

Narrow-headed Gartersnake (*Thamnophis rufipunctatus*) Recovery Plan

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Photograph by Charlie Painter

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Table of Contents

1.0 INTRODUCTION	4
1.1 EXECUTIVE SUMMARY	4
1.2 CITATION	4
1.3 ADDITIONAL COPIES.....	4
2.0 BACKGROUND	5
2.1 NATURAL HISTORY	5
2.1.1 Taxonomy.....	5
2.1.2 Description	5
2.1.3 Distribution.....	6
2.1.4 Required Habitats	7
2.1.5 Food Habits	8
2.1.6 Reproductive Biology.....	8
2.1.7 Movement.....	9
2.1.8 Predators	9
2.1.9 Threats	9
2.2 HISTORICAL PERSPECTIVE	10
2.2.1 Habitat Trends.....	10
2.2.2 Population Trends.....	10
2.2.3 Use and Demand Trends	11
2.2.4 Past Management.....	11
2.3 HABITAT ASSESSMENT	11
2.3.1 Status.....	12
2.4 ECONOMIC AND SOCIAL IMPACTS.....	12
2.4.1 Economic Profile.....	12
2.4.2 Economic Use of Habitat.....	12
2.4.3 Sociological Factors	13
3.0 MANAGEMENT STRATEGY	13
3.1 MANAGEMENT GOAL AND OBJECTIVE	13
3.2 MANAGEMENT ISSUES AND STRATEGIES	13
3.2.1 Issue 1- Need for Information on Declines and Threats to New Mexico Populations.	13
3.2.2 Issue 2- Need for Information on Biology and Natural History of the Narrow-headed Gartersnake	14
3.2.3 Issue 3- Management issues	14
4.0 IMPLEMENTATION SCHEDULE	16
4.1 IMPLEMENTATION SCHEDULE TASKS	16
4.1.1 Improve and maintain knowledge of potential threats to the Narrow-headed Gartersnake.....	16
4.1.2 Improve and maintain knowledge of the biology of the Narrow-headed Gartersnake	16
4.1.3 Develop and maintain high levels of cooperation and coordination between stakeholders and interested parties	16
4.1 IMPLEMENTATION SCHEDULE TIME-LINE.....	17
5.0 LITERATURE CITED	18
6.0 APPROVALS	20
7.0 APPENDICES	21
7.1 HISTORY OF PUBLIC PARTICIPATION	21
7.2 LISTING OF INTERESTED PARTIES AND MEMBERS OF ADVISORY COMMITTEE	22



List of Figures

- Figure 1. Narrow head of Narrow-headed Gartersnake, Catron County, NM.
- Figure 2. Known localities and potential range of Narrow-headed Gartersnake in New Mexico.
- Figure 3. Stream habitat typical of Narrow-headed Gartersnake, Catron County, NM.
- Figure 4. Microhabitat for the Narrow-headed Gartersnake, Catron County, NM. Shown is a minnow trap used by NMDGF for capture of the species.
- Figure 5. Narrow-headed Gartersnake neonates.
- Figure 6. Participants of August 9th 2007 meeting in Silver City, NM, to formulate management section of the Recovery Plan for the Narrow-headed Gartersnake.



1.0 Introduction

This is a Recovery Plan for the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*), developed under the authority of the New Mexico Wildlife Conservation Act (WCA). The New Mexico Department of Game and Fish (NMDGF) is directed under the Act to develop recovery plans for species listed as threatened or endangered by the State [17-2-40.1 NMSA 1978]. Each recovery plan is to have the following components:

- a strategy to restore and maintain viable populations of the listed species and its habitat, to the extent that the species may be downlisted
- a strategy that mitigates adverse social or economic impacts resulting from recovery actions
- a strategy to identify social or economic benefits and opportunities
- a strategy to use existing resources and funding to implement the overall Recovery Plan.

As directed by the WCA, a public information meeting was held on February 22, 2007, at the Global Resources Center on the campus of Western New Mexico University, Silver City, New Mexico at the initiation of the process. An Advisory Committee was then formed to develop the Recovery Plan. Please see Appendix 7.1 for listing of all public participation in the Recovery Plan. Members of the Advisory Committee met on August 9, 2007, in Silver City, New Mexico, to formulate the management section of the Recovery Plan. Please see Appendix 7.2 for a list of committee members.

The organization of this Recovery Plan follows Graves (2002). Section 2 includes background information on the natural history, historical perspective, habitat assessment, and potential economic and social impacts of this Plan. Section 3 contains the goal for the recovery of the Narrow-headed Gartersnake, accompanying objective, the issues affecting the recovery of the species, and the strategies for addressing those issues. Section 4 provides a suggested schedule for implementing the Recovery Plan, pending State Game Commission approval.

1.1 EXECUTIVE SUMMARY

This is a Recovery Plan for the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*), developed under the authority of the New Mexico Wildlife Conservation Act (WCA). The Narrow-headed Gartersnake is a medium-sized snake, olive to gray-brown with reddish-brown spots, that has a long, laterally-compressed head. A highly aquatic species that feeds mostly on native fishes, the Narrow-headed Gartersnake is limited to reaches of the Gila and San Francisco drainages in New Mexico. Habitat alteration, such as sedimentation from erosion and fires is a key concern, as are invasive species. Important recommendations for the recovery of the species are to determine causes for declines seen in species populations in recent years, both in New Mexico and Arizona; better describe the biology and natural history of the species to aid in its management; and to facilitate cooperation and communication in the management of the Narrow-headed Gartersnake and its habitat.

1.2 CITATION

New Mexico Department of Game and Fish. 2007. Narrow-headed Gartersnake (*Thamnophis rufipunctatus*) recovery plan. New Mexico Department of Game and Fish, Conservation Services Division, Santa Fe, New Mexico. 22 p.

1.3 ADDITIONAL COPIES

Additional copies of the Recovery Plan may be obtained from:



New Mexico Department of Game and Fish
P. O. Box 25112
Santa Fe, NM 87504
(505) 476-8101
<http://wildlife.state.nm.us/conservation/index.htm>

2.0 Background

Section 2.0 consists of background information on the distribution, status, habitat requirements, biology, and ecology of the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*). The section also includes economic and social profiles of the region within the range of the species. This information provides the basis for assessing current status, threats to persistence, and the most effective strategies for the recovery of the species.

2.1 NATURAL HISTORY

2.1.1 Taxonomy

The Narrow-headed Gartersnake (*Thamnophis rufipunctatus*) is a member of the family Colubridae, and was first described as *Chilopoma rufipunctatum* (Cope in Yarrow 1875). Given the morphology and feeding habits of the species (see Sections 2.1.2, Description, and 2.1.5, Food Habits) the Narrow-headed Gartersnake had been proposed to belong in the water snake genus, *Nerodia*, but recent work has indicated otherwise; its most likely relative is a Mexican species, the Southern Durango Spotted Gartersnake (*T. nigronuchalis*; Rossman et al. 1988, Hibbitts and Fitzgerald 2005, Chiasson and Lowe 1989, de Queiroz and Lawson 1994, de Queiroz et al 2002). Three subspecies are recognized, with only one (*T. r. rufipunctatus*) found in North America (Tanner 1990). "Rufipunctatus" refers to the reddish-brown spots on some individual snakes.

2.1.2 Description

The Narrow-headed Gartersnake is atypical of the garter snake genus *Thamnophis* in that it lacks long stripes along its body and in the shape of its head (Figure 1). The Narrow-headed Gartersnake ranges in color from olive to brown to gray-brown, and spots run the length of its body; the spots range in color from reddish brown with black borders to dark brown to black. The throat is cream in color and the venter a grayish-brown, usually with 2 - 4 rows of dark wedge-shaped marks on each side. Young of the species are similar in appearance, with the spotting more reddish-brown than in adults (Degenhardt et al. 1996). Body scales are keeled, with 21 rows at midbody (Ernst and Ernst 2003). Ventral scale number range from 151 – 180, with 64 – 89 subcaudal scales (on tail). Anal plate is singular. The snake will reach over 70 cm (2.3 ft) in length, with the tail accounting for 22.1 % of total length in females, 24.2 % in males (Tanner 1990). In New Mexico, 46 females ranged from 26.0 – 88.0 cm (0.9 – 2.9 ft) in length, while 67 males ranged 37.3 – 83.6 cm (1.2 – 2.7 ft) in length (Degenhardt et al. 1996). For the same snakes mass ranged from 10.1 – 285.0 g (0.4 – 10.1 oz) for females, 10.8 – 107.7 g (0.4 – 3.7 oz) for males.





Figure 1. Narrow head of Narrow-headed Gartersnake, Catron County, NM. Photograph by Charlie Painter.

The head of the aptly named Narrow-headed Gartersnake is longer than most garter snakes and the nose is laterally compressed with the eyes positioned high on the head (Ernst and Ernst 2003, Figure 1). The hemipenes of the species have not been described.

2.1.3 Distribution

Historic. Little is known about overall historic range, and no fossil record exists (Ernst and Ernst 2003, Tanner 1990). In both Arizona and New Mexico, some formerly robust populations have shown severe declines (see Section 2.2.2, Population Trends).

Current. The distribution of the Narrow-headed Gartersnake is split between populations in Mexico and the United States. The former is found from northern Chihuahua into Durango, Mexico, the latter from north-central Arizona to Hidalgo, Grant, and Catron counties in southwestern New Mexico (Ernst and Ernst 2003, Degenhardt et al. 1996). A highly aquatic species, the Narrow-headed Gartersnake is limited to reaches of the Gila and San Francisco drainages in New Mexico (Figure 2).

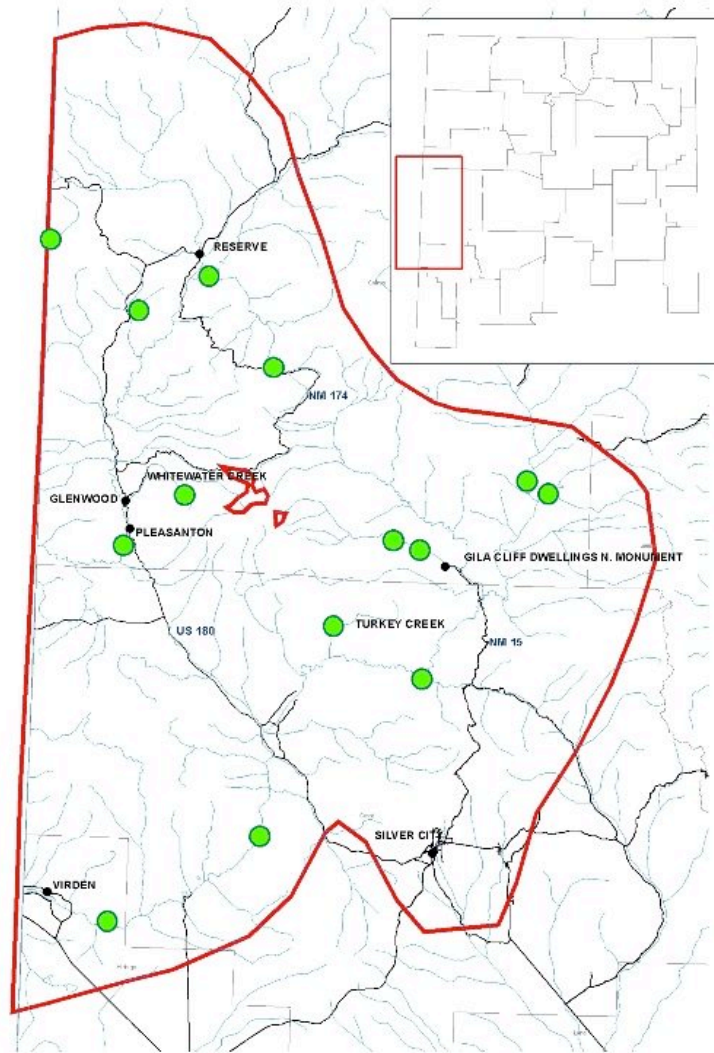


Figure 2. Known localities (green dots) and potential range of Narrow-headed Gartersnake (red border) in New Mexico (NMDGF files).

2.1.4 Required Habitats

Garter snakes are often associated with water, but, even for a garter snake, the Narrow-headed Gartersnake is considered highly aquatic (Rossman et al. 1988, Ernst and Ernst 2003, Degenhardt et al. 1996, Alfaro 2002). The species is found in clear water along the edges of riffles and pools of permanent and semi-permanent rocky streams, between 700.0 – 2400.0 m (2296.6 – 7874.0 ft) elevation (Ernst and Ernst 2003). Streams in the northern part of its range in New Mexico, such as Whitewater Creek, are cold temperature streams, whereas streams in the southern extent of its range in the State are quite warm (R. Jennings, personal communication). In Arizona, the Narrow-headed Gartersnake is found in streams in montane and Great Basin conifer woodlands, chaparral, and upland desert scrub (Brennan and Holycross 2006). In New Mexico, the snake is found most associated with abundant streamside vegetation, presumably used for basking and for escape opportunities (Degenhardt et al. 1996). The Narrow-headed Gartersnake likely makes use of the interstitial spaces between partially submerged rocks and boulders as part of its feeding behavior, and easily achieves negative buoyancy in order to stay

submerged under water (Rosen and Schwalbe 1988, Alfaro 2002, Hibbitts and Fitzgerald 2005, Nowak 2006, see Section 2.1.5, Food Habits).



Figure 3. Stream habitat typical of Narrow-headed Gartersnake, Catron County, NM. Photograph by Charlie Painter.

2.1.5 Food Habits

The Narrow-headed Gartersnake is primarily a piscivore; the elongated head, elevated eyes, and its many teeth likely serve as adaptations for capturing prey (Ernst and Ernst 2003, Hibbitts and Fitzgerald 2005). The snake is a visually-oriented predator and forages along streamside banks and particularly between boulders in the stream itself. The species may use its tail as an anchor in those rocks when pursuing prey, and behavior characteristics indicate it may be an ambush predator (Degenhardt et al. 1996, Hibbitts and Fitzgerald 2005, Alfaro 2002). In laboratory studies, the species was filmed striking at prey with a fast, scissor-like forward bite (Alfaro 2002). Prey taken include suckers (*Catostomus*, *Pantosteus* spp.), rainbow trout (*Oncorhynchus mykiss*), red shiner (*Cyprinella lutrensis*), speckled dace (*Rhinichthys osculus*) and sunfish (*Lepomis* spp.), although non-native, ray-finned fishes such as centrarchids (sunfish) and ictalurids (catfish) are not taken as often as native species (Ernst and Ernst 2003, Degenhardt et al. 1996, Nowak and Santana-Bendix 2002). In Arizona, the snake is reported to prey upon chub (*Gila* spp.; Brennan and Holycross 2006). The Narrow-headed Gartersnake will also prey upon amphibians, such as tiger salamanders (*Ambystoma tigrinum*), and larval and adult toads (*Bufo* spp.) and frogs (*Rana* spp.; Ernst and Ernst 2003).

2.1.6 Reproductive Biology

The Narrow-headed Gartersnake is a live-bearer, giving birth to 8 – 18 young (Degenhardt et al. 1996, Brennan and Holycross 2006). Males achieve sexual maturity around 2.5 years, females around 2, and females likely reproduce every year (Degenhardt et al. 1996, Rosen and Schwalbe 1988). Although the courtship has not been described in this particular species, evidence suggests mating occurs from late July into August (Degenhardt et al. 1996). Snout-to-vent length for neonates at birth range from 16.0 – 20.5 cm (6.3 – 8.0 in).



2.1.7 Movement

An aquatic specialist, the Narrow-headed Gartersnake rarely ventures far from its stream habitat during the spring and summer months (Nowak 2006). In Oak Creek, Arizona, adults tracked via radio transmitters typically found hibernation sites above the floodplain, in habitats ranging from rock fill in roadbanks and old floodplains, to sandstone outcrops over 200 m from the floodplain (Nowak 2006). The snake is primarily diurnal, and is most often found on clear days (Fleaharty 1967, Ernst and Ernst 2003). Basking is likely a necessary behavior to maintain physiological function in an ectotherm such as the Narrow-headed Gartersnake, given that the species forages in potentially cool waters (Ernst and Ernst 2003, Nowak 2006). Adult females in Oak Creek, Arizona had ranges from 0.7 – 1.1 ha (1.7 – 2.7 ac), while males had ranges from 1.5 – 2.2 ha (3.7 – 5.4 ac; Nowak 2006).

2.1.8 Predators

At present there has been no report of direct observation or evidence of predation upon the Narrow-headed Gartersnake, although increases in non-native crayfish, fishes, and American bullfrogs (*Rana catesbeiana*) apparently correspond with severe population declines in Arizona (Ernst and Ernst 2003, Rosen and Schwalbe 1988, see Section 2.1.9, Threats). Other garter snakes in the region with aquatic natural histories, such as the black-necked gartersnake (*Thamnophis crytopsis*) and the checkered gartersnake (*T. marcianus*) are known to be preyed upon by bullfrogs, snakes (*Coluber* spp., *Lampropeltis* spp., and *Masticophis* spp.), Great Blue Herons (*Ardea herodias*), jays (*Aphelocoma* spp.) and hawks (*Buteo* spp.), as well as potentially skunks and coyotes (Ernst and Ernst 2003, E. Nowak, personal communication). In defense, the snake will attempt to bite repeatedly and will void the foul-smelling contents of its anal scent gland if threatened (Degenhardt et al. 1996).

2.1.9 Threats

Habitat alteration and non-native species are the two most important threats to the Narrow-headed Gartersnake. Sedimentation from erosion, fires upstream, and overly intensive livestock grazing can adversely affect the species, specifically through the filling in of the interstitial spaces between boulders where the snake prefers to forage (Degenhardt et al. 1996, Nowak and Santana-Bendix 2002, Rosen and Schwalbe 1988, NMDGF Files). Alteration of vegetation along stream banks, through excessive livestock grazing or human recreational activities may remove basking sites and cover for the snake from potential predators, especially for juveniles (Nowak and Santana-Bendix 2002, Holycross et al. 2006).

Increases in the number of non-native species, such as American bullfrogs and centrarchid fishes (sunfishes, bass) appear to have corresponded with population declines in both Arizona and New Mexico (Holycross et al. 2006, Rosen and Schwalbe 1988, NMDGF files, Nowak 2006). Non-native crayfish are also potential predators of the snake, particularly young snakes (Holycross et al. 2006). Foraging by the Narrow-headed Gartersnake upon non-native fishes with stiff spines like sunfishes (*Lepomis* spp.) and various catfishes (*Ictalurus* spp.) might prove fatal as well due to punctures from the fish's spines if the snake consumes the fish (Nowak and Santana-Bendix 2002). By preying upon or competing with native species, non-native fishes can reduce the prey available to the snake. Humans have been known to shoot the snake, both from the perceived need to do away with a potential competitor for sport fishes and in the mistaken belief the species was the venomous cottonmouth (*Agkistrodon piscivorus*), which does not occur in the regions where the Narrow-headed Gartersnake is found (Ernst and Ernst 2003). During surveys for the Narrow-headed Gartersnake in 2004 – 2005, (Holycross et al. 2006) found the most robust population of 16 historical sites sampled, Whitewater Creek in Catron County, NM, to be the least impacted by either livestock grazing or non-native species. Off-road vehicle use along and within streams might negatively impact the species' habitat as well.





Figure 4. Microhabitat for the Narrow-headed Gartersnake, Catron County, NM. Shown is a minnow trap used by NMDGF for capture of the species. Photograph by Charlie Painter.

2.2 HISTORICAL PERSPECTIVE

2.2.1 Habitat Trends

The Narrow-headed Gartersnake occupies riparian habitat (See Section 2.1.4, Required Habitats); all riparian habitats have been identified as key focal points for future conservation efforts in New Mexico (NMDGF 2005). Many forms of disturbance, such as grazing, flooding, alteration of water flow, and recreational activity may alter riparian habitat resilience, in some cases improving the habitat, in other cases harming it (Szaro 1984). Change in climate might alter the riparian systems the Narrow-headed Gartersnake inhabits (Meyer and Pulliam 1991). For example, alteration of climate might lead to greater flooding events, that could potentially increase sedimentation, which in turn will affect the spawning of native fishes, the main prey base for the Narrow-headed Gartersnake. Sedimentation can also fill in the areas the snake prefers to forage. The trend for one index of climate, the average temperature in July in New Mexico, has been for an increase of 0.83° C (1.5°F) per decade over the last twenty years (National Climatic Data Center, National Environmental Satellite, Data, and Information Service, <http://www.ncdc.noaa.gov/oa/ncdc.html>).

2.2.2 Population Trends

Populations in the Gila and San Francisco river drainage appear to have declined significantly during the past 10 years (Holycross et al. 2006, C. Painter, NMDGF, personal communication). The species was only found in 5 of 16 historical sites in Arizona and New Mexico during surveys conducted in 2004 – 2005 (Holycross et al. 2006). Select populations in the San Francisco River near Pleasanton that were considered robust during 1990 – 2000 are now believed to be

extirpated. Populations in Whitewater Creek appear to be healthy, with recruitment of young observed during 2006, although fewer were observed in 2007 (NMDGF files).



Figure 5. Narrow-headed Gartersnake neonates. Photograph by Charlie Painter.

2.2.3 Use and Demand Trends

At present there appears to be no use of or demand for the Narrow-headed Gartersnake, as there is no evidence that the species has been subject to either commercial or recreational collection. The potential exists for the snake to be of interest to herpetocultural enthusiasts, given its rarity and unique morphology for a garter snake. In mid-summer 2005 herpetological enthusiasts were documented trying to collect the species from Oak Creek, Arizona before the State of Arizona collecting season for the Narrow-headed Gartersnake was officially closed (E. Nowak, personal communication).

2.2.4 Past Management

The Narrow-headed Gartersnake was listed as state threatened under the WCA in New Mexico in 1975 (NMDGF 1990). It is listed as a species of special concern by the U.S. Fish and Wildlife Service (USFWS 1994, 1996), and the snake is also wildlife of special concern in Arizona (AGFD 1996). The Narrow-headed Gartersnake was determined to be a species of greatest conservation need for New Mexico under the Comprehensive Wildlife Conservation Strategy-New Mexico (NMDGF 2005).

2.3 HABITAT ASSESSMENT

A highly aquatic species, the Narrow-headed Gartersnake is limited to reaches of the Gila and San Francisco drainages in New Mexico, along the edges of riffles and pools of permanent and semi-permanent rocky streams with clear water and abundant streamside vegetation (see Sections 2.1.3, Distribution, and 2.1.4, Required Habitats, Figure 2).



2.3.1 Status

The Gila River is the only free-flowing river in New Mexico, not currently regulated by impoundment. Flow is generally continuous, except for irrigation withdrawals during drought in the Cliff-Gila Valley. There are two lowhead diversion dams present on the San Francisco River. Although much of the land around the Gila and San Francisco rivers is managed by the U.S. Forest Service, canyon bottoms and valleys are mainly privately owned. As with many portions of the State of New Mexico, historic fire suppression and over-intensive livestock grazing may have led to recent occurrence of catastrophic fires and increased erosion (NMDGF 2005).

2.4 ECONOMIC AND SOCIAL IMPACTS

2.4.1 Economic Profile

The Narrow-headed Gartersnake is known from three counties in New Mexico, Catron, Grant, and Hidalgo Counties (Degenhardt et al. 1996). The United States Census estimates the population of Catron County at 3,409, a 3.8% decrease since April 1, 2000; the population of Grant County is estimated to be 29,747, a 4.0% decrease; the population of Hidalgo County is estimated to be 5,139, a 13.4% decrease; the population for the entire State of New Mexico is estimated to be 1,928,384, a 6.0 % increase (U.S. Census Bureau 2000, <http://www.census.gov/>). Geographically, Catron County is 17,941 square kilometers (6,927 square miles) in area, with 0.2 persons/square km (0.5/square mi) in 2000; Grant County is 10,269 km (3,965 square mi) in area, with 3.0 persons/square km (7.8/square mi) in 2000; Hidalgo County is 8,923 square km (3,445 square mi) in area, with 0.7 persons/square km (1.7/square mi) in 2000 (U.S. Census Bureau 2000). Per capita income in 2004 for Catron County was \$17,504, Grant County \$21,084, and Hidalgo \$18,882 (New Mexico Economic Development Department, <http://www.edd.state.nm.us/>). The main industries for Catron County are construction (4.0% of total employed persons), retail trade (3.2%), health care and social assistance (2.9%), accommodation and food services (2.8%), and agriculture, forestry, fishing and hunting (2.2%); the main industries for Grant County are health care and social assistance (15.3% of total employed persons), education (13.7%), retail trade (9.7%), accommodation and food services (9.0%), and mining (7.8%); the main industries for Hidalgo County are public administration (8.8% of total employed persons), health care and social assistance (8.5%), accommodation and food services (7.3%), retail trade (6.6%), and construction (3.2%), as of October 2006 (New Mexico Department of Labor, <http://www.dol.state.nm.us/>). As of 2002 Catron County had 206 farms, accounting for 665,682 hectares (164,4937 acres), and ranked 17th in the state in terms of head of cattle in 2006; as of 2002 Grant County had 272 farms, accounting for 492,955 ha (1,218,119 ac), and ranked 13th in the state in terms of head of cattle in 2006; as of 2002 Hidalgo County had 144 farms, accounting for 456,314 ha (1,127,578 ac), and ranked 19th in the state in terms of head of cattle in 2006 (New Mexico Department of Agriculture, <http://nmdaweb.nmsu.edu/>).

2.4.2 Economic Use of Habitat

Within U. S. Forest Service lands livestock have been excluded from streams since at least 2003, except for a few small points to allow cattle the opportunity to drink (J. Monzingo, U.S. Forest Service, personal communication). In some known localities for the Narrow-headed Gartersnake, such as near the Gila Cliff Dwellings National Monument (see Figure 2), hiking along the streams may be a recreational use of the habitat, as is the case for some sites in Arizona (Nowak and Santana-Bendix 2002). Another recreational use would be fishing (NMDGF files).



2.4.3 Sociological Factors

The majority of current localities for the Narrow-headed Gartersnake in New Mexico are found on U.S. Forest Service lands. However, potential habitat for the species might be found on private property, and a chief social misgiving would be for private property to be negatively impacted by the discovery of the species on that land. Currently the Narrow-headed Gartersnake is considered a species of concern by the U.S. Fish and Wildlife Service (USFWS 1994, 1996). New Mexico State recovery plans are by definition implemented to improve the status of the species and, if successful, would aid in precluding listing. Even if listing did occur, however, safe harbor agreements and federal funding would still be available to aid private landowners (L.Thompson, Western Colorado Field Office, U.S. Fish and Wildlife Service, personal communication). Further, the New Mexico Wildlife Conservation Act has no provision for restricting private property use to protect any species. Lastly, through a cooperative process such as this Recovery Plan, private landowners and the State can work to further the survival of any snakes found on the landowner's property in a positive fashion for both the Narrow-headed Gartersnake and the landowner.

3.0 Management Strategy

3.1 MANAGEMENT GOAL AND OBJECTIVE

Goal: Ensure the long-term persistence of natural populations of the Narrow-headed Gartersnake within its historical range in New Mexico, thereby contributing to the maintenance of the biological diversity in the State.

Objective: That by 2030, the populations and distribution of the Narrow-headed Gartersnake are sufficient to ensure its persistence within New Mexico.

Objective Parameters:

All existing populations identified.

Threats are identified and managed to minimize negative impacts to habitat, population viability, and environmental conditions.

Suitable habitat that may be used for repatriation identified.

Establish and maintain secure populations such that no single event threatens the security of the species in New Mexico.

3.2 MANAGEMENT ISSUES AND STRATEGIES

3.2.1 Issue 1- Need for Information on Declines and Threats to New Mexico Populations.

Trends indicate declines or outright extirpation of the Narrow-headed Gartersnake in New Mexico, and the causes for these declines remained to be determined, although information exists on some impacts, such as invasive species and sedimentation. It is important to determine such causes to improve the success of recovery efforts.

Strategy 1. Support research into the causes of declines and identification of potential threats on Narrow-headed Gartersnake populations and their habitat.

Strategy 2. Determine sources and potential impact of sedimentation on Narrow-headed Gartersnake populations and their habitat.



Strategy 3. Determine potential impact of pathogens on Narrow-headed Gartersnake populations.

Strategy 4. Determine potential impact of invasive crayfish on Narrow-headed Gartersnake populations and their prey base.

Strategy 5. Determine potential impact of non-native fishes on Narrow-headed Gartersnake populations and their prey base.

Strategy 6. Determine potential impact of bullfrogs on Narrow-headed Gartersnake populations and their prey base.

3.2.2 Issue 2- Need for Information on Biology and Natural History of the Narrow-headed Gartersnake

Much of the biology and natural history of the Narrow-headed Gartersnake is not well understood. It is important to gather such information to improve the success of recovery efforts.

Strategy 1. Support research into the biology and natural history of the Narrow-headed Gartersnake, to determine the population dynamics necessary to sustain the species, including but not limited to:

- Population viability
- Fitness
- Reproductive biology
- Site fidelity
- Habitat structure
- Predation
- Diet
- Movement
- Habitat Use

Strategy 2. Identify and survey potential suitable habitats throughout natural range, based upon established protocols.

Strategy 3. Support research into the genetic variability and systematics of the Narrow-headed Gartersnake throughout its range.

Strategy 4. Develop a monitoring program to assess the stability of any populations found in New Mexico.

Strategy 5. In cooperation with Arizona, support research into best practices for repatriation of the Narrow-headed Gartersnake.

Strategy 6. Support research into the importance of function of stream hydrology within the range of the Narrow-headed Gartersnake, including but not limited to flooding events, sedimentation, and water quality.

3.2.3 Issue 3- Management issues

The known historic localities for the Narrow-headed Gartersnake in New Mexico are mostly on United States Forest Service lands, as well as Bureau of Land Management lands. The species has been found on and may be repatriated to Federal, State, and private lands.



Coordination of efforts will allow such entities to pursue their own goals while maintaining efforts to recover the species.

Strategy 1. Identify and secure funding to promote the goals of this recovery plan, and coordinate recovery efforts in New Mexico with those in Arizona and Mexico.

Strategy 2. Create a recovery working group of stakeholders and managers to coordinate efforts, guide the direction of conservation efforts, and develop agreements as necessary among interested parties.

Strategy 3. Provide technical guidance and assistance to interested stakeholders in conserving or repatriating Narrow-headed Gartersnake populations on their properties.

Strategy 4. Minimize impacts of grazing along stream habitat, including but not limited to maintenance of undercut banks and streamside vegetation, and reduction of sedimentation.

Strategy 5. Minimize impacts of fire on Narrow-headed Gartersnake populations, and encourage firefighting management to reduce or eliminate the use of fish-killing fire retardants near streams.

Strategy 6. Support research into and develop strategies for intensive management of invasive species.

Strategy 7. In cooperation with Arizona, identify and support as necessary breeding facilities to aid in recovery of the Narrow-headed Gartersnake.

Strategy 8. Re-establish populations in suitable habitat within historic range in New Mexico.

Strategy 9. Develop public information and outreach program to inform the public about the Narrow-headed Gartersnake.

Strategy 10. Develop strategies for responding to population trends from ongoing monitoring efforts.

Strategy 11. Coordinate with other recovery plans, such as the New Mexico Colorado River Basin Chubs Recovery Plan and federal Chiricahua Leopard Frog Recovery Plan.



4.0 Implementation Schedule

Section 4.0 contains the Implementation Schedule for the Recovery Plan. Section 4.1 identifies specific tasks to be carried out to meet the strategies identified in Section 3.2 (Management Issues and Strategies). Section 4.2 presents a suggested time-line for the Implementation Schedule. Anticipated costs, including staffing, for these tasks will be addressed in an Operational Plan, to be developed following final approval of the Recovery Plan by the New Mexico State Game Commission

4.1 IMPLEMENTATION SCHEDULE TASKS

4.1.1 Improve and maintain knowledge of potential threats to the Narrow-headed Gartersnake

- 4.1.1.1. Support research into potential threats to populations of the Narrow-headed Gartersnake
- 4.1.1.2 Identify parties interested in research on potential threats to the Narrow-headed Gartersnake
- 4.1.1.3 Support research into the impact of stream sedimentation on populations of the Narrow-headed Gartersnake
- 4.1.1.4 Survey historic and current localities for the presence of pathogens that might negatively impact populations of the Narrow-headed Gartersnake.
- 4.1.1.5 Support research into the impact of invasive species on populations of the Narrow-headed Gartersnake

4.1.2 Improve and maintain knowledge of the biology of the Narrow-headed Gartersnake

- 4.1.2.1 Support research into the natural history of the Narrow-headed Gartersnake
- 4.1.2.2 Identify parties interested in conducting research on the biology of the Narrow-headed Gartersnake
- 4.1.2.3 Support research into the genetic structure of the various populations of the Narrow-headed Gartersnake for genetic identification to aid in any repatriation efforts
- 4.1.2.4 Support research into developing a best practices protocol for any repatriation efforts
- 4.1.2.5 Support research into the stream hydrology of the drainages in which populations of the Narrow-headed Gartersnake are found.
- 4.1.2.6 Develop public information and outreach programs for coordinating and sharing information on the biology of the Narrow-headed Gartersnake.

4.1.3 Develop and maintain high levels of cooperation and coordination between stakeholders and interested parties

- 4.1.3.1 Formulate a New Mexico Narrow-headed Gartersnake Recovery Team Working Group
- 4.1.3.2 Coordinate with Arizona Recovery Team
- 4.1.3.3 Develop operational plan for the Recovery Plan
- 4.1.3.4 Identify measures of success for the Recovery Plan
- 4.1.3.5 Identify all stakeholders and interested parties
- 4.1.3.6 Identify any agreements necessary to aid in the recovery of the Narrow-headed Gartersnake
- 4.1.3.7 Determine if restocking of known locations of the Narrow-headed Gartersnake is necessary for the recovery of the species, and, if so, develop a protocol for such a program
- 4.1.3.8 Identify measures of success for any restocking program(s)
- 4.1.3.9 Determine if repatriation of the Narrow-headed Gartersnake is necessary for the recovery of the species, and, if so, develop a protocol for such a program
- 4.1.3.10 Identify measures of success for any repatriation program(s)
- 4.1.3.11 Identify potential funding sources



4.1.3.12 Acquire funding for the Recovery Plan

4.1 IMPLEMENTATION SCHEDULE TIME-LINE

<i>Time Frame</i>	<i>Population Surveys</i>	<i>Coordination</i>	<i>Research</i>	<i>Monitoring</i>	<i>Repatriation and Restocking</i>
2 nd Half 2007		Commission Approval	Outreach to interested parties		
1 st Half 2008	Historic, New Localities	Formation of Recovery Working Group	Prioritize research efforts	Monitoring of known populations	Breeding of any necessary populations
2 nd Half 2008	Historic, New	Development of operation plan, success measures, protocols; necessary agreements	Funding Sought	Monitoring of known populations	Potential sites identified
1 st Half 2009	Historic, New	Development of necessary agreements for repatriation		Monitoring of known populations	Potential sites identified
2 nd Half 2009	Historic, New	Development of necessary agreements for repatriation		Monitoring of known populations	Breeding of any necessary populations
1 st Half 2010	New Localities; Acquire Natural History Information			Monitoring of known populations	If necessary, restocking and/or repatriation
2 nd Half 2010	New Localities; Acquire Natural History Information			Monitoring of known and any repatriated populations	If necessary, restocking and/or repatriation
1 st Half 2011	New Localities; Acquire Natural History Information			Monitoring of known and any repatriated populations	If necessary, restocking and/or repatriation
2 nd Half 2011	New Localities; Natural History Information			Monitoring of known and any repatriated populations	If necessary, restocking and/or repatriation



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6.0 Approvals



7.0 Appendices

7.1 HISTORY OF PUBLIC PARTICIPATION

22 February 2007, Silver City, NM: Public meeting to announce the initiation of a Recovery Plan for the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*). 2 NMDGF employees.

April 2007: Formed Advisory Committee.

June 2007: Advisory Committee review of background of Recovery Plan.

July 2007: Advisory Committee development of components of management section of Recovery Plan.

9 August 2007, Silver City, NM: Meeting of Advisory Committee to develop management section of Recovery Plan for the Narrow-headed Gartersnake. 4 attendees + 3 NMDGF employees.



Figure 6. Participants of August 9th 2007 meeting in Silver City, NM, to formulate management section of the Recovery Plan for the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*): left to right, Dr. Randy Jennings (Western New Mexico University), Valerie Boyarski (Arizona Game and Fish), Jim Stuart (NMDGF), Taylor Cotten (Private), Charlie Painter (NMDGF), Art Telles (U. S. Forest Service).

September – October 2007: Advisory Committee review of proposed management section of the Recovery Plan.

October 2007: Internal NMDGF review of the Recovery Plan.

November 2007: Public review of the Recovery Plan.

7.2 LISTING OF INTERESTED PARTIES AND MEMBERS OF ADVISORY COMMITTEE

Active participants on the Narrow-headed Gartersnake Recovery Plan Advisory Committee in **Bold**:

Arizona Department of Game and Fish-**Valerie Boyarski**, Tom Jones

Arizona State University-**Dr. Andy Holycross**

Bureau of Land Management-Mark Hakkila

New Mexico Environment Department-Gary Schiffmiller

New Mexico State University-Ken Boykin

Private Citizen-**Taylor Cotten**

U. S. Forest Service-**Art Telles**, Jerry Monzingo, Melinda Barton

U. S. Geological Survey-Northern Arizona University-**Erika Nowak**

University of Arizona-Dr. Phil Rosen, Dr. Cecil Schwalbe

University of New Mexico-Dr. Howard Snell, **Jacek Tomas Giermakowski**

Western New Mexico University-**Dr. Randy Jennings**

