when lacking vegetation from livestock grazing and may not return to this habitat without reintroduction (Rosen and Schwalbe 1988). *T. e. megalops* is very secretive and takes refuge in vegetative cover for hiding (Degenhardt et al. 1996).

### *iii. Native prey species*

In Arizona, *T. e. megalops* feeds primarily on native leopard frogs, Woodhouse toads, and native fish including Gila chub, roundtail chub, and Gila topminnow. The Mexican garter snake is scarce or absent from ideal habitat if these species are missing. Rosen and Schwalbe (1988) consistently found substantial populations of the Mexican garter snake in habitat with abundant anurans and prey fish and few Mexican garter snakes in habitat with scarce native prey.

A study by Drummond and Marcias Garcia (1989) in the northern portion of the Mexican Plateau also found that loss of native prey negatively impacts *T. eques*. *T. eques* were found to eat primarily frogs (75%) and tadpoles (25%). In 1982, *T. eques* were abundant, and their numbers correlated significantly with the frogs they were foraging on. The frog population crashed the following year and very few *T. eques* were seen foraging. When frogs were unavailable, *T. eques* ceased foraging at the pond even though other prey were available like tadpoles, in addition the species did not attempt to forage elsewhere.

## **H. Distribution**

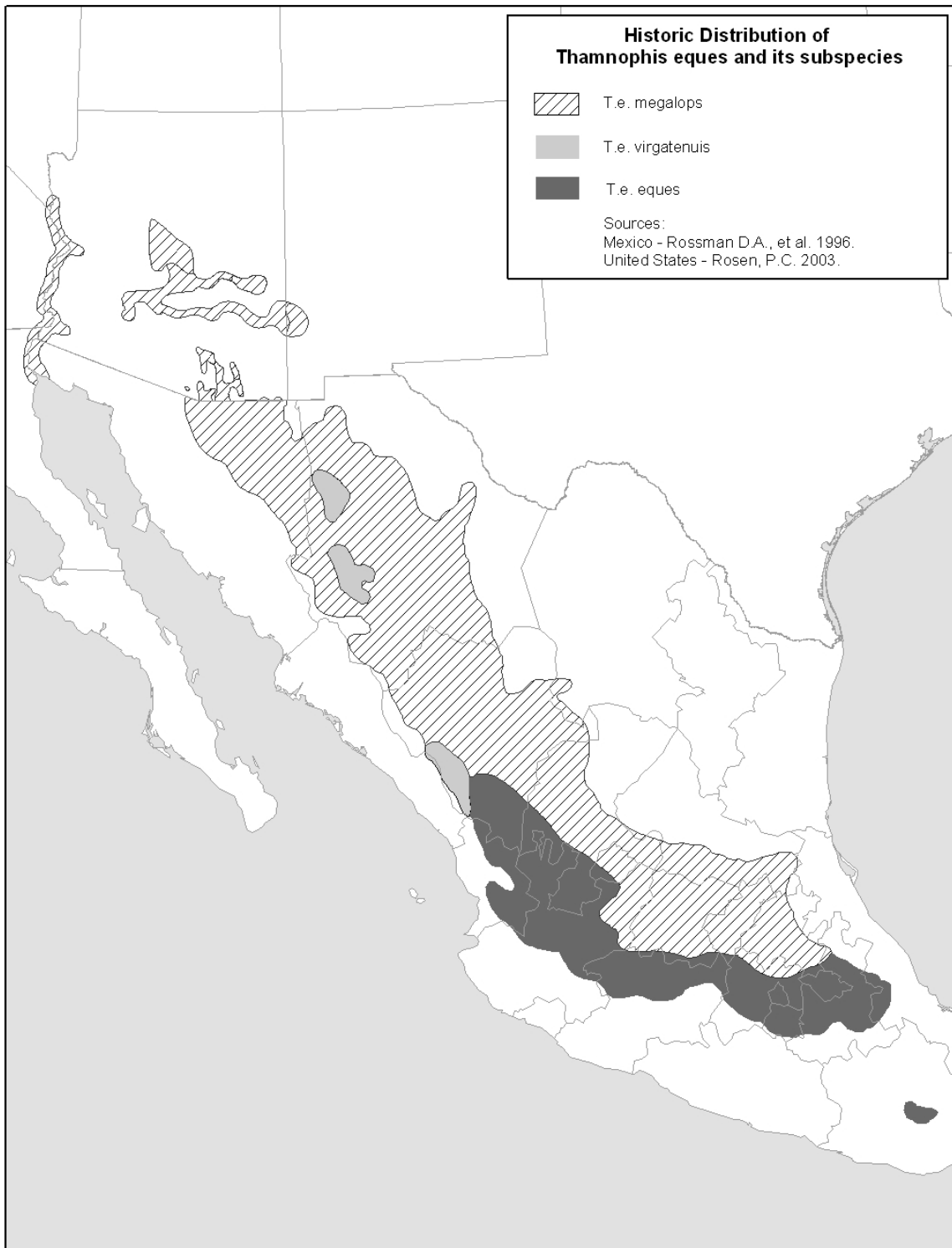
The Mexican garter snake ranges from central and southern Arizona, to southwestern New Mexico, and into Mexico (See Figure 2). Within Mexico, populations are found down into the Sierra Madre Occidental and Chihuahua Desert, north of the Mexican altiplano in the states of Sonora, Chihuahua, Durango, Guanajuato, Hidalgo, and San Luis Potosi. (Rosen and Schwalbe 1988)

Conant (1963) discusses the wide spread distribution of *T. eques*, “The most plausible explanation for the widespread distribution of *Thamnophis eques* and its presence in so many isolated riparian and lacustrine habitats in the midst of arid country is to presume that it wandered widely during one or more pluvial periods and is now relict in a great number of localities” (p.496).

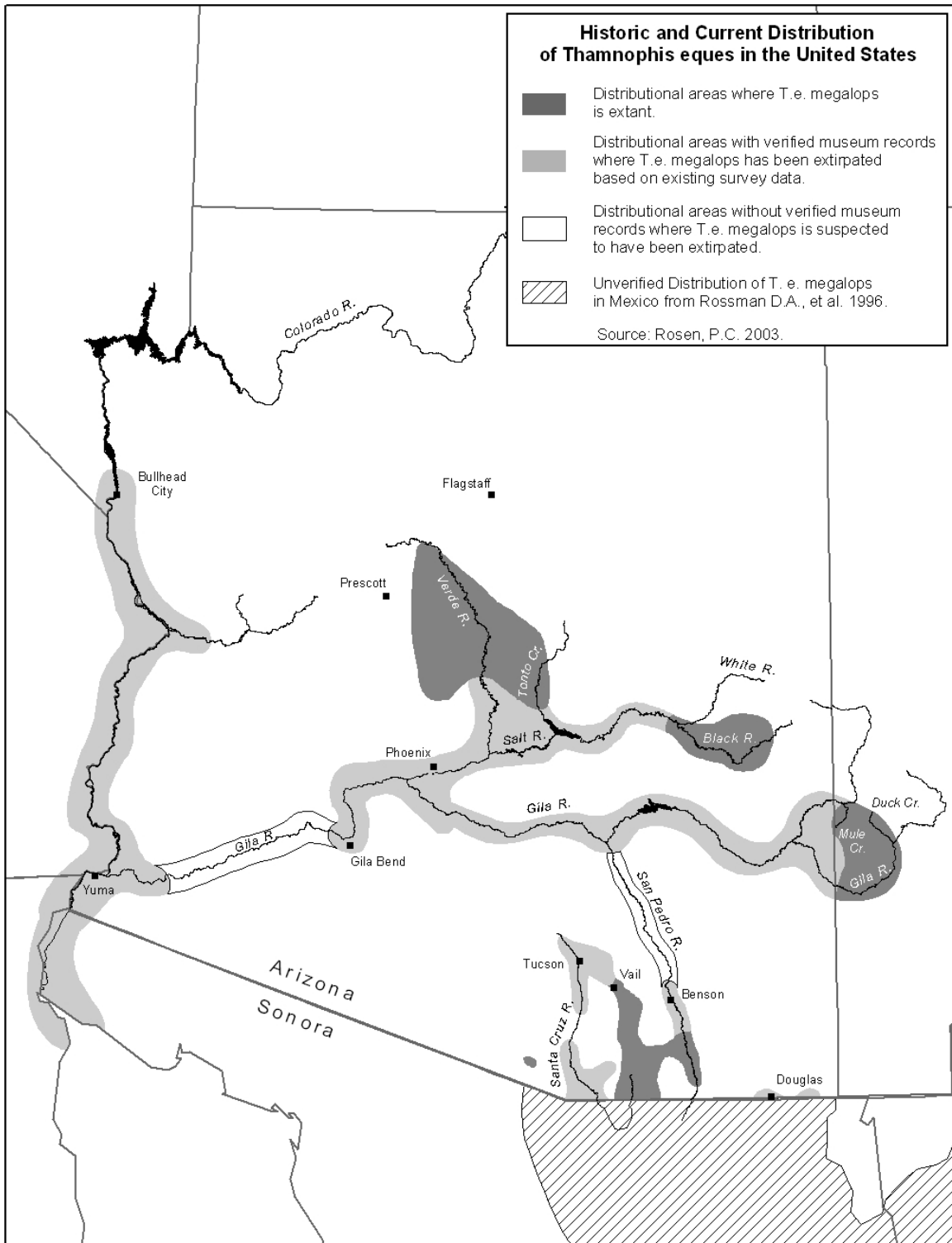
Despite the apparent widespread distribution of *T. e. megalops*, the subspecies has a constricted ecological distribution and low population densities (Lowe 1985). The Mexican garter snake may appear to have a wide range but in actuality its populations are severely fragmented and isolated due to its habitat requirements, loss of habitat, and disturbance of habitat.

### **1. Arizona**

The distribution of the Mexican garter snake in Arizona has decreased from its historic range. *T. e. megalops* has disappeared from its habitat in central Arizona including the Colorado and Gila Rivers, the Salt River gallery forests and its environs in Phoenix. It has been extirpated from the Tucson basin including the Santa Cruz and Rillito. Camp Verde and Sonoita Grassland-Canelo Hills-San Raphael Valley are the only areas with



**Figure 2: Distribution of Thamnophis eques and its subspecies: (1) *T. e. eques*; (2) *T. e. megalops*; (3) *T. e. virgatenuis*.**



**Figure 3: Distribution of the Mexican garter snakes in the U.S.**

substantial populations. In southeastern Arizona populations are found at San Bernadino National Wildlife Refuge, Finley Tank (Audubon Society's Appleton-Whittell Research Ranch), Scotia Canyon (Huachuca Mountains), San Raphael Valley, Canelo Hills, Sonoita Grasslands, Babocomari, Ciénega Creek, Arivaca Cienega, sites on the San Pedro River, and Huachuca Mountain bajada. However, most of these sites are experiencing population declines, low population densities, or possible extirpation (Rosen et al. 2001).

Of the roughly 19 populations located by Rosen et al. (2001), 5 are managed by the U.S. Forest Service, 3 by the Bureau of Land Management, 3 by the state of Arizona, 1 by Pima County and 5 are on private lands, including 3 on the Audubon Society's research ranch. The diversity of jurisdictions that *T. e. megalops* populations are found on is surprising given its limited distribution, and highlights the need for coordinated management through the recovery planning process.

## 2. New Mexico

Records indicate *T. e. megalops* was only found in Grant and Hidalgo counties in single localities along Mule Creek and along the Gila River near Virden (See Figure 3) (Degenhardt et al. 1996). There is one century-old record of *T. e. megalops* at Duck Creek near Cliff (Degenhardt et al. 1996). Recent surveys have only confirmed *T. e. megalops* at Mule Creek in one locality, however this site has not been visited by herpetologist since 1994 since the landowner refused to grant entry (Painter 2000). It is questionable if the species is still extant at this locality. Painter (2000) explained,

While *T. eques* may have survived in the stock tanks at Mule Creek, those populations are prone to extirpation as these habitats are susceptible to draining, siltation, desiccation, flooding, and anthropogenic disturbance including maintenance, dredging, and introduction of non-native predators (e.g., bullfrogs, domestic geese, predatory fishes). (p.39)

Fitzgerald (1986) surveyed the Gila and San Francisco River Basins in New Mexico and did not locate any Mexican garter snakes.

## IV. THE MEXICAN GARTER SNAKE IS A LISTABLE ENTITY UNDER THE ESA

The USFWS acknowledged the Mexican garter snake was eligible for listing under the ESA when the species was designated a candidate species in 1988. It was listed as a Category 2, which indicated listing was appropriate but additional information was needed.

The definitions given in the ESA specify that the USFWS must place the Mexican garter snake on the threatened species list if it determines either (1) that the Mexican garter snake is threatened or endangered throughout "all or a significant portion of its range," or



(2) that a group of the Mexican garter snake constitutes a distinct population segment that is threatened or endangered.

The USFWS has three options for listing the subspecies *Thamnophis eques megalops* as Endangered or Threatened:

- 1) Distinct Vertebrate Population Segment in the U.S.
- 2) Throughout its entire range based on its U.S. status, which constitutes a significant portion of the species range.
- 3) Throughout its entire range based on its rangewide status.

All three are feasible options for the Mexican garter snake as explained below.

### **A. Distinct Vertebrate Population Segment**

USFWS and NMFS established a policy for designating distinct population segments (DPS) in a policy published in the Federal Register on February 7, 1996 (61 Fed. Reg. 4722). To qualify as a DPS, a population segment must be determined both discreet and significant as defined in the Federal Register. The Mexican garter snake in the U.S. qualifies as a distinct population segment by being both discreet and significant as shown in the following sections.

#### **1. Discreetness**

The following is the definition of discreetness as published in the Federal Register:

Discreteness: A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions:

1. It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act. (61 Fed. Reg. 4722.)

*Thamnophis eques megalops* is a discreet population based on the international border between the U.S. and Mexico. The U.S. and Mexico populations differ in regulatory mechanisms, quality of information, habitat occupied, and types of threat.

Although the Mexican garter snake is listed as Threatened by the Mexican government under the *Norma Oficial Mexicana NOM-059-ECOL-1994*, this status does not provide for any conservation programs or recovery plans (Manjarrez, pers. comm.). Mexico does

not have an environmental law equivalent to the U.S. Endangered Species Act. There are currently no conservation programs for the Mexican garter snake in Mexico (Rosen, pers. comm.), and more research is needed for effective conservation.

Research on *T. e. megalops* in Mexico is scarce, with limited information on current distribution and no population estimates. The Mexican garter snake has been surveyed and resurveyed in Arizona to determine population localities and viability. No similar surveys have been conducted in Mexico. There have only been studies on ecology of *T. eques*, but not specifically on the subspecies *megalops*. In Mexico, research is still needed to distinguish the different subspecies of *T. eques* in order to determine their distribution and population status.

The most important habitat for *T. e. megalops* in the U.S. is source area wetlands like ciénegas. Ciénegas do not appear to be common habitat in Mexico. In Mexico, *T. eques* is found in lakes, ponds, rivers, and streams. Lakes appear to be a common habitat for the species in Mexico. *T. e. megalops* is not found in this habitat in the U.S.

*T. e. megalops* faces similar threats in Mexico as it does in Arizona and New Mexico (Rosen, pers. comm.). Bullfrogs and non-native fish are spreading into the species' habitat. Another threat is the degradation and loss of habitat. Conant (2003) noticed alteration to *T. eques*' habitat in the 1960's, and since then environmental degradation has increased. Anthropogenic pressures include: water diverted for human uses, pollution, inflow of raw sewage, eutrophic conditions, silting, and introduction of exotic fish (Conant 2003). It is evident that there are threats to the Mexican garter snake both in the U.S. and Mexico. However, the levels and type of threat likely vary throughout their range.

## **2. Significance**

Once a species is determined discreet, it must meet the DPS criteria for biological and ecological significance. This consideration may include, but is not limited to, the following:

1. Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon,
2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon,
3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range, or
4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics. (61 Fed. Reg. 4722.)

**i. *Loss of the Mexican garter snake in Arizona and New Mexico would create a significant gap in the species range***

Loss of *Thamnophis eques megalops* in Arizona and New Mexico would create a significant gap in the distribution of the species. It would eliminate the entire northern range of the species. *Thamnophis eques megalops* is the only subspecies of *Thamnophis eques* found in Arizona and New Mexico (Rosen and Schwalbe 1988); the other subspecies are found only in Mexico. Elimination of *megalops* would eliminate all *T. eques* from the U.S.

Since passage of the ESA, the U.S. Fish and Wildlife Service has determined that U.S. populations of numerous species qualify as threatened or endangered, despite these species having wide distributions in other countries, including the gray wolf (*Canis lupus*), bald eagle (*Haliaeetus leucocephalus*), grizzly bear (*Ursus arctos horribilis*), Canada lynx (*Lynx Canadensis*), and others. In all of these cases, populations were found to be significant because they comprised the entire U.S. distribution of the species in question. Such decisions were consistent with Congressional intent in specifying listing of distinct population segments, as recently described by the courts in a decision over listing of U.S. populations of the Atlantic salmon: “[t]he use of international boundaries to delineate distinct population segments is consistent with congressional intent that we should not allow the United States population of an animal to go extinct merely because it is more abundant elsewhere.” *State of Maine v. Norton*, \_\_\_ F. Supp.3d \_\_\_, 2003 WL 1955541, \*26 (D. Maine Apr. 24, 2003). In sum, listing of U.S. populations of the Mexican garter snake as a DPS is consistent with U.S. Fish and Wildlife Service policy as exemplified in numerous findings and Congressional intent.

**ii. *The Mexican garter snake in the U.S. likely has different genetic characteristics than Mexican populations***

Increasingly, the populations of *T. e. megalops* are becoming more fragmented and isolated (Howland 1995) and habitat is more fragmented with loss of wetlands and drought conditions. Fragmented populations will hinder and preclude populations in different regions and ecosystems from interbreeding. In the northern portion of its range, the species occurs as isolates with little interbreeding except in the San Raphael Valley (Rosen, pers. comm.) If populations in the U.S. and Mexico are not interbreeding, they are evolving separately. The likelihood of this scenario is verified by field studies of *Thamnophis eques* populations in Mexico by Roger Conant.

Conant (1963) studied *Thamnophis eques* from several drainages of Mexico. Pattern variations were evident within the snakes from different drainages. Conant found *T. eques* at high-altitudes to vary from those in the Chihuahuan Desert. He therefore described a new subspecies in the uplands as *T. e. virgatenuis*. Conant (2003) describes seven new subspecies of *T. eques* in the transvolcanic belt of Mexico. The isolation of

the large volcanic lakes caused the species to evolve separately with different genetic characteristics and create new subspecies. Conant (2003) found “extraordinary variation in coloration and pattern” in the populations of *T. eques* throughout Mexico. Although the genetic characteristics of U.S. and Mexican populations of *T. e. megalops* have not been specifically compared given the isolation of U.S. populations and differences in habitat, and thus selective pressures, it is likely that genetic differences do occur.

**iii. *The Mexican garter snake is an indicator species for southwest riparian ecosystems***

The Mexican garter snake is one of the southwest’s native riparian obligate species (Lowe 1985). Maintaining native riparian species is essential to preserve balance and biodiversity in the riparian system. Lowe (1985) explained at the First American Riparian Conference, “Native animal species that are obligate riparian species are usually the first to disappear from the riparian community as the result of significant alterations to the environment” (p.339). Therefore, *T. e. megalops* can be considered an indicator species for the health of the riparian ecosystem in the southwestern U.S. An indicator species is defined as, “A species that is of narrow ecological amplitude with respect to one or more environmental factors and which is, when present, therefore indicative of a particular environmental condition or set of conditions” (Allaby 1998).

The presence of the Mexican garter snake indicates the presence of permanent water, riparian vegetation, and native ranids and fish. The species will not be found in riparian habitat that has been degraded by exotic bullfrogs and predatory fish, overgrazed, or reduced to an intermittent water source. One of the purposes of the ESA is to “provide a means whereby the ecosystems upon which endangered species depend may be conserved”(16 U. S. C. 1531(b)). Conservation of this species will lead to conservation of the invaluable riparian ecosystems in Arizona and New Mexico.

Being an indicator species, the Mexican garter snake is ecologically significant. Rosen and Schwalbe (1997) assert Mexican garter snakes (and checkered garter snakes) will be the best environmental indicator of the success of bullfrog removal. The species is an important element of the ecosystem, and its abundance testifies to the quality of the ecosystem.

**B. Endangered or Threatened in a Significant Portion of its Range or Throughout its Entire Range.**

Whether or not the Mexican garter snake is determined a DPS, it qualifies as an endangered or threatened species. An endangered species is defined as “any species which is in danger of extinction throughout all or a significant portion of its range” (16 U.S.C. 1532(6)). The ESA defines a “threatened species” as “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (16 U.S.C. 1532(20)). The U.S. Fish and Wildlife Service thus must list the Mexican garter snake either because it is listed in a significant

portion of its range (i.e., the entire U.S.) or because evidence suggests it is threatened or endangered in the entirety of its range.

The Mexican garter snake is in danger of extinction from the U.S., a significant portion of its range. The Mexican garter snake is the northern subspecies of *Thamnophis eques* and only subspecies of *T. eques* found in the U.S. The U.S. portion of its range constitutes a significant portion geographically, ecologically, and genetically. The Mexican garter snake once lived on the Salt, Gila, and Colorado Rivers, and is now entirely gone from those regions (Rosen et al. 2001). Scientific evidence proves the Mexican garter snake population has declined and is threatened in Arizona and New Mexico.

Finally, the Mexican garter snake is threatened or endangered throughout its entire range. Although not as much research has been done in Mexico, there is evidence that the subspecies is facing similar threats as in the U.S., and it is suspected to be reduced in its range and distribution in Mexico (Stebbins 1985, NMDGF 2002). In 1995, *T. e. megalops* was listed as Threatened by the Norma Oficial Mexicana NOM-059-ECOL-1994 (NMDGF 2002).

The most effective way to conserve the rangewide population of the Mexican garter snake is to list it throughout its entire range. Protection throughout its entire range would allow for holistic management and encourage cooperative conservation efforts between the U.S. and Mexico.

## V. CONSERVATION STATUS

### A. Current Status

A complete review of the current status of the Mexican garter snake can be found at the Biota Information System of New Mexico (BISON) compiled by the New Mexico Department of Game and Fish (2002). A summary of the information is found in Table 2 below.

**Table 2: Conservation Status of *Thamnophis eques megalops***

Federal	“Species of Concern”
Arizona	“Species of Special Concern”
New Mexico	“Endangered”
Mexico	“Threatened”
USFS	“Sensitive” in NM and AZ
Global Heritage Status Rank	“Vulnerable to extirpation or extinction”

## **B. Listing History and Definitions of Current Conservation Status**

### **1. Federal**

*T. eques megalops* has never been formally petitioned (Metz 1991). In 1988, the species was named for consideration on the ESA. By 1991, *T. e. megalops* became a Federal Candidate in Category 2, and its recovery priority ranking was 11 (Metz 1991). *T. e. megalops* remained in Category 2 until this category was terminated by the USFWS. All species in Category 2 are now classified as “Species of Concern” (NMDGF 2002).

Species of Concern is defined by the US Fish and Wildlife Service (2001) on their Region 3 website as, “an informal term indicating that the Service has some degree of concern for the future well-being of the taxon, but the taxon does not receive any Endangered Species Act protection.”

As a candidate species, *T. e. megalops* was eligible for listing on the ESA. Now that the Mexican garter snake is a Species of Concern, it is not considered for listing on the ESA, and it does not receive any federal protection.

### **2. Arizona**

In 1988, *T. e. megalops* became a candidate species in Arizona. The Mexican garter snake attained Threatened status from 1994 until 1996 when it was changed to a Species of Special Concern (NMDGF 2002). A Species of Special Concern is defined on the AZ Game and Fish Department website as, “Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona.” The Wildlife of Special Concern in Arizona (WSCA) list has four categories: extinct, endangered, threatened, and candidate species (AGFD 1996). The Mexican garter snake is listed as a candidate species which is defined as, “those species or subspecies for which threats are known or suspected but for which substantial population declines from historical levels have not been documented (though they appear likely to have occurred)” (AGFD 1996). None of Arizona’s designations provide substantial protection.

### **3. New Mexico**

New Mexico declared *T. e. megalops* Threatened or Group 2 in 1983. By 1994, the species was changed to Endangered or Group 1 status (NMDGF 2002). NMDGF does not manage habitat, therefore they can only make recommendations on how to manage habitat for the Mexican garter snake. The Endangered status does provide for penalties of direct take, but this provision is rarely enforced.

#### 4. Mexico

In 1995, both *Thamnophis eques* and *T. e. megalops* were listed as Threatened by the Norma Oficial Mexicana NOM-059-ECOL-1994 (NMDGF 2002). The Mexican federal law appears to only serve as a list designating the conservation status of species in Mexico. This listing does not include and conservation programs or recovery plans (Manjarrez, pers. comm.)

#### 5. Heritage Status

The Global Heritage Status Rank for *T. e. megalops* is G3T3, meaning species vulnerable to extirpation or extinction and subspecies vulnerable to extirpation or extinction. The reasons for this global rank were given as, “Moderate, spotty range in Arizona, New Mexico, and Mexico; documented declines in the number of U.S. populations and abundance, with substantial range contractions in Arizona and probable reductions in Mexico; threats are high and ongoing in the United States and the same threats probably exist in Mexico” (Nature Serve 2003).

### VI. POPULATION STATUS

Mexican garter snake populations are in decline and clearly threatened (Lowe 1985, Stebbins 1985, Rosen et al. 2001, Degenhardt et al. 1996, Howland 2000). Population status is fairly well documented in Arizona with less information in New Mexico and minimal information in Mexico. Population status of the Mexican garter snake, as revealed in the following sections, demonstrate the need for ESA listing.

#### A. Status of Populations in Arizona

Rosen, Wallace, and Schwalbe (2001) conducted a resurvey of the Mexican garter snake in Southeastern Arizona in 2000 with additional information collected between 1993 and 2001. They surveyed all localities where the Mexican garter snake was known or suspected to occur. The survey found major declines at 2 sites, negative trends at 14 sites, possible stability at 2, and recolonization of habitat at one site. The findings are summarized in Table 6 found below. The report documents the ongoing decline of the Mexican garter snake in southern Arizona.

**Table 3: Current Status of the Mexican Garter Snake in Southeastern Arizona**

Locality	Population Status
San Bernadino National Wildlife Refuge	Major, systematic decline, near extinction
Finley Tank	Major, systematic decline
Turkey Creek	Negative trends
Babocomari Ciénega	Negative trends

Bog Hole	Negative trends
O'Donnel Creek	Negative trends
Post Canyon	Negative trends
Scotia Canyon, Huachuca Mountains	Negative trends
Ciénega Creek at Empire-Ciénega Ranch	Negative trends
Lewis Springs (San Pedro River)	Negative trends
San Pedro River at Highway 90	Negative trends
Barchas Ranch Pond (Huachuca Mountain bajada)	Negative trends
Elgin-Sonoita windmill well site	Negative trends
Upper 13 Reservoir (San Raphael Valley)	Negative trends
Lower San Raphael Valley (Heron and Sharp Spring)	Possible stability
Arivaca Ciénega	Nearly extirpated.
Lower Ciénega Creek at Ciénega Creek County Preserve	Recently recolonized

**Table based on Rosen et al. (2001)**

### **1. San Bernardino National Wildlife Refuge**

The Mexican garter snake was the primary garter snake species at San Bernardino National Wildlife Refuge (SBNWR) from the 1950's to 1970's. Since then, the species has declined and become rare. Intensive surveys were done at San Bernardino National Wildlife Refuge during 1985-1989 and 1992-1999. Steady decline of the species was recorded throughout the studies ending in 1999, and by then the species had suffered a decline near extinction. Along with decline of the Mexican garter snake, capture rates show an increase in the checkered garter snake. (Rosen et al. 2001)

Leopard frogs disappeared from the refuge in 1988 (Rosen and Schwalbe 1997). The Mexican garter snake population is declining despite repeated bullfrog removal efforts that began in 1985. Without additional and successful management efforts, the population is heading for extinction (Rosen and Schwalbe 1996).

### **2. Finley Tank**

Surveys were conducted at Finley Tank during 1985-1988 and then again in 2000. The Mexican garter snake population at Finley Tank has significantly declined since the first studies (as seen in Figure 5). Chiricahua leopard frogs were abundant in 1985 and 1986, but have since rapidly declined and have not been seen since 1988. Bullfrogs were found at Finley tank in 2000. The decline of the Mexican garter snake followed the decline of the leopard frog. (Rosen et al. 2001) There is evidence that these declines are related. Rosen et al. (2001) explains,

At sites where leopard frogs are absent, often apparently due to introduced centrarchid fish (especially largemouth bass and green sunfish) as at Babocomari,



Mexican garter snakes have become rare prior to the arrival of the bullfrog. With only fish to eat, growth is probably markedly reduced, and further, at centrarchid sites there are generally few small-to medium-sized fish, of edible size for most garter snakes. In that scenario, garter snake reproduction is likely to be reduced, and juvenile growth slowed, as is consistent with the low densities and generally smaller snakes seen at Babocomari.

Even with the decline of leopard frogs at Finley Tank, there were still abundant pupfish available for foraging. Pupfish likely sustained juvenile snakes but was not sufficient for the growth and reproduction of adult Mexican garter snakes thereby leading to population decline. (Rosen et al. 2001)

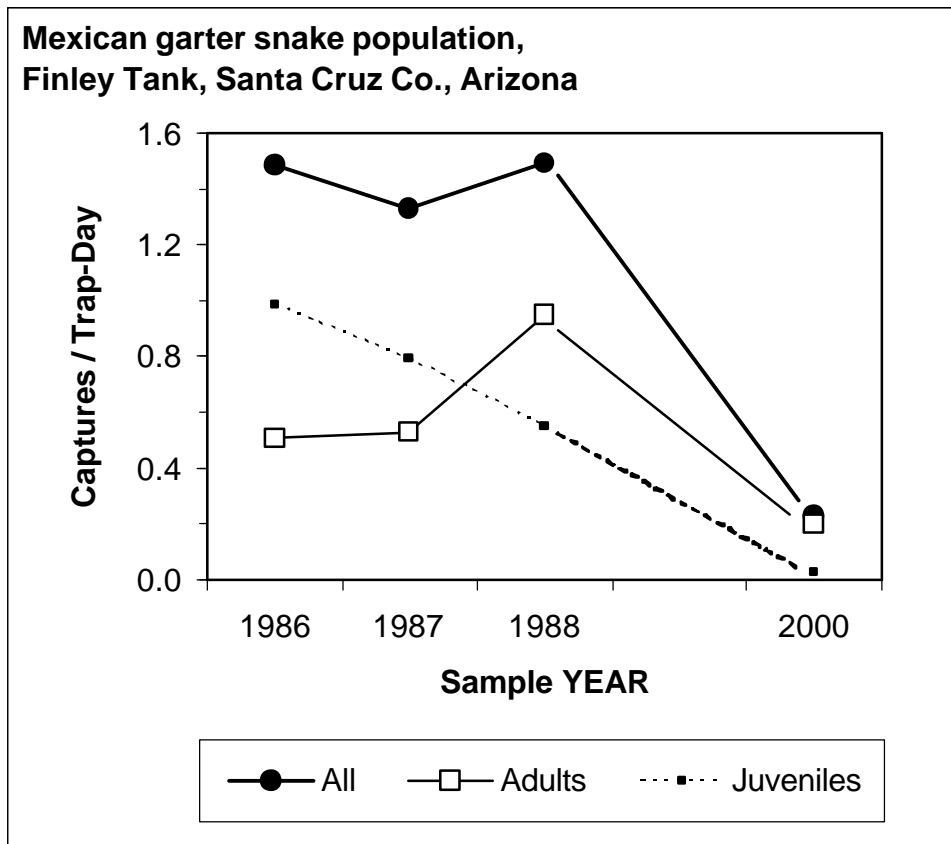


Figure 4: Mexican garter snake population at Finley Tank, AZ, Rosen et al. 2001

### 3. Scotia Canyon

Scotia Canyon, located in the Huachuca Mountains, was surveyed by Rosen and Schwalbe and by Holm and Lowe starting in 1989. Mexican garter snake populations show a possible decline from 1980-1982 and low capture rates in 1993 and 2000 (Rosen et al. 2001).

Holm and Lowe (1995) found the structure of the Mexican garter snake population had changed since the 1980's. Bullfrogs were not observed in Scotia Canyon from 1980-82,

were first observed in 1989, and by 1992 had overrun all aquatic habitats. There was a greater proportion of large adults and less yearlings as a result of bullfrog predation on small snakes. In 1993, most snakes had broken tails whereas no broken tails were observed in the 1980's. Recruitment has been low due to the high mortality of young snakes. (Holm and Lowe 1995)

#### **4. Lower San Raphael Valley**

Rosen and Schwalbe (1988) conjectured that the lower San Raphael Valley potentially held a substantial Mexican garter snake population. Prior to 2000, the population in the Lower San Raphael Valley was not well-known. Rosen et al. (2001) surveyed the area at Santa Cruz River mainstem, Sharp Spring, and Heron Spring. Trappings revealed a population (likely transnational) persisting over an extensive area but at a low population density. A new state park in the area has recently protected much of the habitat from grazing. All perennial waters in the area have been invaded by bullfrogs, however flooding of the river may control bullfrog populations. It is an ideal locality for future studies in how bullfrog populations and cessation of grazing affects Mexican garter snakes.

#### **5. Arivaca Ciénega**

Arivaca Ciénega is a historic locality for Mexican garter snakes, but the species has been extremely rare there since 1980. Extensive trapping in 1994 and 2000 only yielded one Mexican garter snake. No evidence of leopard frogs was found in this locality (Rosen and Schwalbe 1997). *T. e. megalops* is clearly rare in this locality and is likely suppressed by a substantial bullfrog population. (Rosen et al. 2001)

#### **6. Babocomari Ciénega**

Population decline is clearly demonstrated at Babocomari Ciénega. In 1958, the species was found to be extremely abundant at Babocomari Ranch pond. In the 1980's survey, four Mexican garter snakes were found. Surveys in 2000 yielded no Mexican garter snakes. Introduced bass and decline of leopard frogs were noted in the 1970's, and bullfrogs invaded the area in 1986. The evidence at Babocomari supports the findings that decline in leopard frogs leads to the decline in Mexican garter snake populations. Some Mexican garter snakes may still exist at Babocomari, and if so this population will likely continue to decline (Rosen et al. 2001).

#### **7. Ciénega Creek at Empire-Ciénega Ranch**

This ciénega is ideal habitat with dense vegetation supporting dense populations of native fish. Very limited data is available in this locality due to difficulty in trapping, however the available data points toward decline in Mexican garter snake populations. It is possible that scarcity of leopard frogs in this area is causing the population decline (Rosen et al. 2001).

## **8. Lower Ciénega Creek at Ciénega Creek County Preserve**

Prior to 1995, this site was degraded by heavy grazing with insufficient cover for a Mexican garter snake population. In 1995, the area was purchased by Pima County as a natural preserve allowing the habitat to recover. The site was visited a number of times since 1986. A Mexican garter snake was first reported in 1998 (Rosen et al. 2001).

### **B. Status of Populations in New Mexico**

The status of *T. e. megalops* in New Mexico is unknown. Recent surveys have only confirmed *T. eques* at Mule Creek in one locality, however this site has not been visited by herpetologist since 1994 (Painter 2000).

### **C. Extirpated Populations and Decreased Range**

Decreased range and local extirpations have been documented for the Mexican garter snake. Populations have been extirpated in Arizona, New Mexico, and possibly Mexico. In the 1960's the species was found extirpated from the Rillito floodplain in the Tucson vicinity (Lowe 1985). The Mexican garter snake has disappeared from the Phoenix area, Salt River gallery forests, Colorado River, Gila River, and much of the Santa Cruz and San Pedro Valleys (Rosen et al. 2001).

The subspecies was documented at several localities in Grant and Hidalgo counties in New Mexico and is now only verified tenuously at one site.

Jeffrey Howland (1995), the amphibians and reptiles program manager for Arizona Game and Fish Department stated,

Substantial range contraction has been noted, and fairly well documented, in Arizona. As wetland habitats deteriorate and bullfrogs and other non-native predators replace native amphibians and fishes (the primary food of this species), Mexican garter snakes can be expected to become increasingly rare and populations will become more fragmented.

Without ESA listing and critical habitat designation, the Mexican garter snake population will continue in its dangerous trajectory of local extirpations and decreased range.

### **D. Population Numbers**

The current population estimate for the Mexican garter snake in Arizona is 1,763 to 2,938 individuals. Rosen and Schwalbe (1988) conclude that a population of 10,000 snakes would be alarmingly low in the Midwestern United States, indicating the severity of the garter snake's plight in Arizona. The species also appears to be declining. In their 1988 report, Rosen and Schwalbe estimated the total population of the Mexican garter snake in Arizona to be 5,875 individuals. Population numbers for the range-wide population of the

Mexican garter snake are unknown, but are suspected to be declining (Manjarrez and Drummond, pers. comm.)

### **E. Status in Mexico**

There is limited information of the population status of *T. e. megalops* in Mexico. The subspecies is listed as Threatened under the federal government law, NOM-059-ECOL-1994. There is likely confusion as to the extent and distribution of *T. e. megalops* in Mexico. The distribution of *T. eques* is well known, however much work is still needed in distinguishing the subspecies. For example, Conant (2003) described seven new subspecies of *T. eques* in the great lakes populations. This area of Mexico is thought to support upper abundances of *T. eques* (Manjarrez, pers. comm.), and was previously thought to be *T. e. eques* or *T. e. megalops*. It is now evident that *T. eques* populations found at these volcanic lakes such as Cuitzeo, Patzcuaro, and Chapala, are actually distinct subspecies.

Populations of *T. e. megalops* in Mexico are likely suffering from human impacts on wetlands such as lakes drying up, pollution, and alteration of shoreline (Manjarrez and Drummond, pers. comm.)

### **F. Population Viability**

The Mexican garter snake is capable of recovering in restored habitat, but this possibility decreases as certain threats continue. These threats include: decline in the food base, drought conditions, non-native species competition and predation. Non-native bullfrogs and predatory fish are increasing in the Mexican garter snake's habitat. Important prey species, like the leopard frog, if absent from otherwise ideal habitat, may preclude the Mexican garter snake from thriving there. Populations are becoming more fragmented and isolated, making it more difficult to repopulate historical habitat.

Population trends clearly demonstrate the Mexican garter snake is declining in the U.S. Extirpated populations were observed as early as the 1960s. Many populations show negative trends, low densities, and possibility of extirpation. The Mexican garter snake is long-lived, and this factor may distort actual population viability for low-density or declining populations.

The future population trends for the Mexican garter snake can be expected to continue in the current trajectory of widespread decline in the U.S. Population decline can be expected in Mexican populations since similar threats are present.

## **VIII. THE MEXICAN GARTER SNAKE IS ENDANGERED UNDER THE ESA**

Under Section 4(a) of the Endangered Species Act (16 U.S.C. 1531 et seq.), the

Secretary of the Interior is directed to determine whether a species is threatened or endangered based on the following five factors:

1. The present or threatened destruction, modification, or curtailment of its habitat or range
2. Overutilization for commercial, recreational, scientific, or educational purposes
3. Disease or predation
4. The inadequacy of existing regulatory mechanisms
5. Other natural or manmade factors affecting its continued existence

All five factors listed are considered threats to the Mexican garter snake and will be discussed below.

## **A. Destruction, Modification, or Curtailment of its Habitat or Range**

### **1. Destruction and Loss of Wetlands**

The destruction and loss of wetlands is a result of urbanization, draining for human use, grazing, climate change, and drought conditions. In Arizona and New Mexico, nearly 90% of presettlement riparian wetlands have been lost (George 1996). In the southwest, *ciénegas* are considered a vanishing climax community. A habitat requirement for the Mexican garter snake is permanent water, consequently crucial habitat is lost with the loss of wetlands. Lowe (1985) attributes riparian habitat alteration and destruction to pump down, damming, encroachment (agricultural, reclamation, urbanization), pollution (acid rain, pesticides, trace metals), grazing, woodcutting, and exotic species.

*Ciénegas* are considered ideal habitat for the Mexican garter snake (Rosen and Schwalbe 1988). Hendrickson and Minckley (1984) discussed the disappearance of *ciénegas* in the American Southwest. They define *ciénega* as “mid-elevation (1,000 – 2,000 m) wetlands characterized by permanently saturated, highly organic, reducing soils.” Historical evidence shows *ciénegas* and other marshlands have greatly diminished in Arizona. Remaining *ciénegas* persist in headwaters in reduced, modified, or artificially maintained states. *Ciénegas* require permanent, steady sources of water with low probability of scouring by floods. Grazing, streambed modification, cultural impacts, and climate change are all attributed to destruction and loss of *ciénegas*. Permanent groundwater must be sustained to maintain *ciénega* habitat.

Urbanization has caused destruction and modification of riparian habitat. When significant alterations to the environment occur, native riparian species are usually the first to disappear (Lowe 1985). *T. e. megalops* was extirpated from Phoenix and Tucson due to urban development and the complete elimination of vegetated waters (Rosen and Schwalbe 1988). Rosen and Schwalbe (1988) argue that *T. e. megalops* can persist in urban environments with wise resource management and control of non-native species.

Climate change and dry conditions are a threat to the habitat of the Mexican garter snake (Rosen et al. 2001). Climate predictions for the Southwest vary, yet many discuss an increased variability and instability in the precipitation regime. In the 20<sup>th</sup> century the temperature in the West has risen 2-5°F, and extreme precipitation events have increased (USGCRP 2000). Arizona has become drier and experienced more droughts (USGCRP 2000). The U.S. Global Change Research Program (USGCRP) predicts increased temperature, extreme wet and dry years, and increased winter precipitation for the West. There is also the possibility that some areas will be drier (USGCRP 2000).

The future climate of the Southwest was discussed in the Final Report of the Southwest Regional Climate Change Symposium & Workshop (Sept. 3-5, 1997, Tucson). The National Center for Atmospheric Research used a nested Regional Climatic Model (RegCM) for the Southwest in conjunction with the General Circulation Model to predict the future climate change. They found a decrease in winter monthly and summer precipitation, with an average temperature rise of up to 7° F.

Future climate scenarios with an increase in temperature and more precipitation extremes, will increase erratic water flows and/or decrease annual water flows. Neither of these scenarios is beneficial to the Mexican garter snake, since it requires perennial, stable sources of water.

## **2. Livestock grazing**

Livestock grazing in riparian areas results in habitat degradation and destruction. Vegetative cover is an essential habitat component, and when cover is eliminated, the Mexican garter snake is vulnerable to local extirpation. Loss of vegetative cover from livestock grazing in a single season can permanently eliminate *T. eques* from that locality. *T. eques* may not return to an overgrazed area without re-introduction. Small, isolated populations are especially vulnerable to livestock grazing. (Rosen and Schwalbe 1988)

Grazing has been shown to impact another southwest riparian garter snake in a study by Szaro et al. (1985). Szaro et al. compared the populations of *Thamnophis elegans vagrans* in grazed stream segments and exclosed stream segments. The plots exclosed from cattle grazing were significantly higher in snake abundance and biomass. The study found the fenced enclosures greatly increased populations of *T. elegans*. The vegetation and organic material provide favorable habitat conditions for prey and the amount of foraging area. It also provides the garter snake favorable thermal conditions and cover from predators.

Of the remaining populations, several are still being impacted by ongoing livestock grazing (Rosen et al. 2001). The population in Scotia Canyon is found on the Lone Mountain Allotment and the population at Upper 13 Reservoir is found on the Dukuesne Allotment, both of which are found on the Coronado National Forest and are open to livestock grazing without special management for the Mexican garter snake (T. Deecken personal communication). Similarly, populations on private lands, including the

Babocomari Cienega and lower San Rafael Valley, are open to livestock grazing and other impacts without consideration for the garter snake. Moreover, livestock grazing is almost certainly limiting the recovery of *T. e. megalops* to a larger and more viable range by limiting recovery of the numerous riparian areas that once provided habitat for the species.

An indirect consequence of livestock grazing is the maintenance of stock-ponds, which provide habitat for the bull frog, a major predator of and competitor with the Mexican garter snake (Rosen personal communication and Rosen et al. 2001). Artificial impoundments for the purpose of stock occur in the habitat of a number of existing garter snake populations, including Babocomari Cienega, Scotia Canyon, and the lower San Rafael Valley (Rosen personal communication).

### **3. Groundwater pumping and population growth**

Groundwater pumping to support agriculture and human consumption has resulted in loss of extensive historic habitat for the Mexican garter snake, including once perennial reaches of the San Pedro, Santa Cruz, Gila, and other rivers that are now dry for much of the year. Increasing human populations with their concurrent water demands also threaten a number of extant populations. Population growth and increasing numbers of wells threaten populations in the San Pedro River at Lewis Springs and Highway 90, for example. Several recent studies document that pumping by Sierra Vista does impact the San Pedro (references). And projections for population growth paint a grim picture with XX people expected to move to the area in the next XX years. Other populations potentially impacted by groundwater pumping include Arivaca Cienega and populations on the upper Verde.

### **4. Decline in the food base of the Mexican garter snake: Loss of native prey species**

Habitat of the Mexican garter snake has been modified through the introduction of exotic species and loss of native amphibians and fish. The Mexican garter snake is particularly vulnerable to loss of native prey species (Rosen and Schwalbe 1988). The loss of leopard frog populations could be an irreversible decline in the species' foodbase (Rosen et al. 2001). Rosen et al. (2001) poses two explanations for why the Mexican garter snake is sensitive to loss of native prey: (1) the species is unwilling to increase foraging efforts at the expense of increased predation and (2) the species needs to eat substantial food regularly to maintain its weight and health. When key prey species like leopard frogs disappear, snakes are left with eating smaller prey such as native fish. Eating smaller prey will reduce the Mexican garter snake's growth and reproduction. (Rosen et al. 2001).

The most important prey species of the Mexican garter snake, leopard frogs, are in significant decline. The Chiricahua leopard frog (*R. chiricahuensis*) was listed as Threatened under the ESA in 2002. *R. chiricahuensis* is currently restricted to isolated habitat patches, and dispersal corridors are either dried up or thriving with introduced

predators (Howland 1995). The Lowland leopard frog (*R. yavapaiensis*) is not listed on the ESA but has been extirpated from New Mexico and has disappeared from substantial portions of its former range in Arizona (Howland 1995). Both *R. chiricahuensis* and *R. yavapaiensis* are listed as Threatened on the Wildlife of Special Concern in Arizona (AGFD 1996).

The disappearance of leopard frogs has been documented at San Bernadino National Wildlife Refuge, Finley tank, and Babocomari Cienega, and decline is noted in other surveyed areas (Rosen et al. 2001). In Scotia Canyon, Holm and Lowe (1995) observed Mexican garter snakes appeared to be dying of starvation at the time the leopard frogs declined. They asserted the decline and disappearance of leopard frogs led garter snakes to die in the 1980's.

A study in the northern portion of the Mexican Plateau also found that loss of a native prey species negatively impacts a population of *T. eques*. Drummond and Marcias Garcia (1989) studied two garter snakes, *T. eques* and *T. melanogaster*, and compared their foraging behavior. The study was done at a small pond surrounded by desert, where both garter snakes mainly fed on the Rio Grande leopard frog (*Rana berlandieri*). *T. eques* was found to eat primarily frogs (75%) and tadpoles (25%). In 1982, *T. eques* were abundant, and their numbers correlated significantly with the frogs they were foraging on. The frog population crashed the following year and very few *T. eques* were seen foraging. When frogs were unavailable, *T. eques* ceased foraging at the pond even though other prey was available like tadpoles, in addition the species did not attempt to forage elsewhere. "The important finding was that the terrestrial-aquatic generalist, *T. eques*, did not forage on early- or late-stage tadpoles when frogs became unavailable in 1983; it virtually ceased foraging in the pond, numbers waned, and reproduction declined substantially." They go on to say, "it behaved during the study as a competent frog predator that opportunistically added diverse prey to its diet but could not make them major dietary components, even in dire need".

Native fish species, important food sources to the Mexican garter snake, are also in decline. Rosen and Schwalbe listed the Gila chub, roundtail chub, and Gila topminnow as species important to the diet of the Mexican garter snake. The Gila chub was proposed endangered by the U.S. Fish and Wildlife Service in 2002. The Gila topminnow has been listed as endangered since 1967. The roundtail chub is listed as Threatened in the state of Arizona and is under petition for listing under the ESA.

## **B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes**

Collecting has not been proven a threat to the Mexican garter snake, but the small isolated populations of the species are vulnerable to illegal collection or intentional take (Painter 2000). *T. e. megalops* is listed as Endangered in New Mexico, and thereby collection of the species requires a Scientific Collecting Permit (Painter 2000). Arizona Game and Fish Commission Order 43 limited collection of the species to four individuals per year with a valid hunting license (Arizona Game and Fish Department 2001).



Collection of rare reptiles is an ongoing and growing problem, and one that could affect local populations of the Mexican garter snake.

### **C. Disease and Predation**

Disease is not known to be a cause for population decline of *T. e. megalops*. Predation is a serious factor in the Mexican garter snake's decline. The Mexican garter snake has native predators, however exotic predators like the bullfrog are having detrimental effects on the species.

Rosen and Schwalbe (1995) conducted a study to determine the effects of bullfrogs (*Rana catesbeiana*) on native reptiles and amphibians. They monitored populations of leopard frogs and Mexican garter snakes on study plots with bullfrog removal and a control plot with no bullfrog removal. Bullfrogs were observed eating Mexican garter snakes and the last visible leopard frogs along with lizards, birds, fish, mammals and invertebrates.

Bullfrog predation was also observed at Scotia Canyon in the Huachuca Mountains. Bullfrogs rapidly infested Scotia Canyon in the late 1980's to early 1990's. Bullfrog predation on Mexican garter snakes was confirmed by broken tails and loss of young snakes. Most Mexican garter snakes had broken tails in 1993, whereas there were none in the 1980's. (Holm and Lowe 1995)

Bullfrog predation leading to broken tails may negatively affect the health and reproduction of adult Mexican garter snakes. In SBNWR, a gravid female was found with a severely infected tail from repeated bullfrog bites. The gravid female was held captive and fed, yet died giving birth and had sickly young. The litter included completely undeveloped eggs and stillborns. The previous year a female snake with an injured tail from bullfrog bites was held captive and fed. After five days, the snake became lethargic and died. (Rosen and Schwalbe 1996).

Bullfrogs are not only predators of Mexican garter snakes, but they eliminate leopard frogs, an important food source. Currently in southern Arizona, leopard frogs do not persist anywhere where bullfrogs are established. Bullfrogs can be a real threat because their population grows quickly with a large clutch size of up to 20,000 eggs and no key predators. Bullfrog predation changes the population structure of Mexican garter snakes, which can lead to regional extinction. Mexican garter snake populations coexistent with bullfrogs are comprised mostly of older snakes with damaged tails. These populations will not survive without successful recruitment. Populations without bullfrogs consist of a large percentage of young snakes with successful reproduction. (Rosen and Schwalbe 1995)

Introduced fish including catfish, bass, and pike also act as competitor/predators to the Mexican garter snake. These larger fish potentially eat Mexican garter snakes and reduce or eliminate leopard frogs and small native fish. (Rosen and Schwalbe 1988) Painter

(2000) indicated sunfish as potential competitors with *T. e. megalops*. Painter also pointed to geese as predators for neonate *T. e. megalops*.

Rosen et al. (2001) reported three “damaging” non-native predators, the bullfrog, virile crayfish, and green sunfish, have spread and increased in current and historic Mexican garter snake habitat.

The Mexican garter snake faces a formidable array of predators, the most detrimental being the exotic bullfrog. Non-native predators are increasing throughout the species’ range seriously degrading the species’ habitat. As of yet, containment and removal of bullfrog populations has been unsuccessful.

#### **D. Inadequacy of Existing Regulatory Mechanisms**

Existing regulatory mechanisms have failed to mitigate the decline of the Mexican garter snake in Arizona and New Mexico. The following agencies share responsibility in conserving the Mexican garter snake: U.S. Fish and Wildlife Service, Arizona Game and Fish, New Mexico Department of Game and Fish, Bureau of Land Management, and the Forest Service. Co-occurrence with other species protected by the Endangered Species Act has also failed to alleviate the decline of the Mexican garter snake.

There is currently no federal protection, federal management, or federal recovery goals for the Mexican garter snake. The Mexican garter snake was listed as a Candidate Species in Category 2 for the ESA in 1988. *T. e. megalops* remained in Category 2 until this category was terminated by the USFWS. Currently, the Mexican garter snake is not considered a candidate for listing on the ESA, and does not receive any federal protection.

The Mexican garter snake is not receiving adequate protection at the state level. Neither Arizona nor New Mexico has agency-mandated recovery goals for the species. Arizona does not have an endangered species law (George 1996). *T. e. megalops* is listed on Arizona’s “Wildlife of Special Concern” list. Within the list, the subspecies is ranked in the lowest category called “candidate species” (AGFD 1996). With this designation the AGFD hopes to “stimulate” conservation actions (AGFD 1996). This list serves only to notify of the species’ status, and does not require any conservation or management actions. The list’s intention is, “to tell land management agencies which species we want to see emphasized in habitat management” (AGFD 1996).

In New Mexico, the Mexican garter snake was listed as threatened in 1983 and endangered in 1994, yet is still in apparent decline. NMDGF has not created any conservation programs or recovery plans for the Mexican garter snake. NMDGF does not manage habitat, therefore they can only make recommendations on how to manage habitat for the Mexican garter snake. Painter (2000) recommends that the New Mexico State Game Commission should remove all restrictions on the harvest of bullfrog, *Rana catesbeina*, to prevent further population declines.

Neither the Forest Service nor BLM currently have management plans for the Mexican garter snake, nor do they provide special protection for the species where it occurs on their lands. For example, Mexican garter snake occur on both the Lone Mountain and Dukuesne allotments on the Coronado National Forest, which has allowed continued grazing on both allotments without consideration of the species in management plans or protection of its habitat through enclosure of riparian habitats.

The Mexican garter snake co-occurs with other riparian species that are endangered or threatened. Some of these species of co-occurrence are its own prey including: the Chiricahua leopard frog, Gila chub, and Gila topminnow. The Gila topminnow has been listed on the ESA since 1967. A recovery plan was drafted in 1995 by the U.S. Fish and Wildlife Service for the topminnow and other native fish species. The Chiricahua leopard frog was listed on the ESA in 2002, but has no recovery plan and is not part of any habitat conservation plan. The USFWS proposed listing the Gila chub as Endangered with critical habitat in August of 2002. The Mexican garter snake co-occurs with these species at a small number of sites providing some collateral protection. However, because the number of sites where the species co-occurs with other listed species are few and very likely not viable and because the species occurs at a number of sites where listed species do not occur, the Mexican garter snake clearly deserves listing as an endangered species with concurrent individual protection.

None of the various federal and state designations for the Mexican garter snake offer adequate protections to the species or its critical habitat. In addition, none of the federal and state designations for species of co-occurrence offer beneficial safeguards or management for the Mexican garter snake. The existing regulatory mechanisms are therefore inadequate.

### **E. Other Natural or Anthropogenic (human-caused) Factors**

Ecological interactions with the Checkered garter snake (*Thamnophis marcianus*) may also factor in the decline of the Mexican garter snake. When *T. e. megalops* and *T. marcianus* are both present in riparian habitat, bullfrogs eliminate *T. e. megalops* more readily. As the Mexican garter snake decreases from bullfrog predation, the checkered garter snake fills the ecological gap. The increased competition thereby hastens the decline of *T. e. megalops* to extirpation. This scenario has likely occurred at the mouth of Potrero Canyon (north of Nogales), San Bernardino, and possibly Arivaca Creek. (Rosen and Schwalbe 1988)

## **IX. RECOMMENDATIONS FOR RECOVERY PLAN**

Listing the Mexican garter snake under the ESA is an essential step to protect the species, however additional actions are necessary to insure the conservation of the species. The ESA requires conservation efforts to facilitate recovery in its definition of conserve as seen below:

The terms "conserve", "conserving", and "conservation" mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking. (16 U.S.C. § 1532 (3))

The following measures are recommended by the Center for Biological Diversity to effectively conserve the Mexican garter snake:

- 1) Increase surveys of the Mexican garter snake to accurately determine population status and distribution.
- 2) Eliminate non-native predators including bullfrogs and predatory fish.
- 3) Fence wetlands with existing Mexican garter snake populations to sustain and propagate for reintroduction.
- 4) Protect and conserve the species' food base including native leopard frogs, and native fish.
- 5) Manage lands to preserve vegetative cover and manage perennial water flows for lakes, rivers, streams, ciénegas, and stock ponds in current and historical habitat.
- 6) Create an international agreement with Mexico to protect and conserve *T. e. megalops*.

Painter (2000) recommended additional surveys for the Mexican garter snake in his report on listed herpetofauna to the USFWS. Rosen and Schwalbe (1988) suggested further surveys for Arizona and population monitoring to determine stability. There are various localities where *T. e. megalops* was found historically, but has not been recently confirmed in field studies. Many of the remaining populations of *T. e. megalops* are small and fragmented. These small populations are vulnerable and need to be closely monitored. Surveys of the Mexican garter snake are especially needed in Mexico to determine its range, population status, and distinguish all the subspecies.

Along with protection of critical habitat, non-native predators need to be controlled and eliminated. The Mexican garter snake has been extirpated from areas with ideal habitat because of predation and competition from bullfrogs. Bullfrogs need to be completely eliminated from the Mexican garter snakes' habitat. Partial removal will be ineffective because the bullfrog can quickly repopulate. Bullfrog removal can be achieved with intensive manual capture, continuous trapping, and removal of egg masses (Rosen and Schwalbe 1996). In the mean time, Mexican garter snakes can be protected by using permanent fences as explained by Rosen and Schwalbe (1997),

Fenced wetlands with native fishes, leopard frogs, and garter snakes are the best current option for sustaining large populations of native aquatic amphibians and

reptiles...The fenced populations would be the most reasonable source for re-introduction of Mexican garter snakes in restored habitats.

In addition to removing bullfrogs, native prey species need to be conserved, protected, and reintroduced in Mexican garter snake habitat. Rosen et al. (2001) asserted, "It surely is not revolutionary thinking to propose that elimination of the bullfrog without restoration of leopard frogs may do little to save the Mexican garter snake." The Mexican garter snake is very sensitive to the loss of native prey species. The snake may reduce feeding or stop feeding with the loss of native prey.

The Mexican garter snake requires native prey, permanent water, and vegetative cover for suitable habitat. Painter (2000) recommends habitat of *T. eques* needs to be protected from water diversion and excessive grazing. Grazing in *T. e. megalops* habitat must be carefully monitored to maintain vegetative cover. Livestock grazing near riparian areas can lead to extirpation of a Mexican garter snake population. Riparian habitat should be managed to promote perennial water. Ciénegas, the most important habitat in Arizona, are dependent on perennial water sources.

The USFWS may decide to list the Mexican garter snake as a DPS in Arizona and New Mexico. Though this is a necessary step for the conservation of the species, the species needs protection throughout its entire range. Conservation efforts in the U.S. are lacking if similar efforts are not being made in Mexico. The Mexican garter snake therefore needs an international conservation agreement between the U.S. and Mexico.

International conservation efforts are recommended in the ESA. The ESA states that the Secretary shall encourage: (1) foreign countries to provide for the conservation of fish or wildlife and plants including endangered species and threatened species listed pursuant to section 1533 of this title; and (2) the entering into of bilateral or multilateral agreements with foreign countries to provide for such conservation (16 U.S.C. 1537(b)).

## **X. REQUEST FOR CRITICAL HABITAT DESIGNATION**

The Secretary shall designate critical habitat concurrent with determination that a species is endangered or threatened as required by the ESA (16 U.S.C. 1533(a)(3A))

The Center for Biological Diversity requests critical habitat designation concurrent with species listing. Critical habitat should include current and historical habitat of the Mexican garter snake. Populations of the Mexican garter snake are becoming more fragmented and isolated due to loss of habitat, degradation of habitat, and local extirpations. In order to conserve the species, populations must be able to expand and connect with other populations.

Based on prevailing tenets of conservation biology, in order to protect or manage a riparian area, one must protect the watershed. Riverine habitats and streams are very susceptible to disturbances in surrounding ecosystems (Briggs 1999). Based on this

knowledge, protecting only a specific stream reach will be inadequate. Critical habitat must be connected vegetated riparian areas that include floodplains and watersheds.

## **XI. CONCLUSION**

The Mexican garter snake clearly merits protective status under the ESA. Substantial scientific information has been presented to warrant the petition and prove the endangered status of the Mexican garter snake. Scientific studies document the widespread decline of the species and the significant loss and degradation of the species' habitat. Population numbers of the Mexican garter snake in the U.S. are extremely low, with a current population estimate in Arizona ranging from 1,763 to 2,938 individuals. The decline of the Mexican garter snake is closely linked to the decline of wetlands in the Southwest and the decline of native frogs and native fish. In addition, Mexican garter snake populations are aggravated by exotic species predation and competition, particularly from the non-native bullfrog. With the inadequacy of current regulatory mechanisms, the current negative trends will continue and place *T. e. megalops* in danger of extirpation from Arizona and New Mexico. The worldwide population of *T. e. megalops* is likely to become an endangered species in the foreseeable future as wetlands are destroyed, native prey species disappear, and exotic species proliferate on a range-wide scale.

The Center for Biological Diversity understands this petition action sets in motion a specific process placing definite response requirements on the U.S. Fish and Wildlife Service and very specific time constraints upon those responses. The USFWS has 90 days to determine if the Mexican garter snake may warrant listing under the ESA. (16 U.S.C. 1533(b))

We expect the petition will be carefully considered, and the decision will reflect the integrity of the Secretary of the Interior and the U.S. Fish and Wildlife Service.

Respectfully submitted this \_\_\_\_ day of December, 2003.

D. Noah Greenwald  
Center for Biological Diversity  
917 SW Oak St. Suite 413  
Tucson AZ 85717

## XII. REFERENCES

- AGFD. 1996. In prep. Wildlife of special concern in Arizona. Arizona Game and Fish Department Publication. Phoenix, Arizona. 32 pp.
- . 2001. *Thamnophis eques megalops*. Unpublished abstract compiled and edited by the Heritage Data Management Systems, Arizona Game and Fish Department, Phoenix, AZ. 4 pp.
- . 2003. Status definitions. Available: [http://www.azgfd.com/wildlife\\_conservation/edits/hdms\\_status\\_definitions.html](http://www.azgfd.com/wildlife_conservation/edits/hdms_status_definitions.html).
- Allaby, M. (ed). 1998. *A Dictionary of Ecology*. Oxford University Press: Oxford, New York.
- Briggs, M. K. 1999. Benefiting from past experiences: lessons gained from the experiences of past riparian recovery efforts. Pp. 3-10 in P. B. Shafroth, B. Tellman, and M. K. Briggs (editors). Riparian ecosystem restoration in the Gila River Basin: opportunities and constraints. Issue Paper No. 21. Water Resource Center, The University of Arizona, Tucson.
- Conant, R. 1963. Semiaquatic Snakes of the Genus *Thamnophis* from the Isolated Drainage System of the Rio Nazas and Adjacent Areas of Mexico. *Copeia* 3: 473-499.
- . 2003. Observations on garter snakes of the *Thamnophis eques* complex in the lakes of Mexico's Transvolcanic Belt, with descriptions of new taxa. *American Museum Novitates* 3406: 1-64.
- Debano, L. F., and L. J. Schmidt. 1989. Improving southwestern riparian areas through watershed management. General technical report RM-182. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. *Amphibians and Reptiles of New Mexico*. University of New Mexico Press, Albuquerque. pp.317-319.
- Drummond, H. and C. Macias Garcia. 1989. Limitations of a generalist: a field comparison of foraging snakes. *Behavior* 108(2): 23-43.
- Fitzgerald, L. A. 1986. A preliminary status survey of *Thamnophis rufipunctatus* and *Thamnophis eques* in New Mexico. Unpubl. report to New Mexico Department of Game and Fish, Albuquerque, New Mexico.
- George, S. 1996. Saving biodiversity: A status report of the state laws, policies, and programs. Online publications available: <http://www.defenders.org/pb-bst00.html>.

Hendrickson, D. A. and W. L. Minckley. 1984. Ciénegas-vanishing climax communities of the American Southwest. *Desert Plants* 6: 131-175.

Holm, P. A. and C. H. Lowe. 1995. Status and conservation of sensitive herpetofauna in the Madrean riparian habitat of Scotia Canyon, Huachuca Mountains, Arizona. Final report submitted to: Arizona Game and Fish Department, Heritage Fund.

Howland, J. M. 2000. The garter snakes of Arizona. *The Arizona Riparian Council* 13(1), 9-11.

———. 1991. Nongame field notes: Mexican garter snake. *Wildlife Views*. 17.

Lowe, C. H. 1985. Amphibians and reptiles in southwest riparian ecosystems. In *Riparian ecosystems and their management: Reconciling conflict uses*. First American Riparian conference, April 16-18, 1985, Tucson, Arizona, USDA Forest Service General Tech. Report RM-120.

Metz, G. 1991. Letter to D.C. Carlton, Executive Director, Biodiversity Legal Foundation, from Gilbert D. Metz, Acting Field Supervisor, FWS, re: Status of the Mexican garter snake, dated June 27, 1991.

NatureServe. 2003. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.8. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. (Accessed: July 24, 2003 ).

NMDGF. 2002. Mexican garter snake: Biota Information System of New Mexico. Available: [http://www.cmiweb.org/states/nmex\\_main/species/030265.htm](http://www.cmiweb.org/states/nmex_main/species/030265.htm)

Painter, C. W. 2000. Completion report – status of listed and category herpetofauna. Report to the US Fish and Wildlife Service, Albuquerque, NM.

Pima County. 2001. Sonoran Desert Conservation Plan: Priority Vulnerable Species, Mexican garter snake. Available: [http://www.co.pima.az.us/cmo/sdcp/sdcp2/pvs/pdfs/s25\\_smg.pdf](http://www.co.pima.az.us/cmo/sdcp/sdcp2/pvs/pdfs/s25_smg.pdf).

Rosen, P. C. and C. R. Schwalbe. 1988. Status of the Mexican and narrow-headed garter snakes (*Thamnophis eques megalops* and *Thamnophis rufipunctatus*) in Arizona. Unpubl. report from Arizona Game and Fish Dept. (Phoenix, Arizona) to U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

———. 1995. Bullfrogs: introduced predators in southwestern wetlands. Pages 452-454 in Laroe, E. T., G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors. *Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems*. U.S. Department of the Interior, National Biological Service, Washington, D.C. 530 p.



———. 1996. A critical interim evaluation of the effectiveness of bullfrog removal methods at San Bernadino National Wildlife Refuge. Final report to Arizona Game & Fish Department.

———. 1997. Status of native and introduced species of aquatic herpetofauna at San Bernadino National Wildlife Refuge. Final report to Arizona Game & Fish Department and U.S. Fish and Wildlife Service.

Rosen, P. C., Wallace, E. J., and Schwalbe, C. R. 2001. Resurvey of the Mexican Garter Snake (*Thamnophis eques*) in Southeastern Arizona.

Rossmann, D. A., N. B. Ford, and R. A. Seigel. 1996. *The Garter Snakes*. University of Oklahoma Press: Norman, Oklahoma.

Szaro, R. C., S. C. Belfit, J. K. Aitkin, and J. N. Rinne. 1985. Impact of grazing on a riparian garter snake. In *Riparian ecosystems and their management: Reconciling conflicting uses*. First American Riparian conference, April 16-18, 1985, Tucson, Arizona, USDA Forest Service General Tech. Report RM-120.

USFWS. 2001. *Endangered Species: Guidance for Conducting Status Assessments for Taxa which are Under Consideration for Listing as Threatened or Endangered Species*. Available: <http://midwest.fws.gov/Endangered/concern/sa-guid.html>

———. 2003. Southwest Region Ecological Services: Endangered Species List. Available: <http://ifw2es.fws.gov/endangeredspecies/lists/>.

U.S. Global Change Research Program (USGCRP). 2000. *Climate change impacts on the United States: the potential consequences of climate variability and change*. Available: <http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewwest.htm>.

### **XIII. UNPUBLISHED SOURCES**

The following biologists were cited for personal communications or unpublished data or reports:

Hugh Drummond, Instituto de Ecologia, Universidad Nacional Autonoma de Mexico

Dr. Javier Manjarrez, Science Faculty, Universidad Autonoma del Estado de Mexico

Dr. Philip Rosen, Assistant Research Scientist, University of Arizona