

**THREATENED AND ENDANGERED SPECIES
OF NEW MEXICO**

2006 BIENNIAL REVIEW

AUGUST 25, 2006



**New Mexico Department of Game and Fish
Conservation Services Division**

THREATENED AND ENDANGERED SPECIES OF NEW MEXICO

Final 2006 Biennial Review and Recommendations

Authority: Wildlife Conservation Act (17-2-37 through 17-2-46 NMSA 1978)

EXECUTIVE SUMMARY: A total of 118 species and subspecies are on the 2006 list of threatened and endangered New Mexico wildlife. The list includes 2 crustaceans, 25 mollusks, 23 fishes, 6 amphibians, 15 reptiles, 32 birds and 15 mammals (Tables 1, 2). An additional 7 species of mammals has been listed as restricted to facilitate control of traffic in federally protected species. A species is endangered if it is in jeopardy of extinction or extirpation from the state; a species is threatened if it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in New Mexico. Species or subspecies of mammals, birds, reptiles, amphibians, fishes, mollusks, and crustaceans native to New Mexico may be listed as threatened or endangered under the Wildlife Conservation Act (WCA). During the Biennial Review, species may be upgraded from threatened to endangered, or downgraded from endangered to threatened, based upon data, views, and information regarding the biological and ecological status of the species. Investigations for new listings or removals from the list (delistings) can be undertaken at any time, but require additional procedures from those for the Biennial Review.

The 2004 Biennial Review contained a recommendation for maintaining the status for 123 species and subspecies listed as threatened, endangered, or restricted under the WCA, and uplisting 2 species (Jemez Mountains salamander and sand dune lizard) from threatened to endangered. The 2004 Biennial Review was completed when New Mexico State Game Commission approved all of these recommendations in March 2005.

The final draft of the 2006 Biennial Review contains a recommendation regarding listing status for each of the 125 species or subspecies listed as threatened, endangered, or restricted under the WCA. Of these, 119 are recommended to retain their current listing status. Two species (shortneck snaggletooth and piping plover) are recommended for downlisting from endangered to threatened. Four species (meadow jumping mouse, Arizona grasshopper sparrow, Pecos bluntnose shiner and spikedace) are currently recommended for uplisting from state threatened to endangered. Uplisting from threatened to endangered confers no regulatory authority to the New Mexico Department of Game and Fish (NMDGF) over the habitat of these species. However, a state-endangered status emphasizes the importance of, and demonstrates the ability for, state-level management to support the long-term persistence of otherwise imperiled native wildlife. This recommendation was approved by the State Game Commission in August 2006.

A summary of the distribution, current status, threats (existing, past or future actions that can create uncertainty of species persistence if they are not carried out in a manner that considers wildlife and habitat needs), and recommendations regarding listing status and conservation actions are presented for each species or subspecies on the state list. Species accounts contain only key references. The Department's database on these species consists of over 6000 taxa. Databases for individual species are available on the internet at: <http://www.bison-m.org>.

NMDGF emphasizes the need for identifying and protecting endangered wildlife in New Mexico. The State of New Mexico has lost, and continues to lose, its wildlife diversity. More than 90 different taxa have been extirpated from one or more counties, including 25 that are believed to be extinct (i.e., no longer exist anywhere), and at least 15 others that have been extirpated from the state (but continue to exist elsewhere).

Final 2006 Biennial Review of T & E Species of NM, 8/25/06

Table 1. Summary of review and recommendation for 2006 New Mexico endangered species list.

| TAXA and 2004 STATUS | Number of Species or Subspecies and 2006 Recommendations | | |
|----------------------|--|--------------------------|--------------------------|
| | No Change | Reclassify As Endangered | Reclassify As Threatened |
| INVERTEBRATES | | | |
| Endangered | 12 | -- | 1 |
| Threatened | 14 | 0 | -- |
| FISHES | | | |
| Endangered | 10 | -- | 0 |
| Threatened | 11 | 2 | -- |
| AMPHIBIANS | | | |
| Endangered | 4 | -- | 0 |
| Threatened | 2 | 0 | -- |
| REPTILES | | | |
| Endangered | 7 | -- | 0 |
| Threatened | 8 | 0 | -- |
| BIRDS | | | |
| Endangered | 11 | -- | 1 |
| Threatened | 19 | 1 | -- |
| MAMMALS | | | |
| Endangered | 6 | -- | 0 |
| Threatened | 9 | 1 | -- |
| Restricted (CITES) | 7 | 0 | 0 |
| TOTAL | 119 | 4 | 2 |

Table 2. Taxonomic review of New Mexico threatened and endangered species. Taxa listed as subspecies under the Wildlife Conservation Act are denoted by placing subspecies name in parentheses.

INVERTEBRATES (27)

Endangered:

no change: (12)

Socorro isopod, *Thermosphaeroma thermophilum*
Noel's amphipod, *Gammarus desperatus*
paper pondshell, *Utterbackia imbecillis*
Texas hornshell, *Popenaias popeii*
Koster's springsnail, *Juturnia kosteri*
Alamosa springsnail, *Psuedotryonia alamosae*
Chupadera springsnail, *Pyrgulopsis chupaderae*
Socorro springsnail, *Pyrgulopsis neomexicana*
Roswell springsnail, *Pyrgulopsis roswellensis*
Pecos assimineia, *Assimineia pecos*
wrinkled marshsnail, *Stagnicola caperata*
Florida mountainsnail, *Oreohelix florida*

Downlist to threatened: (1)

shortneck snaggletooth, *Gastrocopta dalliana dalliana*

Threatened:

no change: (14)

lake fingernailclam, *Musculium lacustre*
swamp fingernailclam, *Musculium partumeium*
long fingernailclam, *Musculium transversum*
Lilljeborg peaclam, *Pisidium lilljeborgi*
Sangre de Cristo peaclam, *Pisidium sanguinichristi*
Gila springsnail, *Pyrgulopsis gilae*
Pecos springsnail, *Pyrgulopsis pecosensis*
New Mexico springsnail, *Pyrgulopsis thermalis*
star gyro, *Gyraulus crista*
ovate vertigo, *Vertigo ovata*
Hacheta Grande woodlandsnail, *Ashmunella hebardii*
Cooke's Peak woodlandsnail, *Ashmunella macromphala*
Mineral Creek mountainsnail, *Oreohelix pilsbryi*
Doña Ana talussnail, *Sonorella todseni*

FISHES (23)

Endangered:

no change: (10)

Gila chub, *Gila intermedia*
Chihuahua chub, *Gila nigrescens*
roundtail chub, *Gila robusta*
Rio Grande silvery minnow, *Hybognathus amarus*
Arkansas River shiner, *Notropis girardi*
southern redbelly dace, *Phoxinus erythrogaster*
Colorado pikeminnow, *Ptychocheilus lucius*
(Zuni) bluehead sucker, *Catostomus discobolus yarrowi*
blue sucker, *Cycleptus elongatus*
Pecos gambusia, *Gambusia nobilis*

Threatened:

no change: (11)

Gila trout, *Oncorhynchus gilae*

Mexican tetra, *Astyanax mexicanus*
peppered chub, *Macrhybopsis tetranema*
suckermouth minnow, *Phenacobius mirabilis*
loach minnow, *Tiaroga cobitis*
gray redhorse, *Moxostoma congestum*
Pecos pupfish, *Cyprinodon pecosensis*
White Sands pupfish, *Cyprinodon tularosa*
Gila topminnow, *Poeciliopsis occidentalis*
greenthroat darter, *Etheostoma lepidum*
bigscale logperch, *Percina macrolepida*

Uplist to endangered: (2)

(Pecos) bluntnose shiner, *Notropis simus pecosensis*
spikedace, *Meda fulgida*

AMPHIBIANS (6)

Endangered:

no change: (4)

Jemez Mountains salamander, *Plethodon neomexicanus*
lowland leopard frog, *Rana yavapaiensis*
mountain toad, *Bufo boreas*
Great Plains narrow-mouthed toad, *Gastrophryne olivacea*

Threatened:

no change: (2)

Sacramento mountain salamander, *Aneides hardii*
Sonoran desert toad, *Bufo alvarius*

REPTILES (15)

Endangered:

no change: (7)

Gila monster, *Heloderma suspectum*
sand dune lizard, *Sceloporus arenicolus*
gray-checked whiptail, *Aspidoscelis dixonii*
gray-banded kingsnake, *Lampropeltis alterna*
Mexican gartersnake, *Thamnophis eques*
plain-bellied water snake, *Nerodia erythrogaster*
(New Mexico) ridgenosed rattlesnake, *Crotalus willardi obscurus*

Threatened:

no change: (8)

western river cooter, *Pseudemys gorzugi*
Slevin's bunchgrass lizard, *Sceloporus slevini*
canyon spotted whiptail, *Aspidoscelis burti*
mountain skink, *Eumeces callicephalus*
green ratsnake, *Senticolis triaspis*
narrow-headed gartersnake, *Thamnophis rufipunctatus*
western ribbonsnake, *Thamnophis proximus*
(mottled) rock rattlesnake, *Crotalus lepidus lepidus*

BIRDS (32)

Endangered:

no change: (11)

brown pelican, *Pelecanus occidentalis*
aplomado falcon, *Falco femoralis*
white-tailed ptarmigan, *Lagopus leucurus*
whooping crane, *Grus americana*

least tern, *Sterna antillarum*
common ground-dove, *Columbina passerina*
buff-collared nightjar, *Caprimulgus ridgwayi*
elegant trogon, *Trogon elegans*
northern beardless-tyrannulet, *Camptostoma imberbe*
(southwestern) willow flycatcher, *Empidonax traillii extimus*
thick-billed kingbird, *Tyrannus crassirostris*

Downlist to threatened: (1)
piping plover, *Charadrius melodus*

Threatened:

no change: (19)
neotropical cormorant, *Phalacrocorax brasilianus*
bald eagle, *Haliaeetus leucocephalus*
common black-hawk, *Buteogallus anthracinus*
peregrine falcon, *Falco peregrinus*
(Gould's) wild turkey, *Meleagris gallopavo mexicana*
whiskered screech-owl, *Megascops trichopsis*
boreal owl, *Aegolius funereus*
broad-billed hummingbird, *Cynanthus latirostris*
white-eared hummingbird, *Hylocharis leucotis*
violet-crowned hummingbird, *Amazilia violiceps*
lucifer hummingbird, *Calothorax lucifer*
Costa's hummingbird, *Calypte costae*
Gila woodpecker, *Melanerpes uropygialis*
Bell's vireo, *Vireo bellii*
gray vireo, *Vireo vicinior*
Abert's towhee, *Pipilo aberti*
Baird's sparrow, *Ammodramus bairdii*
yellow-eyed junco, *Junco phaeonotus*
varied bunting, *Passerina versicolor*

Uplist to endangered: (1)
(Arizona) grasshopper sparrow, *Ammodramus savannarum ammoregus*

MAMMALS (22)

Endangered:

no change: (6)
Arizona shrew, *Sorex arizonae*
Mexican long-nosed bat, *Leptonycteris nivalis*
(Peñasco) least chipmunk, *Neotamias minimus atristriatus*
(Arizona) montane vole, *Microtus montanus arizonensis*
gray wolf, *Canis lupis*
(desert) bighorn sheep, *Ovis canadensis mexicana*

Threatened:

no change: (8)
least shrew, *Cryptotis parva*
southern long-nosed bat, *Leptonycteris curasoae*
spotted bat, *Euderma maculatum*
western yellow bat, *Lasiurus xanthius*
white-sided jackrabbit, *Lepus callotis*
(Organ Mountains) Colorado chipmunk, *Neotamias quadrivittatus australis*
southern pocket gopher, *Thomomys umbrinus*
American marten, *Martes americana*

Uplist to endangered: (1)

meadow jumping mouse, *Zapus hudsonius*

Restricted Species (CITES):

no change: (7)

leopard, *Panthera pardus*

clouded leopard, *Neofelis nebulosa*

snow leopard, *Panthera uncia*

jaguar, *Panthera onca*

Florida panther, *Felis concolor coryi*

tiger, *Panthera tigris*

ocelot, *Felis pardalis*

TAXONOMIC AUTHORITIES

INVERTEBRATES

- Herrington, H. B. 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Museum of Zoology, University of Michigan. Misc. Pub. No. 118.
- Hershler, R. H. and F. C. Thompson. 1987. North American Hydrobiidae (Gastropoda: Rissoacea): redescription and systematic relationships of *Tryonia* Stimpson, 1865 and *Pyrgulopsis* Call and Pilsbry, 1896. *The Nautilus* 101(1):25-32.
- Hershler, R. H. 2001. Systematics of the North and Central American genus *Tryonia* (Rissoidea:Hydrobiidae). Smithsonian Institution Press, Washington, D. C. Smithsonian Contributions to Zoology, No. 612. 53 pp.
- Hershler, R. H., H. Liu, and C. A. Stockwell. 2002. A new genus and species of aquatic gastropods (Rissoidea:Hydrobiidae) from the North American Southwest: phylogenetic relationships and biogeography. *Proceedings of the Biological Society of Washington* 115(1):171-188.
- Taylor, D. W. 1987. Fresh-water molluscs from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources. Bulletin 116.
- Turgeon, D. D., J. F. Quinn, A. E. Bogan, E. V. Coan, F. C. Hochberg, W. G. Lyons, P. M. Mikkelsen, R. J. Neves, C. F. E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F. G. Thompson, M. Vecchione, and J. D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd edition. American Fisheries Society Special Publication 26.
- Williams, J. E., M. L. Warren, Jr., K. S. Cummings, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. *Fisheries* 18(9):6-22.

FISHES

- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society Special Publication 29. Bethesda, Maryland.

Exception:

Tiaroga cobitis from: Minckley, W. L. 1973. *Fishes of Arizona*. Arizona Game and Fish Department, Phoenix, Arizona.

AMPHIBIANS AND REPTILES

- Crother, B. I., J. Boundy, J. A. Campbell, K. DeQuiroz, D. Frost, D. M. Green, R. Highton, J. B. Iverson, R. W. Scientific and standard English names of amphibians and reptiles of North America north of Mexico: Update. *Herpetol. Rev.* 34(3):196-203.

Exception:

Mountain toad, *Bufo boreas* complex, from: Hammerson, G.A. 1999. *Amphibians and Reptiles in Colorado: A Colorado Field Guide*. 2nd Ed. University Press of Colorado, Niwot, Colorado xxvi + 484 p.

BIRDS

American Ornithologists' Union. 1998. Check-list of North American Birds, 7th edition. American Ornithologists' Union, Washington, D.C. 829 p.

MAMMALS

Frey, J. K. 2004. Taxonomy and distribution of the mammals of New Mexico: an annotated checklist. Occasional papers Museum of Texas Tech University 240:1.32.

Wilson, D. E. and D. M. Reeder. 2005. Mammal Species of the World: A Taxonomic and Geographic Reference, 3rd edition. Johns Hopkins University Press, Baltimore, 2 vols., xxxviii +2142 pp.

INVERTEBRATES

CRUSTACEA

ENDANGERED

Socorro isopod, *Thermosphaeroma thermophilum*

Distribution: The Socorro isopod is endemic to a small thermal spring located southwest of Socorro, New Mexico (Richardson 1897, Shuster 1981). A captive population exists at the Socorro Isopod Propagation Facility (SIPF) near Socorro, and a refuge population is maintained at the Albuquerque Biological Park.

Current Status: The Socorro isopod was listed as a state (NMDGF Reg. 563) and federal (USFWS 1982) endangered species in 1978. In August 1988, *T. thermophilum* was extirpated in the wild when diminished discharge of the native spring resulted in habitat desiccation. Spring flow was reestablished in September 1988, which likely flushed isopods from the underground plumbing system into the native spring. The native population was augmented a month later from a captive population housed at the Department of Biology, University of New Mexico. This near extinction event prompted resource agencies to build the Socorro Isopod Propagation Facility (SIPF) near the native habitat. Construction of this facility (1990) expanded the total area occupied by the Socorro isopod, and provided opportunity for captive propagation, genetic, and life history studies (Lang et al. In Press, Shuster et al. 2005). Population and habitat monitoring at the native spring and SIPF has occurred monthly since November 1994. Native and captive populations are stable with lower densities of isopods occurring under artificial habitat conditions of the SIPF compared to higher densities at the natural spring (Lang et al. In Press).

Threats: Primary threats include vandalism, modification of spring flows, and potential disruption of thermal groundwater discharge from surface/sub-surface explosive tests on Department of Defense lands immediately west of the natural spring (Lang 2001).

Recommendations: No change in listing status is recommended. NMDGF has been involved with conservation activities detailed in the federal recovery plan (USFWS 1982) and in NMDGF grant documents since 1988. This plan identifies goals and actions to achieve recovery and delisting of the species. Conservation efforts are coordinated with the U. S. Fish and Wildlife Service, Albuquerque Biological Park, and the private land owner.

Literature Cited

- Lang, B. K. 2001. New Mexico endangered invertebrates: monitoring and management. New Mexico Department of Game and Fish, Completion Report (E-37) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Lang, B. K., D. A. Kelt, and S. M. Shuster. In Press. The role of controlled propagation on an endangered species: demographic effects of habitat heterogeneity among captive and native populations of the Socorro isopod (Crustacea: Flabellifera). *Biodiversity and Conservation*.
- Shuster, S. M. 1981. Life history characteristics of *Thermosphaeroma thermophilum*, the Socorro isopod (Crustacea: Peracarida). *Biological Bulletin*. 161:291-302.
- Shuster, S. M., M. P. Miller, B. K. Lang, N. Zorich, L. Huynh, and P. Keim. 2005. The effects of controlled propagation on an endangered species: genetic differentiation and divergence in body size among native and captive populations of the Socorro isopod (Crustacea: Flabellifera). *Conservation Genetics* 6:355-368.
- Richardson, H. 1897. Description of a new crustacean of the genus *Sphaeroma* from a warm spring in New Mexico. *Proceedings of the U. S. National Museum* 20:465-466.
- United States Fish and Wildlife Service. 1982. Recovery plan for the Socorro isopod (*Thermosphaeroma thermophilum*). 13 pp.

Noel's amphipod, *Gammarus desperatus*

Distribution: Historically, Noel (1954) and Cole (1981, 1985, 1988a, 1988b) reported this amphipod from three Chaves County sites near Roswell: Lander Springbrook, North Spring (type locality), and Bitter Lake National

Wildlife Refuge (BLNWR). Noel's amphipod currently occurs only on BLNWR (Bitter Creek, Sago Spring, Unit 6 and 7 spring-ditch, Hunter Marsh) and on private land near Hunter Marsh (Federal Register 2005).

Current Status: The Lander Springbrook population was extirpated during the period 1951-1957, whereas loss of the North Spring population occurred during the period 1978-1988 (Cole 1981, 1985, 1988a, 1988b). Extirpation at the type locality prompted the 1990 uplisting of the species from state threatened to endangered under NMDGF Regulation 682. Gammarid amphipods were not present in recent collections from North Spring (Mehlhop 1992, 1993; Lang 2005). Populations on BLNWR have been monitored routinely since 1995 (Lang 2002, 2005). NMDGF has implemented a conservation plan for four state-listed macroinvertebrate species of Chaves County, including *G. desperatus* (NMDGF 2005). The USFWS listed this species as endangered under the Endangered Species Act (Federal Register 2005).

Acquisition of federal water rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for this species. Preliminary results of genetic studies imply the presence of cryptic species at BLNWR (Gervasio et al. 2004). Deposition of post-fire ash, laden with polycyclic aromatic hydrocarbons resulting from the March 2000 Sandhill Fire at BLNWR, may account for the overall dramatic decline of macroinvertebrate populations observed in Bitter Creek at Dragonfly Spring; especially effected was Noel's amphipod (Lang 2005). Morphologic and genetic studies are ongoing to assess intra- and inter-specific relationships between amphipods of this species complex.

Threats: The specific epithet, *desperatus*, refers to what Cole (1981) considered an imperiled situation for the species: the progressive loss of isolated gammarid populations in Chaves County, New Mexico, between 1951-1988 (Cole 1985, 1988a, 1988b). Cole attributed these extirpations to regional ground water depletion and habitat alterations (e.g., artesian spring source diversion, dewatering, capping). Similar factors likely affected localized gammarid populations in west Texas (Lang et al. 2003).

While populations of *G. desperatus* are stable under current refuge management plans (Research Management Consultants, Inc. 1998), off-refuge land use practices within areas of the Roswell Artesian Basin (Basin) pose threats to the long-term viability of populations at BLNWR. Regional ground water pumping for agriculture, municipal water supplies, and oil and gas industry operations continue in the Basin (BLM 1994, USFWS 1997). Any increases in groundwater extraction similar to aquifer drawdown levels that occurred in the Basin from the 1950's to 1970's could lead to habitat impacts on BLNWR. Oil and gas development is ongoing within areas of the Basin that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water source-zones for surface waters at BLNWR. Such extractive processes and industry operations can result in aquifer drawdown, alter aquitard hydraulics, and contaminate ground and surface waters in New Mexico (Hennighausen 1969; Jercinovic 1982, 1984; Longmire 1983; Quarles 1983; Boyer 1986; Richard 1988a, 1988b; Rail 1989; Richard and Boehm 1989a, 1989b; Balleau Groundwater, Inc. 1996; Martinez et al. 1998). Amphipod crustaceans are acutely sensitive to ground and surface water contaminants (Eisler 1987, Green and Trett 1989, Pennak 1989, Covich and Thorpe 1991). There is increased risk of degradation of ground and surface water quality posed by sewage contamination (i.e., municipal waste, septic discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR (Federal Register 2005). Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) in sinkholes is known to contaminate ground water resources in karst areas of the United States (White et al. 1995, Zokaites 1997) and in New Mexico (Bitner and Graves 1992, McQuillan et al. 1989).

Natural stochastic events, such as fire or drought, could adversely impact extant *G. desperatus* populations at BLNWR. In the short-term, Noel's amphipod is threatened by impoverished aquatic conditions following the March 2000 Sandhill Fire which severely burned reaches of Bitter Creek formerly inhabited by *G. desperatus* (Lang 2002, 2005; Lang et al. 2003). The long-term impact of these effects, whether beneficial or adverse, on the aquatic biota and riparian corridor of Bitter Creek remain undetermined. Prolonged drought may affect hydrologic conditions on BLNWR by reducing discharge through refuge surface waters while concomitantly increasing salinity and concentrating contaminants.

Recommendation: No change in listing status is recommended. In collaboration with the U. S. Fish and Wildlife Service, NMDGF should continue to monitor post-fire effects on the aquatic macroinvertebrates and riparian corridor of Bitter Creek. NMDGF and cooperators should continue to actively implement strategies of the state conservation plan to alleviate threats and achieve recovery of this species.

Literature Cited

- Bitner, M. J. and T. Graves. 1992. Effect of lot sizes on potential ground-water contaminants from conventional septic-tank systems: numerical modeling. Policy Coordinating Committee. 47 pp.
- Boyer, D. G. 1986. Differences in produced water contaminants from oil and gas operations in New Mexico - implications for regulatory action. Pp. 291-316, *In Proceedings of the Conference on Southwestern Ground Water Issues* (National Water Well Association, Publisher).
- Balleau Groundwater, Inc. 1996. Interrelation of groundwater and surface water at Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 16 pp. (with addenda).
- Balleau Groundwater, Inc. 1997. Annotated abstract of water-rights administration Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 22 pp. (with addenda).
- Balleau Groundwater, Inc. 1999. Source-water protection zones for Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 42 pp.
- Bureau of Land Management. 1994. Draft resource management plan/environmental impact statement for the Roswell Resource Area, Roswell, New Mexico, and draft resource management plan amendment/environmental impact statement for the Carlsbad Resource Area, Carlsbad, New Mexico. Bureau of Land Management, Roswell, NM.
- Cole, G. A. 1981. *Gammarus desperatus*, a new species from New Mexico (Crustacea: Amphipoda). *Hydrobiologia* 76:27-32.
- Cole, G. A. 1985. Analysis of the *Gammarus*-pecos complex (Crustacea: Amphipoda) in and New Mexico, USA. *Journal of the Arizona-Nevada Academy of Science* 20:93-103.
- Cole, G. A. 1988a. Noel's amphipod (*Gammarus desperatus*). Final Report submitted to the New Mexico Department of Game and Fish Endangered Species Program under Professional Service Contract 519-77-02. 6 pp.
- Cole, G. A. 1988b. A report on the status of Amphipoda, including *Gammarus desperatus* in New Mexico. Submitted to the New Mexico Department of Game and Fish Endangered Species Program under Professional Service Contract 519-77-02. 15 pp.
- Covich, A. P. and J. H. Thorp. 1991. Crustacea: introduction and Peracarida. Pp. 665-689, *In Ecology and Classification of North American Freshwater Invertebrates*, James H. Thorp and Alan P. Covich, eds. Academic Press, 911 pp.
- Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a syntopic review. U.S. Fish and Wildlife Service. Contaminant Hazard Reviews Report No. 11, Biological Report 85 (1.11).
- Federal Register. 1996. Endangered and threatened wildlife and plants; Review of plant and animal taxa that are candidates for listing as endangered or threatened species. 50 CFR Part 17, 61(40):7595-7613.
- Federal Register. 2005. Endangered and Threatened Wildlife and Plants; Listing Roswell springsnail, Koster's tryonia, Pecos Assiminea, and Noel's Amphipod as Endangered with Critical Habitat; Final Rule. 50 CFR Part 17, 70(152):46303-46333.
- Gervasio, V., D. J. Berg, B. K. Lang, N. Allan, and S. I. Guttman. 2004. Genetic structure of the *Gammarus pecos* species complex (Crustacea: Amphipoda) in Chihuahuan Desert springs. *Limnology and Oceanography* 49(2):520-531.
- Green, J. and M. W. Trett. 1989. The fate and effects of oil in freshwater. Elsevier Science Publishing Co., Inc., New York.
- Havlik, M. E. and L. L. Marking. 1987. Effects of contaminants on naiad mollusks (Unionidae): a review. U. S. Fish and Wildlife Service, Resource Publication 164.
- Hennighausen, F. H. 1969. Meters and their effects in the Roswell Artesian Basin in Chaves and Eddy counties, New Mexico. Pp. 29-33, *In 14th Annual New Mexico Water Conference* (Water Resources Institute).
- Jercinovic, D. E. 1982. Assessment of refined petroleum-product contamination problems in surface and ground waters of New Mexico. Water Pollution Control Bureau, New Mexico Environmental Improvement Division, EID/WPC-82/5.
- Jercinovic, D. E. 1984. Petroleum-product contamination of soil and water in New Mexico. New Mexico Environmental Improvement Division, EID/GWH84/2.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. NMDGF Completion Report E-20 (5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Lang, B. K. 2005. Macroinvertebrate of Bitter Lake National Wildlife Refuge. NMDGF Completion Report E-56 submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.

- Lang, B. K., V. Gervasio, D. J. Berg, S. I. Guttman, N. L. Allan, M. E. Gordon, and G. Warrick. 2003. Gammarid amphipods of northern Chihuahuan Desert spring systems: an imperiled fauna. Pp. 47-57, *In* Aquatic Fauna of the Northern Chihuahuan Desert, G. P. Garrett and N. L. Allan, Eds. Museum of Texas Tech University, Special Publications Series, Number 46. Lubbock, TX.
- Longmire, P. A. 1983. Petroleum-product contamination of ground and surface water: a literature review. Ground Water Section, Water Pollution Control Bureau, New Mexico Environmental Improvement Division. EID/WPC-83/7.
- Martinez, J. D., K. S. Johnson, and J. T. Neal. 1998. Sinkholes in evaporite rocks. *American Scientist* 86:38-51.
- McQuillan, D. M., M. J. Jasper, and B. H. Swanson. 1989. Ground-water contamination by septic-tank use: a field study in the Albuquerque south Valley - West Mesa Region, Bernalillo County, New Mexico. New Mexico Health and Environment Department, Environmental Improvement Division, Ground Water Bureau.
- Mehlhop, P. 1992. Establishment of a rare mollusc inventory and monitoring program for New Mexico. Progress Report. NMDGF Professional Services Contract 80-519-52.
- Mehlhop, P. 1993. Establishment of a rare mollusc inventory and monitoring program for New Mexico. Year II Progress Report. NMDGF Professional Services Contract No. 80-519-52-Amendment 1.
- New Mexico Department of Game and Fish. 2005. Recovery and conservation plan for four invertebrate species: Noel's amphipod (*Gammarus desperatus*), Pecos assiminea (*Assiminea pecos*), Koster's springsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). 80 pp.
- New Mexico Department of Game and Fish. 2004. Recovery and conservation plan for four invertebrate species: Noel's amphipod (*Gammarus desperatus*), Pecos assiminea (*Assiminea pecos*), Koster's springsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). Second revised draft.
- Noel, M. 1954. Animal ecology of a New Mexico springbrook. *Hydrobiologia* 6:120-135.
- Pennak, R. W. 1989. Fresh-water invertebrates of the United States: Protozoa to Mollusca. 3rd ed. John Wiley & Sons, Inc. 628pp.
- Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.
- Rail, C. D. 1989. Groundwater contamination: sources, control, and preventative measures. Technomic Publishing Company, Inc. Lancaster, PA.
- Research Management Consultants, Inc. 1998. Final comprehensive conservation plan and Environmental Assessment: Bitter Lake National Wildlife Refuge.
- Richard, M. 1988a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: review of the geohydrology in the vicinity of Rattlesnake Springs and the contamination problem. Report 1. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. 1988b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the first field investigation, August 1988. Report 2. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the second field investigation, March, 1988. Report 3. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: final summary of the investigation. Report 4. National Park Service Contract RFQ 7029-8-0025.
- United States Department of Justice. 1996. United States of America's statement of claim for reserved surface water and groundwater rights for Bitter Lake National Wildlife Refuge. Roswell Basin Section, RAB 923 and 1793, Denver.
- United States Fish and Wildlife Service. 1997. Biological opinion on the Roswell Resource Area Resource Management Plans. Section 7 Consultation #2-22-96-102.
- White, B. W., D. C. Culver, J. S. Herman, T. C. Kane, and J. E. Mylroie. 1995. Karst lands: the dissolution of carbonate rock produces unique landscapes and poses significant hydrological and environmental concerns. *American Scientist* 83:450-459.
- Zokaites, C. 1997. Living on karst: a reference guide for landowners in limestone regions. Cave Conservancy of the Virginias. 25 pp.

MOLLUSCA

BIVALVIA

ENDANGERED

Paper pondshell, *Utterbackia imbecillis*

Distribution: The paper pondshell is one of the most widely distributed freshwater mussels in North America (Taylor 1983, Williams et al. 1993), occurring over a wide variety of substrata (mud to gravel) in reservoirs, lakes, rivers, and streams (Gordon and Layzer 1989). The only known New Mexico population was documented by recent shells from Conchas Lake, San Miguel County; hundreds of miles from the nearest known occurrences in adjacent states and northern México (Río Conchos) (Taylor 1983).

Current Status: The paper pondshell was listed as state endangered (NMDGF Reg. 624) in 1983. Historic populations in the Conchas River near Variadero are apparently extirpated (Lang and Mehlhop 1996), and may represent the source for populations found in Conchas Lake (Taylor 1983). A basin-wide mussel inventory of the Canadian River yielded only one fresh valve of an immature paper pondshell from Ute Creek near Ute Reservoir, Harding County (Lang and Mehlhop 1996). While this record represents an eastward range extension in New Mexico, this species was not found in Conchas Lake, nor has it been reported as extant in New Mexico. This species has many glochidial (larval) host fish, and has been introduced to impounded waters throughout the United States by fish stocking and bait bucket introductions (Howells et al. 1996). The genus *Anodonta* is taxonomically complex with many questions regarding the phylogenetic status of putative species (Hoeh 1993). Taxonomic studies and anthropogenic modes of dispersal pose questions regarding specific identity and native status of this species in New Mexico.

Threats: Habitat modification (stream channelization, dewatering, poor watershed management, and manipulation of natural flows) is likely responsible for loss of native riverine populations (Lang and Mehlhop 1996). Contaminants and the potential for introduction of zebra mussels represent threats to paper pondshell populations of Canadian River mainstem impoundments.

Recommendations: No change recommended in listing status. Systematic surveys should be undertaken to document current status of the species in New Mexico. State and federal agencies should take preventative measures to prevent the introduction of zebra mussels and other aquatic nuisance species to New Mexico's surface waters.

Literature Cited

- Gordon, M. E. and J. B. Layzer. 1989. Mussels (Bivalvia: Unionidae) of the Cumberland River: review of life histories and ecological relationships. U. S. Fish and Wildlife Service, Biological Report 89 (15).
- Hoeh, W. R. 1993. Phylogenetic relationships among eastern North American *Anodonta* (Bivalvia: Unionidae). *Malacological Review* 23:63-82.
- Howells, R. G., R. W. Neck, and H. D. Murray. 1996. Freshwater mussels of Texas. Texas Parks and Wildlife Department, Austin.
- Lang, B. K. and P. Mehlhop. 1996. Distribution of freshwater mussels (Unionidae) of the Canadian River drainage: New Mexico and Texas. Segment I: Survey of freshwater bivalve mollusks of the Canadian River, New Mexico. National Biological Service, State Partnership Program, Final Report, 39 pp.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Williams, J. E., M. L. Warren, Jr., K. S. Cummings, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. *Fisheries* 18(9):6-22.

Texas hornshell, *Popenaias popeii*

Distribution: *Popenaias popeii* is reported from Western Gulf and Mexican Gulf coastal drainages of the Rio Grande Basin south to the northern Estado de Vera Cruz, México (Johnson 1999). In the United States, this mussel

occurred in the Rio Grande basin from Brownsville, Cameron County, Texas (Metcalf 1982, Neck and Metcalf 1988, Howells et al. 1996), upstream in the Pecos River to North Spring River, Roswell, Chaves County, New Mexico (Cockerell 1902).

Current Status: The sporadic occurrence of *P. popeii* in Texas led Strecker (1931) to regard this species as “scarce.” The Texas hornshell was listed as state endangered in 1983. The dearth of information in historic and contemporaneous collection records prompted the listing of this mussel as threatened by the American Fisheries Society (Williams et al., 1993). Currently, *P. popeii* is considered a federal candidate for listing (priority 2) under the Endangered Species Act (Federal Register 2001).

Popenaias popeii has declined notably throughout its range. The species currently occupies about 12% of its historic range in New Mexico, where the extant population is confined to a 14 km reach of the Black River, Eddy County (Lang 2001). Howells (2004) reported live Texas hornshell in the Rio Grande near Laredo, Webb County, Texas. Research focusing on the distribution and abundance, habitat affinities, life history, salinity tolerance, and population genetics of the Black River population are summarized in Lang (2001). Smith et al. (2003) described the breeding periodicity and reproductive anatomy of the species.

Threats: Anthropogenic modification of riverine ecosystems (e.g., construction of mainstem impoundments, diversion and redistribution of water, water pollution, introduction of exotic mollusks) responsible for the imperilment of freshwater mussels in the eastern United States (Allan and Flecker 1993, Mehlhop and Vaughn 1993, Neves 1993, Williams et al. 1993, Ricciardi and Rasmussen 1999, Vaughn and Taylor 1999) likewise accounts for significant loss of mussel populations in the Pecos River of New Mexico and Texas (Taylor 1983, Neck and Metcalf 1988, Howells et al. 1996, Howells 2003). In southeastern New Mexico, construction of impoundments (Lake MacMillan, Brantley Reservoir, Lake Avalon) is one of the many factors responsible for extirpation of *P. popeii* from the Pecos River mainstem (Taylor 1983). Low-head dams on the Black River likely prevent movement of glochidial-bearing host fishes to riverine reaches upstream of Black River Village where this mussel does not occur (Lang 2001). Opportunities for recolonizing reaches downstream of the Carlsbad Irrigation District dam appear limited by altered physicochemical and hydrologic regimes.

Groundwater depletion and ground and surface water contaminants are considered principal causes of decline in unionid mussels (Metcalf 1982, Taylor 1983, NMDGF 1988, Williams et al. 1993, Neves et al. 1997, Strayer 1999). Numerous contaminants of ground and surface water can adversely impact aquatic mollusks (Havlik and Marking 1987, Green and Trett 1989, Neves et al. 1997, Augspurger et al. 2003). Regional groundwater pumping for agriculture and petroleum industry operations are ongoing in the Black River drainage. Such extractive processes are known to deplete groundwater aquifers (Fiedler and Nye 1933, Thomas 1959, Havenor 1968) and to contaminate ground and surface waters in the Pecos and Black River valleys (Hennighausen 1969; Metcalf 1974; Jercinovic 1982, 1984; Longmire 1983; Quarles 1983, Boyer 1986; Rail 1989; Martinez et al. 1998).

The Black River Valley has experienced repeated problems of groundwater depletion and contamination. Water levels of domestic, agricultural/range wells in the area have lowered and even dried-up. Richard (1988a, 1998b) and Richard and Boehm (1989a) documented groundwater contamination of domestic and agricultural/range wells (i.e., Washington Ranch, Ballard Wells, etc.) from petroleum-derived hydrocarbons and sulfides in the upper Black River valley. Richard and Bohem (1989b) reported “severe” sulfide contamination of Blue Spring (ca.1988) from gas contamination originating up-gradient that was likely transported ca. 20 miles down-gradient to Blue Spring, a regionally significant artesian spring that is a primary hydrologic source for the Black River (Hendrickson and Jones 1952). Such long-distance transport of groundwater is common in karst, evaporite rock (White et al. 1995, Martinez et al. 1998), and raises concerns for surface water quality of the Black River, especially considering the current proliferation of petroleum industry operations in the Black River drainage. Several low-water bridge crossings span the Black River. Transit of heavy trucks carrying refined and produced petroleum-derived products across these areas could result in surface water contamination from traffic accidents.

In July 2002, surface waters of the Black River were contaminated by tebuthiuron, an herbicide used to control woody plants. Lang (2003) reported no adverse effects of tebuthiuron on *P. popeii* of the Black River. Recent fish kills (2002-2005) in the lower Pecos River from Lake Brantley downstream to the Black River confluence have been attributed to toxins produced by the golden alga, *Prymnesium parvum*. These toxins are highly lethal to aquatic, gill-breathing fauna such as mollusks (bivalves, snails), crustaceans, fish, and larval stages of amphibians. While

there are no known instances of golden alga blooms within the range of Texas hornshell, such a catastrophic event could decimate the species in New Mexico.

Introduction of exotic bivalves, namely the Asian clam (*Corbicula fluminea*), quagga mussel (*Dreissena bugensis*), and zebra mussel (*D. polymorpha*), threaten unionid populations throughout the United States (Williams et al. 1993, Neves et al. 1997). A chance introduction of New Zealand mudsnail to the Black River could result in negative ecological impacts (<http://www.esg.montana.edu/aim/mollusca/nzms/nzmsbib.html>).

Over the long-term, insensitive land-use practices (e.g., excessive clearing of native vegetation, prolonged overgrazing, poor soil and water conservation practices, non-point source discharge of pollutants [toxic chemicals, hydrocarbons, sediments], etc.) within a watershed, and the accumulative impacts of such activities, may: (a) increase erosion and sedimentation; (b) exacerbate drainage entrenchment; (c) increase pulse discharge of instream flows, sediments, and pollutants into the drainage; and (d) alter stream channel morphology and substrate composition (see references in Wood and Armitage 1997). These environmental perturbations can have profound effects on the overall health of aquatic ecosystems, long-term viability of mussel populations, and habitat suitability of flow refuges colonized by unionid mussels (Williams et al. 1993, Neves et al. 1997, Strayer 1999, Lang 2001).

Recommendation: No change in listing status is recommended. Short-term management efforts are focusing on monitoring extant populations of the Texas hornshell and habitat conditions of the Black River. In the long-term, it is incumbent on State and Federal agencies to work cooperatively with private land stewards along the Black River to protect key habitat for *P. popeii*. Such a conservation process is likely most favorable by developing and implementing a state recovery plan or through a federal incentive program, such as a Candidate Conservation Agreement with Assurances (Federal Register 1997). NMDGF will be initiating a recovery and conservation plan for the Texas hornshell in 2006.

Literature Cited

- Allan, J. D. and A. S. Flecker. 1993. Biodiversity conservation in running waters. *BioScience* 43:32-43.
- Boyer, D. G. 1986. Differences in produced water contaminants from oil and gas operations in New Mexico - implications for regulatory action. Pp. 291-316, *In Proceedings of the Conference on Southwestern Ground Water Issues* (National Water Well Association, Publisher).
- Augsburger, T., A. E. Keller, M. C. Black, W. G. Cope, and F. J. Dwyer. 2003. Water quality guidance for protection of freshwater mussels (Unionidae) from ammonia exposure. *Environmental Toxicology and Chemistry* 22(11):2569-2575.
- Cockerell, T. D. A. 1902. *Unio popei*, Lea, in New Mexico. *The Nautilus* 16:69-70.
- Federal Register. 1997. Announcement of Draft Policy for Candidate Conservation Agreements; Notice of Review. 50 CFR 62(113):32183-32188.
- Federal Register. 2001. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Species that are Candidates or Proposed for listing as Endangered or Threatened, Annual Notice of Findings on Recycled Petitions; and Annual Description of Progress on Listing Actions; Proposed Rule. 50 CFR Part 17, 66(210):54808-54832.
- Fiedler, A. G. and S. S. Nye. 1933. Geology and groundwater resources of the Roswell artesian basin, New Mexico. U.S. Geologic Survey, Water Supply Paper 639, 372 pp.
- Green, J. and M. W. Trett. 1989. The fate and effects of oil in freshwater. Elsevier Science Publishing Co., Inc., New York.
- Havenor, K. C. 1968. Structure, stratigraphy, and hydrogeology of the northern Roswell Artesian Basin, Chaves County, New Mexico. New Mexico Institute of Mining and Technology, Bureau of Mines and Mineral Resources Division, Circular 93, 29 pp.
- Havlik, M. E. and L. L. Marking. 1987. Effects of contaminants on naiad mollusks (Unionidae): a review. U. S. Fish and Wildlife Service, Resource Publication 164.
- Hendrickson, G. E., and R. S. Jones. 1952. Geology and ground-water resources of Eddy County, New Mexico. U.S. Geological Survey, Ground-Water Report 3, 169 pp.
- Hendrickson, G. E., and R. S. Jones. 1952. Geology and ground-water resources of Eddy County, New Mexico. U.S. Geological Survey, Ground-Water Report 3, 169 pp.
- Hennighausen, F. H. 1969. Meters and their effects in the Roswell Artesian Basin in Chaves and Eddy counties, New Mexico. Pp. 29-33, *In 14th Annual New Mexico Water Conference* (Water Resources Institute).
- Howells, R. G., R. W. Neck, and H. D. Murray. 1996. Freshwater mussels of Texas. Texas Parks and Wildlife

- Department, Austin.
- Howells, R. G. 2003. Declining status of freshwater mussels of the Rio Grande, with comments on other bivalves. Pp. 59-73, *In Aquatic Fauna of the Northern Chihuahuan Desert*, G. P. Garrett and N. L. Allan, Eds. Museum of Texas Tech University, Special Publications Series, Number 46. Lubbock, TX.
- Howells, R. G. 2004. Distributional surveys of freshwater mussels in Texas: progress report for 2003. Texas Parks and Wildlife Department, Management Data Series 222, Austin 50 pp.
- Jercinovic, D. E. 1982. Assessment of refined petroleum-product contamination problems in surface and ground waters of New Mexico. Water Pollution Control Bureau, New Mexico Environmental Improvement Division, EID/WPC-82/5.
- Jercinovic, D. E. 1984. Petroleum-product contamination of soil and water in New Mexico. New Mexico Environmental Improvement Division, EID/GWH84/2.
- Johnson, R. I. 1999. Unionidae of the Rio Grande (Rio Bravo del Norte) system of Texas and Mexico. *Museum of Comparative Zoology, Harvard University, Occasional Papers on Mollusks*, 6(77):1-65.
- Lang, B. K. 2001. Status of the Texas hornshell and native freshwater mussels (Unionoidea) in the Rio Grande and Pecos River of New Mexico and Texas. Completion Report (E-38) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Lang, B. K. 2003. Artificial Culture and Captive Rearing of the Texas hornshell. New Mexico Department of Game and Fish, Performance Report (E-51-2) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Longmire, P. A. 1983. Petroleum-product contamination of ground and surface water: a literature review. Ground Water Section, Water Pollution Control Bureau, New Mexico Environmental Improvement Division. EID/WPC-83/7.
- Martinez, J. D., K. S. Johnson, and J. T. Neal. 1998. Sinkholes in evaporite rocks. *American Scientist* 86:38-51.
- Metcalf, A. L. 1982. Fossil unionacean bivalves from three tributaries of the Rio Grande. *Proceedings of the Symposium of Recent Benthological Investigations of Texas and Adjacent States*, pp. 43-59.
- Neck, R. W. and A. L. Metcalf. 1988. Freshwater bivalves of the lower Rio Grande, Texas. *The Texas Journal of Science* 40(3):259-268.
- Neves, R. J. 1993. A state-of-the-unionids address. Pp. 1-10, *in Proceedings of the Upper Mississippi River Conservation Commission Symposium: Conservation and Management of Freshwater Mussels* (K. S. Cummings, A. C. Buchanan, and L. M. Koch, Eds.). Upper Mississippi River Conservation Commission, Rock Island, Illinois.
- Neves, R. J., A. E. Bogan, J. D. Williams, S. A. Ahlstedt, and P. W. Hartfield. 1997. Status of aquatic mollusks in the southeastern United States: A downward spiral of diversity. Pp.43-85, *In Aquatic Fauna in Peril* (George W. Benz and David E. Collins, Eds.). Southeast Aquatic Research Institute Special Publication 1. Lenz Design & Communications, Decatur, Georgia.
- Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.
- Rail, C. D. 1989. Groundwater contamination: sources, control, and preventative measures. Technomic Publishing Company, Inc. Lancaster, PA.
- Ricciardi, A. and J. B. Rasmussen. 1999. Extinction rates of North American Freshwater Fauna. *Conservation Biology* 13(5):1220-1222.
- Richard, M. 1988a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: review of the geohydrology in the vicinity of Rattlesnake Springs and the contamination problem. Report 1. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. 1988b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the first field investigation, August 1988. Report 2. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the second field investigation, March, 1988. Report 3. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: final summary of the investigation. Report 4. National Park Service Contract RFQ 7029-8-0025.
- Smith, D. G., B. K. Lang, and M. E. Gordon. 2003. Gametogenetic cycle, reproductive anatomy, and larval morphology of *Popenaias popeii* (Unionoidea) from the Black River, New Mexico. *The Southwestern Naturalist* 48(3):333-340.
- Strayer, D. L. 1999. Use of flow refuges by unionid mussels in rivers. *Journal North American Benthological Society* 18:468-476.

- Strecker, J. K. 1931. The distribution of naiades or pearly fresh-water mussels of Texas. Baylor University Museum, Special Bulletin 2:1-7.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Thomas, H. E. 1959. Causes of depletion of the Pecos River in New Mexico. Contributions to the Hydrology of the United States, Geological Survey Water Supply Paper 619-G. U.S. Government Printing Office, Washington, D.C., 14 pp.
- Vaughn, C. C. and C. M. Taylor. 1999. Impoundments and the decline of freshwater mussels: a case study of an extinction gradient. Conservation Biology 13(4):912-920.
- White, B. W., D. C. Culver, J. S. Herman, T. C. Kane, and J. E. Mylroie. 1995. Karst lands: the dissolution of carbonate rock produces unique landscapes and poses significant hydrological and environmental concerns. American Scientist 83:450-459.
- Williams, J. D., M. L. Warren, Jr., K. S. Cummings, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18:6-22.
- Wood, P. J. and P. D. Armitage. 1997. Biological effects of fine sediment in the lotic environment. Environmental Management 21(2):203-217.

GASTROPODA

ENDANGERED

Koster's springsnail, *Juturnia kosteri*

Distribution: Taylor (1987) described this springsnail from Sago Spring, Bitter Lake National Wildlife Refuge (BLNWR). Additional populations on BLNWR include: Lake St. Francis, Bitter Creek, Sago Spring wetland complex, western perimeter of Unit 3, spring-ditch of units 5-7, and the northwest corner of Hunter Marsh (Lang 2002, 2005; Federal Register 2005). The western limit of the species range was from North Spring, Roswell Country Club, where Taylor (1987) and Lang (2005) reported its extirpation.

Current Status: Hershler (2001) reassigned *Tryonia kosteri* Taylor, 1987 to the genus, *Duragonella* Morrison, 1945 on the basis of reproductive anatomy. Phylogenetic analysis of mitochondrial DNA sequences led Hershler et al. (2002) to allocate *D. kosteri* to a new genus, *Juturnia* Hershler, Liu, Stockwell, comprising two other cochliopid snails from the Desert Southwest Rio Grande region.

Koster's springsnail was listed as state threatened in 1983, and uplisted to endangered based on threats posed by impoverished habitat conditions following the March 2000 Sandhill Fire in Bitter Creek (NMDGF 2000). The USFWS listed this species as endangered under the Endangered Species Act (Federal Register 2005). The Department has routinely monitored populations on BLNWR since 1995 (Lang 2002, 2005). Acquisition of federal water rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for this species. The NMDGF (2005) implemented a conservation plan for a suite of four state-listed invertebrates of Chaves County, including *J. kosteri*.

Threats: While populations of *J. kosteri* are stable under current refuge management plans (Research Management Consultants, Inc. 1998), off-refuge land use practices within areas of the Roswell Artesian Basin pose threats to their long-term viability on BLNWR. Regional ground water pumping for agriculture, municipal water supplies, and oil and gas industry operations continue in the Basin (BLM 1994, USFWS 1997). Any increases in groundwater extraction similar to aquifer drawdown levels that occurred in the Basin from the 1950's to 1970's could lead to habitat impacts on BLNWR. Oil and gas development is ongoing within areas of the Basin that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water source-zones for surface waters at BLNWR. Such extractive processes and industry operations can result in aquifer drawdown, alter aquitard hydraulics, and contaminate ground and surface waters in New Mexico (Hennighausen 1969; Jercinovic 1982, 1984; Longmire 1983; Quarles 1983; Boyer 1986; Richard 1988a, 1988b; Rail 1989; Richard and Boehm 1989a, 1989b; Balleau Groundwater, Inc. 1996; Martinez et al. 1998). Aquatic mollusks are acutely sensitive to ground and surface water contaminants (Havlik and Marking 1987, Eisler 1987, Green and Trett 1989, Augspurger 2003). There is increased risk of degradation of ground and surface water quality posed by sewage contamination (i.e., municipal waste, septic

discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR (Federal Register 2005). Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) in sinkholes is known to contaminate ground water resources in karst areas of the United States (White et al. 1995, Zokaites 1997) and in New Mexico (Bitner and Graves 1992, McQuillan et al. 1989).

Natural stochastic events, such as fire or drought, could adversely impact extant *J. kosteri* populations at BLNWR. Although Lang (2001) demonstrated short-term fire effects on the physicochemical conditions in Bitter Creek following the March 20000 Sandhill Fire, the long-term impact of these effects, whether beneficial or adverse, on the aquatic biota and riparian corridor remain undetermined (Lang 2002, 2005). Prolonged drought may affect hydrologic conditions on BLNWR by reducing discharge through refuge surface waters while concomitantly affecting aquatic physicochemical conditions and concentrating potential contaminants.

Recommendation: No change in listing status is recommended. In collaboration with the U. S. Fish and Wildlife Service, NMDGF should continue monitoring post-fire effects on aquatic macroinvertebrates and the riparian corridor of Bitter Creek. NMDGF and cooperators should continue to actively implement strategies of the state conservation plan to alleviate threats and achieve recovery of this species.

Literature Cited

- Augspurger, T., A. E. Keller, M. C. Black, W. G. Cope, and F. J. Dwyer. 2003. Water quality guidance for protection of freshwater mussels (Unionidae) from ammonia exposure. *Environmental Toxicology and Chemistry* 22(11):2569-2575.
- Bitner, M. J. And T. Graves. 1992. Effect of lot sizes on potential ground-water contaminants from conventional septic-tank systems: numerical modeling. Policy Coordinating Committee. 47 pp.
- Boyer, D. G. 1986. Differences in produced water contaminants from oil and gas operations in New Mexico – implications for regulatory action. Pp. 291-316, *In Proceedings of the Conference on Southwestern Ground Water Issues* (National Water Well Association, Publisher).
- Balleau Groundwater, Inc. 1996. Interrelation of groundwater and surface water at Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 16 pp. (with addenda).
- Balleau Groundwater, Inc. 1997. Annotated abstract of water-rights administration Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 22 pp. (with addenda).
- Balleau Groundwater, Inc. 1999. Source-water protection zones for Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 42 pp.
- Bureau of Land Management. 1994. Draft resource management plan/environmental impact statement for the Roswell Resource Area, Roswell, New Mexico, and draft resource management plan amendment/environmental impact statement for the Carlsbad Resource Area, Carlsbad, New Mexico. Bureau of Land Management, Roswell, NM.
- Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a syntopic review. U.S. Fish and Wildlife Service. Contaminant Hazard Reviews Report No. 11, Biological Report 85 (1.11).
- Federal Register. 1996. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates for Listing as Endangered or Threatened Species. 50 CFR Part 17, 61(40):7595-7613.
- Federal Register. 2005. Endangered and Threatened Wildlife and Plants; Listing Roswell springsnail, *Koster's tryonia*, Pecos Assimineia, and Noel's Amphipod as Endangered with Critical Habitat; Final Rule. 50 CFR Part 17, 70(152):46303-46333.
- Green, J. and M. W. Trett. 1989. The fate and effects of oil in freshwater. Elsevier Science Publishing Co., Inc., New York.
- Havlik, M. E. and L. L. Marking. 1987. Effects of contaminants on naiad mollusks (Unionidae): a review. U. S. Fish and Wildlife Service, Resource Publication 164.
- Hennighausen, F. H. 1969. Meters and their effects in the Roswell Artesian Basin in Chaves and Eddy counties, New Mexico. Pp. 29-33, *In 14th Annual New Mexico Water Conference* (Water Resources Institute).
- Hershler, R. H. 2001. Systematics of the North and Central American aquatic genus *Tryonia* (Rissooidea: Hydrobiidae). Smithsonian Institution Press, Washington, D. C. Smithsonian Contributions to Zoology, No. 612. 53 pp.
- Hershler, R., H-S Liu, and C. A. Stockwell. 2002. A new genus and species of aquatic gastropods (Rissooidea: hydrobiidae) from the North American Southwest: phylogenetic relationships and biogeography. *Proc. Biol. Soc. Wash.* 115(1):171-188.

- Jercinovic, D. E. 1982. Assessment of refined petroleum-product contamination problems in surface and ground waters of New Mexico. Water Pollution Control Bureau, New Mexico Environmental Improvement Division, EID/WPC-82/5.
- Jercinovic, D. E. 1984. Petroleum-product contamination of soil and water in New Mexico. New Mexico Environmental Improvement Division, EID/GWH84/2.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish Completion Report (E-20,5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Lang, B. K. 2005. Macroinvertebrate of Bitter Lake National Wildlife Refuge. NMDGF Completion Report E-56 submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Longmire, P. A. 1983. Petroleum-product contamination of ground and surface water: a literature review. Ground Water Section, Water Pollution Control Bureau, New Mexico Environmental Improvement Division. EID/WPC-83/7.
- Martinez, J. D., K. S. Johnson, and J. T. Neal. 1998. Sinkholes in evaporite rocks. *American Scientist* 86:38-51.
- McQuillan, D. M., M. J. Jasper, and B. H. Swanson. 1989. Ground-water contamination by septic-tank use: a field study in the Albuquerque south Valley - West Mesa Region, Bernalillo County, New Mexico. New Mexico Health and Environment Department, Environmental Improvement Division, Ground Water Bureau.
- New Mexico Department of Game and Fish. 2000. Threatened and endangered species of New Mexico: biennial review and recommendations. 116 pp.
- New Mexico Department of Game and Fish. 2005. Recovery and conservation plan for four invertebrate species: Noel's amphipod (*Gammarus desperatus*), Pecos assiminea (*Assiminea pecos*), Koster's springsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). 80 pp.
- Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.
- Rail, C. D. 1989. Groundwater contamination: sources, control, and preventative measures. Technomic Publishing Company, Inc. Lancaster, PA.
- Research Management Consultants, Inc. 1998. Final comprehensive conservation plan and Environmental Assessment: Bitter Lake National Wildlife Refuge.
- Richard, M. 1988a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: review of the geohydrology in the vicinity of Rattlesnake Springs and the contamination problem. Report 1. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. 1988b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the first field investigation, August 1988. Report 2. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the second field investigation, March, 1988. Report 3. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: final summary of the investigation. Report 4. National Park Service Contract RFQ 7029-8-0025.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.
- United States Department of Justice. 1996. United States of America's statement of claim for reserved surface water and groundwater rights for Bitter Lake National Wildlife Refuge. Roswell Basin Section, RAB 923 and 1793, Denver, CO.
- United States Fish and Wildlife Service. 1997. Biological opinion on the Roswell Resource Area Resource Management Plans. Section 7 Consultation #2-22-96-102.
- White, B. W., D. C. Culver, J. S. Herman, T. C. Kane, and J. E. Mylroie. 1995. Karst lands: the dissolution of carbonate rock produces unique landscapes and poses significant hydrological and environmental concerns. *American Scientist* 83:450-459.
- Zokaites, C. 1997. Living on karst: a reference guide for landowners in limestone regions. Cave Conservancy of the Virginias. 25 pp.

Alamosa springsnail, *Pseudotryonia alamosae*

Distribution: This endemic springsnail is known only from Ojo Caliente (type locality) and thermal spring sources forming the headwaters of Alamosa Creek, Socorro County (Taylor 1983, 1987).

Current Status: *Pseudotryonia alamosae* was listed as state threatened in 1983, and was uplisted to endangered based on threats posed by an open pit beryllium mine within the immediate watershed of Alamosa Creek (NMDGF 2000). The Alamosa springsnail is a federal endangered species (Federal Register 1994). Based on studies of molecular genetics (Hershler et al. 1999) and reproductive anatomy, Hershler (2001) reassigned *Tryonia alamosae* Taylor, 1987 to a new genus, *Pseudotryonia* Hershler.

Pseudotryonia alamosae occurs in spring sources and spring-fed tributaries along the north riverbank of Alamosa Creek downstream to approximately 30 meters above the Monticello Box (Lang 2001, Lang 2003). Within this available habitat, the species is most abundant in the lowest velocity, warmest and most stenothermic microhabitats associated with thermal spring vents situated in the upper reach of this perennial spring-fed system. Private land use practices currently favor persistence of this species in Alamosa Creek.

Threats: Primary threats include local/regional groundwater depletion, ground and surface water contamination, direct habitat alteration (stream diversion and impoundment), mineral mining, and poor watershed management (Taylor 1983; NMDGF 1988; Lang 2001, 2003). Invasion of salt cedar throughout the floodway of Alamosa Creek poses a threat to aquatic and riparian habitat conditions (Lang 2001). The introduction of invasive species can result in elimination of springsnail populations by predation or habitat degradation (i.e., non-native crayfish, Fernandez and Rosen 1996) or by direct competition for food sources (i.e., New Zealand mudsnail; <http://www.esg.montana.edu/aim/mollusca/nzms/nzmsbib.html>).

Recommendation: No change in listing status is recommended. NMDGF is collaborating with the U. S. Fish and Wildlife Service (USFWS) and the Monticello Community Ditch Association (MCDA) for conservation activities detailed in the federal recovery plan (USFWS 1994). Removal of salt cedar from Alamosa Creek is ongoing by the MCDA, as funded by the USFWS. Resource agencies should pursue opportunities to acquire private lands, including mineral and groundwater rights, where future beryllium ore exploration or mining may adversely affect groundwater aquifers that supply surface waters and spring-fed wetlands of Alamosa Creek upstream of the Monticello Box.

Literature Cited

- Federal Register. 1994. Endangered and threatened wildlife and plants. Federal Register, 50 CFR 17.11 & 17.12. 42 pp.
- Fernandez, P. J. and P. C. Rosen. 1996. A microcosm study of the effects of an introduced crayfish (*Orconectes virilis*) on aquatic plants, invertebrates, and herpetofauna from Arizona. Final Report, Part II, IIPAM Project No. I9404, Heritage Program, Arizona Game and Fish Department.
- Hershler, R. H., H. -P. Liu, and M. Mulvey. 1999. Phylogenetic relationships within the aquatic snail genus *Tryonia*: Implications for biodiversity of the North American Southwest. *Molecular Phylogenetics and Evolution* 13(2):377-391.
- Hershler, R. H. 2001. Systematics of the North and Central American aquatic genus *Tryonia* (Rissooidea: Hydrobiidae). Smithsonian Institution Press, Washington, D. C. Smithsonian Contributions to Zoology, No. 612. 53 pp.
- Lang, B. K. 2001. New Mexico endangered invertebrates: monitoring and management. New Mexico Department of Game and Fish, Completion Report (E-37) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Lang, B. K. 2003. New Mexico endangered invertebrates: monitoring and management. New Mexico Department of Game and Fish, Performance Report (E-37-8) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-305.
- New Mexico Department of Game and Fish. 2000. Threatened and endangered species of New Mexico: biennial review and recommendations. 116 pp.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.

United States Fish and Wildlife Service. 1994. Alamosa springsnail (*Tryonia alamosae*) and Socorro springsnail (*Pyrgulopsis neomexicana*) draft recovery plan. Albuquerque, NM. 24 pp.

Chupadera springsnail, *Pyrgulopsis chupaderae*

Distribution: The Chupadera springsnail is known from two hillside seeps situated along the southern flank of the Chupadera Mountains, southeast Socorro County (Taylor 1983, 1987). This species is endemic to Willow Spring (type locality), and once occurred in an unnamed spring located about 0.25 mile north of the type locality.

Current Status: *Pyrgulopsis chupaderae* was listed as state threatened in 1983, and uplisted to endangered (NMDGF 1996) due to habitat overgrazing by cattle which resulted in the apparent extirpation of the species at the unnamed spring. The Chupadera springsnail is a candidate for listing (priority 2) under the Endangered Species Act (Federal Register 2002).

Despite intensive long-term land use practices at Willow Spring (grazing, spring source diversion, spring run impoundment), the Chupadera springsnail persisted at the type locality (Taylor 1983, Lang 2002). Population monitoring initiated in 1996 was preempted by transference of ownership of Willow Spring in August 1999. Since then annual requests to visit Willow Spring have been repeatedly denied by all owners. *Pyrgulopsis chupaderae* was last observed live in August 1999, and the status of the species has not been confirmed since that time.

Threats: Imminent threats include local/regional groundwater depletion, diversion or impoundment of spring flow, loss of riparian vegetation, and overgrazing of the watershed during extended drought (Taylor 1983, NMDGF 1988, Lang 2002). Introduction of non-native crayfish can have irrevocable impacts on springsnail populations and aquatic habitats (Fernandez and Rosen 1996).

Recommendation: No change in listing status is recommended. Due to the species' restricted distribution, small population size and lack of access, controlled propagation at the Albuquerque Biological Park might be warranted. The NMDGF has attempted to initiate a state recovery plan for this species but the private land owner declined participation.

Literature Cited

- Federal Register. 2002. Endangered and threatened wildlife and plants; Review of species that are candidates or proposed for listing as endangered or threatened; Annual notice of findings on recycled petitions; Annual description of progress on listing actions. 50 CFR Part 17, 67(114):40657-40679.
- Fernandez, P. J. and P. C. Rosen. 1996. A microcosm study of the effects of an introduced crayfish (*Orconectes virilis*) on aquatic plants, invertebrates, and herpetofauna from Arizona. Final Report, Part II, IIPAM Project No. I9404, Heritage Program, Arizona Game and Fish Department.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. Completion Report (E-20, 5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-302.
- New Mexico Department of Game and Fish. 1996. Threatened and endangered species of New Mexico: biennial review and recommendations.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.

Socorro springsnail, *Pyrgulopsis neomexicana*

Distribution: Although this species was evidently described by Pilsbry (1916) from one of three springs of the Socorro Thermal Area (Summers 1976), no empty shells or live specimens have ever been collected from this area located three miles west of Socorro (Landye 1981; Taylor 1983, 1987). Taylor (1987) provided a morphological

description of this species based on specimens collected in 1981 from Torreon Springs, Socorro County, while noting uncertainty of taxonomic affinities of this population with those from the Socorro Thermal Area.

Prior to 1971, significant water development and habitat alterations likely resulted in extirpation of the species at the type locality (Landye 1981, Taylor 1987). At Torreon Springs, Taylor (1987) reported collecting live snails from a small spring source and its outflow; the total population was then estimated (1981) at about 5000 individuals.

Current Status: *Pyrgulopsis neomexicana* was listed as state endangered in 1983. This snail is considered a federal endangered species (Federal Register 1994). Lang (2001) last visited Torreon Springs in 1996, and noted that the spring source had been capped by a windmill; live *P. neomexicana* were observed in the spring outflow channel (~2.0l x 0.5w x 0.1d m). The private landowner has since denied site access to monitor and study *P. neomexicana*, and the current status remains unknown.

Threats: Regional/local groundwater depletion, spring run dewatering, contamination, and riparian habitat degradation represent principal threats to the population (NMDGF 1988, Lang 2001). Natural stochastic events such as drought could adversely impact this population by reducing spring discharge.

Recommendation: No change in listing status is recommended. The remnant population merits resurvey to determine current status. A refuge population should be established at the Albuquerque Biological Park.

Literature Cited

- Federal Register. 1994. Endangered and Threatened Wildlife and Plants. 50 CFR Part 17.11 & 17.12. 42 pp.
- Landye, J. J. 1981. Current status of endangered, threatened, and/or rare mollusks of New Mexico and Arizona. Endangered Species Office, U. S. Fish and Wildlife Service, Final Report 13.
- Lang, B. K. 2001. New Mexico endangered invertebrates: monitoring and management. New Mexico Department of Game and Fish. Completion Report (E-37) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account: A-297.
- Pilsbry, H. A. 1916. New species of *Ammicola* from New Mexico and Utah. *The Nautilus* 29:111-112.
- Summers, W. K. 1976. New Mexico thermal waters. New Mexico Bureau of Mines & Mineral Resources, Hydrologic Report 4.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources, Bulletin 116.

Roswell springsnail, *Pyrgulopsis roswellensis*

Distribution: Taylor (1987) reported three populations of *P. roswellensis* on Bitter Lake National Wildlife Refuge (BLNWR) and a population in North Spring, Roswell Country Club (RCC). The trend in species range reduction by extirpation of once widely distributed, but localized, populations is supported by the Pleistocene fossil record and reinventory of known site occurrences (Noel 1954, Taylor 1987, Federal Register 2005).

Current Status: Roswell springsnail was listed as state endangered in 1983. The USFWS listed this species as endangered under the Endangered Species Act (Federal Register 2005). Extant populations on BLNWR occur in: Bitter Creek, Sago Spring, and the Unit 7 spring-ditch. This species is apparently extirpated from North Spring (Lang 2005). The Department has routinely monitored populations on BLNWR since 1995 (Lang 2002, 2005). Acquisition of federal water rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for this species. The NMDGF (2005) implemented a conservation plan for a suite of four state-listed invertebrates of Chaves County, including *P. roswellensis*.

Threats: While populations of *P. roswellensis* are stable under current refuge management plans (Research Management Consultants, Inc. 1998), off-refuge land use practices within areas of the Roswell Artesian Basin pose threats to their long-term viability on BLNWR. Regional ground water pumping for agriculture, municipal water

supplies, and oil and gas industry operations continue in the Basin (BLM 1994, USFWS 1997). Any increases in groundwater extraction similar to aquifer drawdown levels that occurred in the Basin from the 1950's to 1970's could lead to habitat impacts on BLNWR. Oil and gas development is ongoing within areas of the Basin that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water source-zones for surface waters at BLNWR. Such extractive processes and industry operations can result in aquifer drawdown, alter aquitard hydraulics, and contaminate ground and surface waters in New Mexico (Hennighausen 1969; Jercinovic 1982, 1984; Longmire 1983; Quarles 1983; Boyer 1986; Richard 1988a, 1988b; Rail 1989; Richard and Boehm 1989a, 1989b; Balleau Groundwater, Inc. 1996; Martinez et al. 1998). Aquatic mollusks are acutely sensitive to ground and surface water contaminants (Havlik and Marking 1987, Eisler 1987, Green and Trett 1989, Augspurger 2003). There is increased risk of degradation of ground and surface water quality posed by sewage contamination (i.e., municipal waste, septic discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR (Federal Register 2005). Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) in sinkholes is known to contaminate ground water resources in karst areas of the United States (White et al. 1995, Zokaites 1997) and in New Mexico (Bitner and Graves 1992, McQuillan et al. 1989).

Natural stochastic events, such as fire or drought, could adversely impact extant *P. roswellensis* populations at BLNWR. Although Lang (2001) demonstrated short-term fire effects on the physicochemical conditions in Bitter Creek following the March 20000 Sandhill Fire, the long-term impact of these effects, whether beneficial or adverse, on the aquatic biota and riparian corridor remain undetermined (Lang 2002, 2005). Prolonged drought may affect hydrologic conditions on BLNWR by reducing discharge through refuge surface waters while concomitantly affecting aquatic physicochemical conditions and concentrating potential contaminants.

Recommendation: No change in listing status is recommended. In collaboration with the U. S. Fish and Wildlife Service, NMDGF should continue monitoring post-fire effects on aquatic macroinvertebrates and the riparian corridor of Bitter Creek. NMDGF and cooperators should continue to actively implement strategies of the state conservation plan to alleviate threats and achieve recovery of this species.

Literature Cited

- Bitner, M. J. and T. Graves. 1992. Effect of lot sizes on potential ground-water contaminants from conventional septic tank systems: numerical modeling. Policy Coordinating Committee. 47 pp.
- Boyer, D. G. 1986. Differences in produced water contaminants from oil and gas operations in New Mexico - implications for regulatory action. Pp. 291-316, *In* Proceedings of the Conference on Southwestern Ground Water Issues (National Water Well Association, Publisher).
- Balleau Groundwater, Inc. 1996. Interrelation of groundwater and surface water at Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 16 pp. (with addenda).
- Balleau Groundwater, Inc. 1997. Annotated abstract of water-rights administration Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 22 pp. (with addenda).
- Balleau Groundwater, Inc. 1999. Source-water protection zones for Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 42 pp.
- Bureau of Land Management. 1994. Draft resource management plan/environmental impact statement for the Roswell Resource Area, Roswell, New Mexico, and draft resource management plan amendment/environmental impact statement for the Carlsbad Resource Area, Carlsbad, New Mexico. Bureau of Land Management, Roswell, NM.
- Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a syntopic review. U.S. Fish and Wildlife Service. Contaminant Hazard Reviews Report No. 11, Biological Report 85 (1.11).
- Federal Register. 1996. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates for Listing as Endangered or Threatened Species. 50 CFR Part 17, 61(40):7595-7613.
- Federal Register. 2005. Endangered and Threatened Wildlife and Plants; Listing Roswell springsnail, Koster's tryonia, Pecos Assiminea, and Noel's Amphipod as Endangered with Critical Habitat; Final Rule. 50 CFR Part 17, 70(152):46303-46333.
- Green, J. and M. W. Trett. 1989. The fate and effects of oil in freshwater. Elsevier Science Publishing Co., Inc., New York.
- Havlik, M. E. and L. L. Marking. 1987. Effects of contaminants on naiad mollusks (Unionidae): a review. U. S. Fish and Wildlife Service, Resource Publication 164.
- Hennighausen, F. H. 1969. Meters and their effects in the Roswell Artesian Basin in Chaves and Eddy counties, New Mexico. Pp. 29-33, *In* 14th Annual New Mexico Water Conference (Water Resources Institute).

- Jercinovic, D. E. 1982. Assessment of refined petroleum-product contamination problems in surface and ground waters of New Mexico. Water Pollution Control Bureau, New Mexico Environmental Improvement Division, EID/WPC-82/5.
- Jercinovic, D. E. 1984. Petroleum-product contamination of soil and water in New Mexico. New Mexico Environmental Improvement Division, EID/GWH84/2.
- Lang, B. K. 2001. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish, Annual Performance Report (E-20-8) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish, Completion Report (E-20, 5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Lang, B. K. 2005. Macroinvertebrate of Bitter Lake National Wildlife Refuge. NMDGF Completion Report E-56 submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Longmire, P. A. 1983. Petroleum-product contamination of ground and surface water: a literature review. Ground Water Section, Water Pollution Control Bureau, New Mexico Environmental Improvement Division. EID/WPC-83/7.
- Martinez, J. D., K. S. Johnson, and J. T. Neal. 1998. Sinkholes in evaporite rocks. *American Scientist* 86:38-51.
- McQuillan, D. M., M. J. Jasper, and B. H. Swanson. 1989. Ground-water contamination by septic-tank use: a field study in the Albuquerque south Valley - West Mesa Region, Bernalillo County, New Mexico. New Mexico Health and Environment Department, Environmental Improvement Division, Ground Water Bureau.
- Noel, M. 1954. Animal ecology of a New Mexico springbrook. *Hydrobiologia* 6:120-135.
- New Mexico Department of Game and Fish. 2005. Recovery and conservation plan for four invertebrate species: Noel's amphipod (*Gammarus desperatus*), Pecos assiminea (*Assiminea pecos*), Koster's springsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). 80 pp.
- Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.
- Rail, C. D. 1989. Groundwater contamination: sources, control, and preventative measures. Technomic Publishing Company, Inc. Lancaster, PA.
- Research Management Consultants, Inc. 1998. Final comprehensive conservation plan and Environmental Assessment: Bitter Lake National Wildlife Refuge.
- Richard, M. 1988a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: review of the geohydrology in the vicinity of Rattlesnake Springs and the contamination problem. Report 1. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. 1988b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the first field investigation, August 1988. Report 2. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the second field investigation, March, 1988. Report 3. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: final summary of the investigation. Report 4. National Park Service Contract RFQ 7029-8-0025.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.
- United States Fish and Wildlife Service. 1997. Biological opinion on the Roswell Resource Area Resource Management Plans. Section 7 Consultation #2-22-96-102.
- White, B. W., D. C. Culver, J. S. Herman, T. C. Kane, and J. E. Mylroie. 1995. Karst lands: the dissolution of carbonate rock produces unique landscapes and poses significant hydrological and environmental concerns. *American Scientist* 83:450-459.
- Zokaites, C. 1997. Living on karst: a reference guide for landowners in limestone regions. Cave Conservancy of the Virginias. 25 pp.

Pecos assiminea, *Assiminea pecos*

Distribution: Historically, Pecos assiminea occurred in isolated populations in New Mexico (Bitter Lake National Wildlife Refuge [BLNWR] and North Spring, Roswell County Club, Chaves County), Texas (Diamond Y Preserve, Pecos County), and sporadically throughout the Bolsón de Cuarto Cienegas, Coahuila, México (Taylor 1983, 1987).

The species however shows a pattern of localized extinctions throughout its historic range. Taylor (1987) reported extirpation of *A. pecos* from North Spring and at the type locality (Unit 7) on BLNWR. Extant populations on BLNWR occur in marsh habitats along Bitter Creek, Sago Spring wetland complex near Sinkhole #31, and the spring-ditch of units 7 and 15 (Federal Register 2005). An additional population was located at East Sandia Spring, Reeves County, Texas (Lang 2002).

Current Status: *Pecos assiminea* was listed as state endangered in 1983. The USFWS listed this species as endangered under the Endangered Species Act (Federal Register 2005). Populations on BLNWR have been routinely monitored since 1995 (Lang 2002). In Texas, populations of *A. pecos* occur on lands (Diamond Y Spring Preserve, East Sandia Spring) under stewardship of The Nature Conservancy (Lang 2002). Acquisition of federal water rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for this species. The NMDGF (2005) implemented a conservation plan for a suite of four state-listed invertebrates of Chaves County, including *A. pecos*. NMDGF is collaborating with Dr. Robert Hershler (Smithsonian Institution) on molecular genetic studies of the *A. pecos* species complex.

Threats: While populations of *A. pecosensis* are stable under current refuge management plans (Research Management Consultants, Inc. 1998), off-refuge land use practices within areas of the Roswell Artesian Basin pose threats to their long-term viability on BLNWR. Regional ground water pumping for agriculture, municipal water supplies, and oil and gas industry operations continue in the Basin (BLM 1994, USFWS 1997). Any increases in groundwater extraction similar to aquifer drawdown that occurred in the Basin from the 1950's to 1970's could lead to habitat impacts on BLNWR. Oil and gas development is ongoing within areas of the Basin that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water source-zones for surface waters at BLNWR. Such extractive processes and industry operations can result in aquifer drawdown, alter aquitard hydraulics, and contaminate ground and surface waters in New Mexico (Hennighausen 1969; Jercinovic 1982, 1984; Longmire 1983; Quarles 1983; Boyer 1986; Richard 1988a, 1988b; Rail 1989; Richard and Boehm 1989a, 1989b; Balleau Groundwater, Inc. 1996; Martinez et al. 1998). Aquatic mollusks are acutely sensitive to ground and surface water contaminants (Havlik and Marking 1987, Eisler 1987, Green and Trett 1989, Augspurger 2003). There is increased risk of degradation of ground and surface water quality posed by sewage contamination (i.e., municipal waste, septic discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR (Federal Register 2005). Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) in sinkholes is known to contaminate ground water resources in karst areas of the United States (White et al. 1995, Zokaites 1997) and in New Mexico (Bitner and Graves 1992, McQuillan et al. 1989).

Natural stochastic events, such as frequent fires or drought, could adversely impact extant *A. pecos* populations at BLNWR. However, contrary to Taylor (1987), it appears that *A. pecos* is tolerant of fire, and that intensity, duration, and frequency of fire are principal factors that likely determine the species' ability to recover in response to variable fire regimes (Lang 2002). Prolonged drought may affect hydrologic conditions on BLNWR by reducing discharge through refuge surface waters which could result in desiccation of riparian habitats occupied by this species.

Recommendation: No change in listing status is recommended. In collaboration with the U. S. Fish and Wildlife Service, NMDGF should continue monitoring post-fire effects on aquatic macroinvertebrates and the riparian corridor of Bitter Creek. NMDGF and cooperators should continue to actively implement strategies of the state conservation plan to alleviate threats and achieve recovery of this species.

Literature Cited

- Bitner, M. J. and T. Graves. 1992. Effect of lot sizes on potential ground-water contaminants from conventional septic-tank systems: numerical modeling. Policy Coordinating Committee. 47 pp.
- Boyer, D. G. 1986. Differences in produced water contaminants from oil and gas operations in New Mexico implications for regulatory action. Pp. 291-316, *In* Proceedings of the Conference on Southwestern Ground Water Issues (National Water Well Association, Publisher).
- Balleau Groundwater, Inc. 1996. Interrelation of groundwater and surface water at Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 16 pp. (with addenda).
- Balleau Groundwater, Inc. 1997. Annotated abstract of water-rights administration Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 22 pp. (with addenda).

- Balleau Groundwater, Inc. 1999. Source-water protection zones for Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 42 pp.
- Bureau of Land Management. 1994. Draft resource management plan/environmental impact statement for the Roswell Resource Area, Roswell, New Mexico, and draft resource management plan amendment/environmental impact statement for the Carlsbad Resource Area, Carlsbad, New Mexico. Bureau of Land Management, Roswell, NM.
- Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a syntopic review. U. S. Fish and Wildlife Service. Contaminant Hazard Reviews Report No. 11, Biological Report 85 (1.11).
- Federal Register. 1996. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates for Listing as Endangered or Threatened Species. 50 CFR Part 17, 61(40):7595-7613.
- Federal Register. 2005. Endangered and Threatened Wildlife and Plants; Listing Roswell springsnail, Koster's tryonia, Pecos Assiminea, and Noel's Amphipod as Endangered with Critical Habitat; Final Rule. 50 CFR Part 17, 70(152):46303-46333.
- Green, J. and M. W. Trett. 1989. The fate and effects of oil in freshwater. Elsevier Science Publishing Co., Inc., New York.
- Havlik, M. E. and L. L. Marking. 1987. Effects of contaminants on naiad mollusks (Unionidae): a review. U. S. Fish and Wildlife Service, Resource Publication 164.
- Hennighausen, F. H. 1969. Meters and their effects in the Roswell Artesian Basin in Chaves and Eddy counties, New Mexico. Pp. 29-33, *In* 14th Annual New Mexico Water Conference (Water Resources Institute).
- Jercinovic, D. E. 1982. Assessment of refined petroleum-product contamination problems in surface and ground waters of New Mexico. Water Pollution Control Bureau, New Mexico Environmental Improvement Division, EID/WPC-82/5.
- Jercinovic, D. E. 1984. Petroleum-product contamination of soil and water in New Mexico. New Mexico Environmental Improvement Division, EID/GWH84/2.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish, Completion Report (E-20, 5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Longmire, P. A. 1983. Petroleum-product contamination of ground and surface water: a literature review. Ground Water Section, Water Pollution Control Bureau, New Mexico Environmental Improvement Division. EID/WPC-83/7.
- Martinez, J. D., K. S. Johnson, and J. T. Neal. 1998. Sinkholes in evaporite rocks. *American Scientist* 86:38-51.
- McQuillan, D. M., M. J. Jasper, and B. H. Swanson. 1989. Ground-water contamination by septic-tank use: a field study in the Albuquerque south Valley - West Mesa Region, Bernalillo County, New Mexico. New Mexico Health and Environment Department, Environmental Improvement Division, Ground Water Bureau.
- New Mexico Department of Game and Fish. 2005. Recovery and conservation plan for four invertebrate species: Noel's amphipod (*Gammarus desperatus*), Pecos assiminea (*Assiminea pecos*), Koster's springsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). 80 pp.
- Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.
- Rail, C. D. 1989. Groundwater contamination: sources, control, and preventative measures. Technomic Publishing Company, Inc. Lancaster, PA.
- Research Management Consultants, Inc. 1998. Final comprehensive conservation plan and Environmental Assessment: Bitter Lake National Wildlife Refuge.
- Richard, M. 1988a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: review of the geohydrology in the vicinity of Rattlesnake Springs and the contamination problem. Report 1. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. 1988b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the first field investigation, August 1988. Report 2. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the second field investigation, March, 1988. Report 3. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: final summary of the investigation. Report 4. National Park Service Contract RFQ 7029-8-0025.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.

- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.
- United States Department of Justice. 1996. United States of America's statement of claim for reserved surface water and groundwater rights for Bitter Lake National Wildlife Refuge. Roswell Basin Section, RAB 923 and 1793, Denver.
- United States Fish and Wildlife Service. 1997. Biological opinion on the Roswell Resource Area Resource Management Plans. Section 7 Consultation #2-22-96-102.
- White, B. W., D. C. Culver, J. S. Herman, T. C. Kane, and J. E. Mylroie. 1995. Karst lands: the dissolution of carbonate rock produces unique landscapes and poses significant hydrological and environmental concerns. *American Scientist* 83:450-459.
- Zokaites, C. 1997. Living on karst: a reference guide for landowners in limestone regions. Cave Conservancy of the Virginias. 25 pp.

Wrinkled marshsnail, *Stagnicola caperata*

Distribution: While this widespread species is stable over much its North American range, populations are disjunct in New Mexico, Texas, and higher elevations of some western states where declines or local extinctions have been documented (Bequaert and Miller 1973; Taylor 1983a, 1983b). Extirpation of the BLNWR population between 1983-1985 was attributed to extensive wetland habitat loss, alteration, and sewage contamination from the Roswell waste-water treatment plant (Taylor 1983a, NMDGF 1988). In New Mexico, Taylor (1983a, 1983b) also reported this species from Valles Caldera National Preserve, Jemez Mountains, Sandoval County.

Current Status: The wrinkled marshsnail was listed as state endangered in 1983. This species was recently documented from live specimens in: Hunter Marsh on BLNWR; vernal grassland pools on the Valle Grande, Valles Caldera National Preserve; and in high-elevation snowmelt pools near Big Costilla Peak, Taos County (Lang 2005).

Threats: Water contamination from sewage effluent and habitat loss due to removal of wetland vegetation (e.g., wildland fire, prescribed burning, cutting, excessive grazing pressure) represent primary threats (Taylor 1983a, NMDGF 1988).

Recommendations: No change in listing status is recommended. NMDGF should continue to conduct statewide surveys of high-elevation vernal pools and low-elevation ephemeral marsh habitats, and work with land managers to provide continued protection for known populations.

Literature Cited

- Bequaert, J. C. and W. B. Miller. 1973. The mollusks of the Arid Southwest with an Arizona checklist. University of Arizona Press, Tucson. 271 pp.
- Lang, B. K. 2005. Macroinvertebrates of Bitter Lake National Wildlife Refuge. New Mexico Department of Game and Fish, Completion Report E-56 (1-3) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-264.
- Taylor, D. W. 1983a. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor, D. W. 1983b. Status survey of aquatic molluscs in Diamond Y Draw, Pecos County, Texas. Report to USFWS, 24 pp.

Shortneck snaggletooth, *Gastrocopta dalliana dalliana*

Distribution: *Gastrocopta dalliana dalliana* is widespread in Arizona (central, southern, and western), and has been documented throughout northern México (Chihuahua and Sonora) south to Baja California (Bequaert and Miller 1973). In New Mexico, the shortneck snaggletooth appears restricted to geographically disparate populations in the Upper Sonoran Life Zone of the Animas (Indian Creek Canyon), Big Hatchet, and San Luis (Lang Canyon) and

Peloncillo mountains (Coronado National Forest lands) of Hidalgo County (Metcalf and Smartt 1997, Lang 2000). Fossil records near Santa Rosa from drift along the Pecos River are questionable (Branson et al. 1966).

Current Status: The shortneck snaggletooth was listed as state endangered in 1990. In New Mexico, *G. d. dalliana* is more widespread than previously thought. This species occurs in a diversity of low-elevation plant communities of southwestern Hidalgo County: densely wooded, mesic habitat of Indian Creek Canyon in the Animas Mountains (Lang 2000); along the riparian corridor of Guadalupe Canyon (Dr. Artie L. Metcalf, UTEP, unpub. data); and sparse juniper-oak forest (J. Nekola, unpub. data). It also occurs sporadically on exposed dry slopes in the Big Hatchet and San Luis mountains (Lang 2000). Habitat vital to *G. d. dalliana* in the Animas and San Luis Mountains is under stewardship of the private landowner. The population in the Big Hatchet Mountains occurs on BLM lands.

Threats: Habitat loss from logging, mining, and forest fire represent primary threats to localized populations (NMDGF 1988, Lang 2000).

Recommendation: Shortneck snaggletooth is recommended for downlisting, but should maintain protected status as a threatened species under the WCA. While it occurs commonly at low-elevation forest habitat, this species is clearly restricted in New Mexico to southwestern Hidalgo County, where most known populations occur on private lands. The species may be relatively secure within its known range. NMDGF should continue land snail surveys to refine the range of this species in southern New Mexico, and work with landowners and land managers to ensure that habitat management promotes persistence of the species.

Literature Cited

- Bequaert, J. C. and W. B. Miller. 1973. The mollusks of the Arid Southwest with an Arizona checklist. University of Arizona Press, Tucson. 271 pp.
- Branson, B. A., M. E. Sisk, and C. J. McCoy. 1966. Observations on and distribution of some western and southwestern mollusks. The Veliger 9(2):149.
- Lang, B. K. 2000. Status and distribution of terrestrial snails of southern New Mexico. New Mexico Department of Game and Fish, Completion Report (E-36) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Metcalf, A. L. and R. A. Smartt. 1997. Land snails of New Mexico: a systematic review. Pp. 1-69, *In* Land Snails of New Mexico. (A. L. Metcalf and R. A. Smartt, Eds.). New Mexico Museum of Natural History and Science Bulletin 10.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-222.

Florida mountainsnail, *Oreohelix florida*

Distribution: *Oreohelix florida* is endemic to the Florida Mountains, Luna County (Metcalf and Smartt 1997). Pilsbry (1915) first reported this species as "*Oreohelix strigosa* var." from two fossil specimens. In his species description, Pilsbry (1939) considered it a subspecies of *O. metcalfei*. Metcalf (1974) elevated *florida* to full species rank based on unique shell characteristics. Additional state records from Santa Rita and Tres Hermanas mountains, Cooke Peak, and Apache Hills are also of fossil specimens (Metcalf and Smartt 1997).

Current Status: The Florida mountainsnail was listed as state endangered in 1990. This species is known only from fossil shells; no live snails were found despite numerous malacological explorations during the late 1900's (Metcalf and Smartt 1997, Lang 2000). The apparent extinction of *O. florida*, and other primitive oreohelids in southern and eastern New Mexico, might be attributed to climatic deterioration during the Holocene or natural extinction processes on small "montane islands" (MacArthur 1972, Metcalf and Smartt 1997).

Threats: Threats are not easily identified since an extant population has not been documented. However, land snails occupying high-elevation limestone outcrops are at risk from global warming, natural catastrophe (rock slide, wildfire), prescribed burning, and soil disturbance from mining and logging (NMDGF 1988, Lang 2000).

Recommendation: Inventory of high-elevation limestone outcrops is recommended on “montane islands” along the international border of New Mexico and Mexico. In the unlikely event an unknown population is discovered, then habitat protection would be paramount.

Literature Cited

- Lang, B. K. 2000. Status and distribution of terrestrial snails of southern New Mexico. New Mexico Department of Game and Fish, Completion Report (E-36) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- MacArthur, R. M. 1972. Geographical Ecology: Patterns in the Distribution of Species. Princeton University Press. 269 pp.
- Metcalf, A. L. 1974. Peripheral species of the *Oreohelix* Cockerell complex (Pulmonata: Oreohelicidae). The Nautilus 88:94-100.
- Metcalf, A. L. and R. A. Smartt. 1997. Land snails of New Mexico: a systematic review. Pp.1-69, *In* Land Snails of New Mexico. (A. L. Metcalf and R. A. Smartt, Eds.). New Mexico Museum of Natural History and Science Bulletin 10.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-116.
- Pilsbry, H. A. 1915. Mollusca of the southwestern states, IV: the Hacheta Grande, Florida, and Peloncillo Mountains, New Mexico. Proceeding of the Academy of Natural Sciences of Philadelphia 67:323-350.
- Pilsbry, H. A. 1939. Land mollusca of North America (north of Mexico). Academy of Natural Sciences of Philadelphia 3(1):418-419, 514-515.

BIVALVIA

THREATENED

Lake fingernailclam, *Musculium lacustre*

Distribution: *Musculium lacustre* is known from Central and South America, Hawaii, Japan, Australasia, and Europe (Herrington 1962). Populations in North America occur most frequently in high-elevation, deep water marshes from Canada and Alaska south to the Sierra Nevada of California and in the Rock Mountains of southern Utah (Burch 1975). In New Mexico, the lake fingernailclam is reported from Upper Cieneguilla Creek, Colfax County, near Angel Fire Recreation Area (Taylor 1983).

Current Status: The lake fingernailclam was listed as state threatened in 1983. The sole New Mexico population occurs on private land managed for recreational uses. The current status of *M. lacustre* in New Mexico is unknown.

Threats: Threats include contaminants from forest fire retardants (McDonald and Hamilton 1995) and habitat loss due to land development (NMDGF 1988). Poor watershed management could increase sedimentation of the wetland complex (Taylor 1983, NMDGF1988).

Recommendation: No change in listing status is recommended. NMDGF should continue aquatic surveys to determine the statewide distribution of sphaeriid clams.

Literature Cited

- Burch, J. B. 1975. Freshwater sphaeriacean clams (Mollusca: Pelecypoda) of North America. U. S. Environmental Protection Agency, Biota of Freshwater Ecosystems, Identification Manual No. 3. 96 pp.
- Herrington, H. B. 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Museum of Zoology, University of Michigan, Miscellaneous Publications No. 118.
- McDonald, S. F. and S. J. Hamilton. 1995. Fire retardant and foam suppressant chemicals may be toxic to aquatic invertebrates and algae. National Biological Service. NBS Information Bulletin 35.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-318.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.

Swamp fingernailclam, *Musculium partumeium*

Distribution: The swamp fingernailclam is widespread throughout southern Canada and the United States, south to Nuevo Leon, México (Herrington 1962, Burch 1975). In New Mexico, this species is known only from Road Canyon Creek, Union County (Taylor 1983, NMDGF 1988).

Current Status: *Musculium partumeium* was listed as state threatened in 1983. The single documented population occurs on private land. The current status of this species in New Mexico is unknown.

Threats: Actions that likely represent the primary threats to species persistence include poor watershed management, stream modification (channelization, diversion, dewatering), and water pollution (NMDGF 1988).

Recommendation: No change in listing status is recommended. NMDGF should continue aquatic surveys of to determine the statewide distribution of sphaeriid clams.

Literature Cited

- Burch, J. B. 1975. Freshwater sphaeriacean clams (Mollusca: Pelecypoda) of North America. U. S. Environmental Protection Agency, Biota of Freshwater Ecosystems, Identification Manual No. 3. 96 pp.
- Herrington, H. B. 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Museum of Zoology, University of Michigan, Miscellaneous Publications No. 118.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-319.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.

Long fingernailclam, *Musculium transversum*

Distribution: Native range includes most of temperate and subtropical North America, from Labrador west to the Northwest Territories, south to central México (Herrington 1962, Burch 1975, Bequaert and Miller 1973). New Mexico populations are known from sites within the Canadian River Basin (Conchas River, Cabra Springs, and Ute Creek near Gladstone) and Dry Cimarron River Basin (Clayton Lake and Road Canyon Creek; Taylor 1983, NMDGF 1988). The largest known population in New Mexico was extirpated from the Pecos River below Carlsbad (Taylor 1983).

Current Status: The long fingernailclam was listed as state threatened in 1983. While the statewide status of this species is unknown, an extant population occurs in the Black River (Lang 2005).

Threats: Taylor (1983) attributed extirpation of the Pecos River population to irrigation water diversions. Additional threats could include stream modification (channelization, dewatering), water pollution, and poor watershed stewardship (NMDGF 1988).

Recommendation: No change in listing status is recommended. NMDGF should continue aquatic surveys to determine the statewide distribution of sphaeriid clams.

Literature Cited

- Bequaert, J. C. and W. B. Miller. 1973. The mollusks of the Arid Southwest with an Arizona checklist. University of Arizona Press, Tucson. 271 pp.
- Burch, J. B. 1975. Freshwater sphaeriacean clams (Mollusca: Pelecypoda) of North America. U. S. Environmental Protection Agency, Biota of Freshwater Ecosystems, Identification Manual No. 3. 96 pp.
- Herrington, H. B. 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Museum of Zoology, University of Michigan, Miscellaneous Publications No. 118.
- Lang, B. K. 2005. Texas hornshell population monitoring. New Mexico Department of Game and Fish, Performance Report T-30-P-1 submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.

New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-320.

Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.

Lilljeborg's peaclam, *Pisidium lilljeborgi*

Distribution: In North America, this circumboreal species occurs in lakes and rivers from the Arctic south across the northern United States (Herrington 1962, Burch 1975). *Pisidium lilljeborgi* is found in high-elevation lakes of California (Trinity Alps), Utah (Uinta Mountains), and New Mexico (Sangre de Cristo Mountains) (Taylor 1983). In New Mexico, Lilljeborg's peaclam is known only from Nambe Lake, Santa Fe County. This population represents the most southern and highest elevational occurrence in either North America or Eurasia (Taylor 1983, NMDGF 1988). Nambe Lake is a remote glacial cirque located in the Santa Fe National Forest, and is managed as a water supply reservoir for the City of Santa Fe.

Current Status: Lilljeborg's peaclam was listed as state threatened in 1983. The current status of this species is unknown in New Mexico.

Threats: Due to its restricted distribution, the Nambe Lake population is vulnerable to contaminants from fire suppressant chemicals and natural stochastic events (fire, sedimentation) (Taylor 1983, NMDGF 1988, McDonald and Hamilton 1995). Water drawdown practices during drought could affect the Nambe Lake population.

Recommendation: No change in listing status is recommended. NMDGF should continue surveys of high-elevation, aquatic habitats to determine the statewide distribution of sphaeriid clams.

Literature Cited

- Burch, J. B. 1975. Freshwater sphaeriacean clams (Mollusca: Pelecypoda) of North America. U. S. Environmental Protection Agency, Biota of Freshwater Ecosystems, Identification Manual No. 3. 96 pp.
- Herrington, H. B. 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Museum of Zoology, University of Michigan, Miscellaneous Publications No. 118.
- McDonald, S. F. and S. J. Hamilton. 1995. Fire retardant and foam suppressant chemicals may be toxic to aquatic invertebrates and algae. National Biological Service. NBS Information Bulletin 35.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-333.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.

Sangre de Cristo peaclam, *Pisidium sanguinichristi*

Distribution: This narrowly distributed peaclam is endemic to a single, high-elevation (10485 ft) glacial cirque (Middle Fork Lake) at the base of Bull of the Woods Mountain, Taos County. The Sangre de Cristo peaclam colonizes muddy shallows along the lake perimeter and a short reach of the lake outflow, Middle Fork Creek (Taylor 1983, 1987; NMDGF 1988). This peaclam can be considered the most narrowly restricted of all known North American pisidia and perhaps worldwide (Lang 2002).

Current Status: The Sangre de Cristo peaclam was listed as state threatened in 1983. Annual population monitoring began in July 1995 under a multi-agency conservation effort initiated by the U. S. Forest Service (1996). A total of 42 sites was surveyed from 1996-1999 in the northern Sangre de Cristo Mountains to determine the species' range. Only six valves out of an abundance of *Pisidium* voucher material (i.e., exceeding ca. 750 specimens) collected from Middle Fork Lake (1995-1999) remotely resembled *P. sanguinichristi* specimens (B. Lang, NMDGF, and Dr. G. L. Mackie, University of Guelph, Canada; *pers. obs.*). No pisidia collected from any other sites during this 3-year survey were referable to *P. sanguinichristi*. Based on the absence of *P. sanguinichristi* from the type locality, and the lack of discernable differences in shell shape and hinge dentition between paratype *P. sanguinichristi* and the conchologically similar and co-occurring congener, *Pisidium milium*, the NMDGF requested

taxonomic assessment of the putative *P. sanguinichristi* as a valid species (NMDGF 1996). A mitochondrial DNA study comparing the nominal species with *P. milium* yielded inconclusive results since the biochemical analysis was restricted to a comparison of DNA extracted from shell proteins (Wilson et al. 1998). The taxonomic validity of this species merits further study (Lang 2002).

Threats: Whereas the remoteness and ownership of Middle Fork Lake (Carson National Forest) affords some measure of protection, the site experiences intense periods of active and passive recreational use (USFS 1996). Threats include shoreline destabilization (erosion and sedimentation due to foot and vehicular traffic), contamination from chemicals used in fish stocking and forest fire suppressants, placer mining runoff, and natural stochastic events (fire, drought) (Taylor 1983, NMDGF 1988, McDonald and Hamilton 1995, USFS 1996).

Recommendation: No change in listing status is recommended. The NMDGF should continue sphaeriid clam surveys in high-elevation, wetland habitats throughout the Sangre de Cristo Mountains, and expand this effort to include the Jemez Mountains. In the event live peaclams referable to *P. sanguinichristi* are located, genetic studies comparing *P. sanguinichristi* with *P. milium* would be in order. While a study comparing shell characteristics of these conspecifics may help resolve outstanding taxonomic questions, considerable ecophenotypic variation in shell morphology and hinge dentition of sphaeriid clams manifested by local environmental influences could render such an effort futile (Herrington 1962).

Literature Cited

- Herrington, H. B. 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Museum of Zoology, University of Michigan, Miscellaneous Publications No. 118.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish, Completion Report (E-20 [5-9]) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- McDonald, S. F. and S. J. Hamilton. 1995. Fire retardant and foam suppressant chemicals may be toxic to aquatic invertebrates and algae. National Biological Service. NBS Information Bulletin 35.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-334.
- New Mexico Department of Game and Fish. 1996. Status of aquatic and terrestrial mollusks. Completion Report submitted to the U. S. Fish and Wildlife Service, Albuquerque, NM.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.
- United States Forest Service. 1996. Habitat conservation assessment for the Sangre de Cristo peaclam (*Pisidium sanguinichristi*).
- Wilson, A. B., W. T. Claxton, and G. L. Mackie. 1998. mtDNA COI sequencing of *Pisidium milium* and *P. sanguinichristi*: Does molecular data support species-level designations? Final Report under Professional Services Contract, 5 pp.

GASTROPODA

THREATENED

Gila springsnail, Pyrgulopsis gilae

Distribution: The Gila springsnail is endemic to a series of thermal spring in the Gila River Basin, Gila Wilderness, Grant County (Taylor 1983, 1987). This species is known from ten isolated populations throughout the Basin: Alum Hot Spring, Gila River mainstem; an unnamed spring in the Middle Fork Gila River; three populations from the East Fork Gila River; and five populations from headwater tributaries (i.e., Taylor Creek, 3 sites; Beaver Creek, 2 sites) of the East Fork Gila River (Taylor 1983, 1987; Mehlhop 1993; Lang 2002).

Current Status: The Gila springsnail was listed as state threatened in 1985 (NMDGF Regulation 624). The species is a federal candidate for listing under the Endangered Species Act (Federal Register 2002). Lang (2002)

documented the persistence of this species at the type locality (East Fork Gila River). Based on scientific collection permit records, live *P. gilae* are reported from Alum Hot Spring (NMDGF files). Populations along the Gila River mainstem and Middle Fork Gila River occur on U. S. Forest Service (USFS) land. The East Fork Gila River sub-basin harbors eight populations: two each on private and dual stewardship (private-USFS) lands, and four populations on USFS managed land.

Threats: Natural stochastic events (drought, forest fire, sedimentation, flooding), wetland habitat degradation from recreational bathing, and poor watershed management (e.g., over-grazing, forest over-harvesting) represent primary threats to *P. gilae* populations on federal and private lands (Taylor 1983, 1987; NMDGF 1988; Mehlhop 1993). Fire suppression chemicals can have potentially deleterious effects on *P. gilae* populations (McDonald and Hamilton 1995). Introduction of non-native crayfish and the New Zealand mudsnail can adversely impact spring snails and aquatic habitats (Fernandez and Rosen 1996, <http://www.esg.montana.edu/aim/mollusca/nzms/nzmsbib.html>). Long-term persistence of this species is contingent upon protection of spring sources, their outflows, and the riparian corridor immediately adjacent to these habitats.

Recommendation: No change in listing status is recommended. NMDGF should monitor extant populations and expand aquatic surveys to include unexplored reaches within the Gila River Basin. Recommend allocation of funding to assess genetic divergence of *P. gilae* between geographically isolated populations throughout the Gila River Basin. Any significant genetic divergence may warrant taxonomic reevaluation of the species, which may confer specific management recommendations particular to genetically distinct populations relative to current ownership and land-use practices.

Literature Cited

- Federal Register. 2002. Endangered and threatened wildlife and plants; Review of species that are candidates or proposed for listing as endangered or threatened; Annual notice of findings on recycled petitions; Annual description of progress on listing actions. 50 CFR Part 17, 67(114):40657-40679.
- Fernandez, P. J. and P. C. Rosen. 1996. A microcosm study of the effects of an introduced crayfish (*Orconectes virilis*) on aquatic plants, invertebrates, and herpetofauna from Arizona. Final Report, Part II, IIPAM Project No. I9404, Heritage Program, Arizona Game and Fish Department.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish, Completion Report (E-20,5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- McDonald and Hamilton. 1995. Fire retardant and foam suppressant chemical may be toxic to aquatic invertebrates and algae. NBS Information Bulletin, No. 35.
- Mehlhop, P. 1993. Establishment of a rare mollusc inventory and monitoring program for New Mexico. Year II Progress Report. NMDGF Professional Services Contract No. 80-519-52-Amendment 1.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-298.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.

Pecos springsnail, *Pyrgulopsis pecosensis*

Distribution: *Pyrgulopsis pecosensis* is endemic to two perennial tributaries of the Black River, Eddy County, New Mexico: Blue Spring (type locality) and Castle Spring (Taylor 1987).

Current Status: The Pecos springsnail was listed as state threatened in 1983. Acquisition of Blue Spring surface water rights (72-5-28 NMSA 1995) and the "...lack of oil and gas reserves in the area..." prompted reclassification of *P. pecosensis* from a federal candidate for listing under the ESA to a species of concern (Federal Register 1996). Contrary to conclusions possibly drawn from this reclassification, the Black River Valley has experienced repeated problems of ground water depletion and contamination. Water levels of domestic and agricultural/range wells in the Black River Valley have lowered and even dried-up (residents of Black River Village and environs, *pers. com.*). The acquisition of surface water rights from Blue Spring was a temporary state lease (72-5-28 NMSA 1995). Pecos

springsnail is apparently extirpated from Castle Spring (Landye 1981, NMDGF 1988, Mehlhop 1992). Lang (2002, 2004) reported persistence of *P. pecosensis* in Blue Spring from springhead sources downstream through the middle reach of the spring run. This population has been monitored annually since 1997.

Threats: Taylor (1983) identified groundwater depletion as the primary threat to extant populations of *P. pecosensis*. Extirpation of the Castle Spring population was attributed to a number of factors including flood scour, ground water depletion, and possible contamination from an upstream livestock tank (Landye 1981, NMDGF 1988, Mehlhop 1992).

Regional groundwater withdrawals for agriculture and oil and gas industry operations (exploration, storage, transfer and refining) are ongoing in the Black River valley and adjacent aquifers in Eddy County (BLM 1997). Such extractive processes and industry operations are known to deplete ground water aquifers and to contaminate ground and surface waters in New Mexico (Hennighausen 1969; Jercinovic 1982, 1984; Longmire 1983; Quarles 1983; Boyer 1986; Richard 1988a, 1988b; Rail 1989; Richard and Boehm 1989a, 1989b; Balleau Groundwater, Inc. 1996; Martinez et al. 1998). Aquatic mollusks are acutely sensitive to ground and surface water contaminants (Havlik and Marking 1987, Eisler 1987, Green and Trett 1989, Augspurger et al. 2003). Richard (1988a, 1988b) and Richard and Boehm (1989a, 1989b) documented ground water contamination of domestic and agricultural/range wells in the upper Black River valley (i.e., Washington Ranch, Ballard Wells) by petroleum-derived hydrocarbons and sulfides. Richard and Boehm (1989b) reported "severe" sulfide contamination of Blue Spring, a regionally significant artesian spring that is a primary hydrologic source for the Black River (Hendrickson and Jones 1952). These authors indicated that gas contamination originating up-gradient was likely transported about 20 miles down-gradient to Blue Spring. Such long distance transport of ground water is common in karst, evaporite rock (White et al. 1995, Martinez et al. 1998). This raises long-term concerns for surface water quality of the Blue Spring wetland complex and the Black River, especially considering the concentration of petroleum industry operations in the Black River valley. Oil and gas industry operations within the immediate watershed of Blue Spring are ongoing.

Prolonged drought could reduce flow through the system, resulting in habitat loss while also increasing salinity and potentially concentrating contaminants. Introduction of non-native crayfish and the New Zealand mudsnail can adversely impact spring snails and aquatic habitats (Fernandez and Rosen 1996; <http://www.esg.montana.edu/aim/mollusca/nzms/nzmsbib.html>).

Recommendation: No change in listing status is recommended. NMDGF should develop a state recovery plan for this species. A "Candidate Conservation Agreement" (Federal Register 1997) could provide a mechanism for species and habitat conservation compatible with past and present land-use practices. Continue annual habitat and population monitoring of *P. pecosensis* in Blue Spring.

Literature Cited

- Augspurger, T., A. E. Keller, M. C. Black, W. G. Cope, and F. J. Dwyer. 2003. Water quality guidance for protection of freshwater mussels (Unionidae) from ammonia exposure. *Environmental Toxicology and Chemistry* 22(11):2569-2575.
- Balleau Groundwater, Inc. 1996. Interrelation of groundwater and surface water at Bitter Lake National Wildlife Refuge. A report prepared for the U.S. Department of Justice. 16 pp. (with addenda).
- Boyer, D. G. 1986. Differences in produced water contaminants from oil and gas operations in New Mexico – implications for regulatory action. Pp. 291-316, *In Proceedings of the Conference on Southwestern Ground Water Issues* (National Water Well Association, Publisher).
- Bureau of Land Management. 1997. Carlsbad Approved Resource Management Plan, Amendment and Record of Decision, Carlsbad Resource Area, Roswell District, New Mexico. BLM-NM-PT-98-004-1610.
- Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a syntopic review. U.S. Fish and Wildlife Service. Contaminant Hazard Reviews Report No. 11, Biological Report 85 (1.11).
- Federal Register. 1996. Endangered and Threatened Species; Reclassification of 96 Candidate Taxa. 50 CFR Part 17, 61(40):7457-7463.
- Federal Register. 1997. Announcement of Draft Policy for Candidate Conservation Agreements; Notice of Review. 50 CFR Part 17, 62(113):32183-32188.
- Fernandez, P. J. and P. C. Rosen. 1996. A microcosm study of the effects of an introduced crayfish (*Orconectes virilis*) on aquatic plants, invertebrates, and herpetofauna from Arizona. Final Report, Part II, IIPAM Project No. I9404, Heritage Program, Arizona Game and Fish Department.

- Green, J. and M. W. Trett. 1989. The fate and effects of oil in freshwater. Elsevier Science Publishing Co., Inc., New York.
- Havlik, M. E. and L. L. Marking. 1987. Effects of contaminants on naiad mollusks (Unionidae): a review. U. S. Fish and Wildlife Service, Resource Publication 164.
- Hendrickson, G. E., and R. S. Jones. 1952. Geology and ground-water resources of Eddy County, New Mexico. U.S. Geological Survey, Ground-Water Report 3, 169 pp.
- Hennighausen, F. H. 1969. Meters and their effects in the Roswell Artesian Basin in Chaves and Eddy counties, New Mexico. Pp. 29-33, *In* 14th Annual New Mexico Water Conference (Water Resources Institute).
- Jercinovic, D. E. 1982. Assessment of refined petroleum-product contamination problems in surface and ground waters of New Mexico. Water Pollution Control Bureau, New Mexico Environmental Improvement Division, EID/WPC-82/5.
- Jercinovic, D. E. 1984. Petroleum-product contamination of soil and water in New Mexico. New Mexico Environmental Improvement Division, EID/GWH84/2.
- Landye, J. J. 1981. Current status of endangered, threatened, and/or rare mollusks of New Mexico and Arizona. Endangered Species Office, U.S. Fish and Wildlife Service, Final Report 13.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish, Completion Report (E-20,5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Lang, B. K. 2004. Aquatic mollusks of Bitter Lake National Wildlife Refuge. New Mexico Department of Game and Fish, Annual Performance Report (E-56-2) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Longmire, P. A. 1983. Petroleum-product contamination of ground and surface water: a literature review. Ground Water Section, Water Pollution Control Bureau, New Mexico Environmental Improvement Division. EID/WPC-83/7.
- Martinez, J. D., K. S. Johnson, and J. T. Neal. 1998. Sinkholes in evaporite rocks. *American Scientist* 86:38-51.
- Mehlhop, P. 1992. Establishment of a rare mollusc inventory and monitoring program for New Mexico. Progress Report. NMDGF Professional Services Contract 80-519-52.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-299.
- Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.
- Rail, C. D. 1989. Groundwater contamination: sources, control, and preventative measures. Technomic Publishing Company, Inc. Lancaster, PA.
- Richard, M. 1988a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: review of the geohydrology in the vicinity of Rattlesnake Springs and the contamination problem. Report 1. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. 1988b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the first field investigation, August 1988. Report 2. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989a. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: report of the second field investigation, March, 1988. Report 3. National Park Service Contract RFQ 7029-8-0025.
- Richard, M. and A. Boehm. 1989b. Natural gas contamination at Rattlesnake Springs, Carlsbad Caverns National Park: final summary of the investigation. Report 4. National Park Service Contract RFQ 7029-8-0025.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.
- White, B. W., D. C. Culver, J. S. Herman, T. C. Kane, and J. E. Mylroie. 1995. Karst lands: the dissolution of carbonate rock produces unique landscapes and poses significant hydrological and environmental concerns. *American Scientist* 83:450-459.

New Mexico springsnail, *Pyrgulopsis thermalis*

Distribution: *Pyrgulopsis thermalis* is restricted to a series of thermal springs along the East Fork Gila River, and an isolated thermal spring (Alum Hot Spring) on the mainstem below the confluence of the East and West forks, Gila River, Gila Wilderness, Grant County (Taylor 1983, 1987; NMDGF 1988; Mehlhop 1993). This species

prefers thermal spring flows with temperatures from 33 to 39°C, but occurs most abundantly within lower limits of this range (Taylor 1987).

Current Status: The New Mexico springsnail was listed as state threatened in 1983, and is a federal candidate for listing (Federal Register 1996). Mehlhop (1992, 1993) reported stable populations along the Gila River. Lang (2002) documented persistence of this species at the type locality (Alum Hot Spring) and at Taylor's (1987) East Fork Gila River site.

Threats: While the Gila Wilderness may afford some measure of protection, both populations are vulnerable to habitat degradation by natural stochastic events (forest fire, flooding, sedimentation), poor watershed management, water pollution/contaminants from recreational bathing and fire suppressant chemicals (Taylor 1983, 1987; NMDGF 1988, McDonald and Hamilton 1995; Lang 2002). Introduction of non-native crayfish and the New Zealand mudsnail can adversely impact hydrobiid snails and aquatic habitats (Fernandez and Rosen 1996; <http://www.esg.montana.edu/aim/mollusca/nzms/nzmsbib.html>).

Recommendation: No change in listing status is recommended. NMDGF should monitor extant populations and expand surveys to malacologically unexplored reaches within the Gila River Basin. Efforts to control the use of personal hygiene detergents (e.g., soap, shampoo, etc.) by bathers could protect habitat for *P. thermalis* in downstream reaches of Alum Hot Spring. Signage that prohibits use of cleansing agents would still allow for recreational use of the spring. Recommend allocation of funding to assess genetic divergence of *P. thermalis* between geographically isolated populations throughout the Gila River Basin. Any significant genetic divergence may warrant taxonomic reevaluation of the species, which may confer specific management recommendations particular to genetically distinct populations relative to current ownership and land-use practices.

Literature Cited

- Federal Register. 1996. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates for Listing as Endangered or Threatened Species. 50 CFR Part 17, 61(40):7595-7613.
- Fernandez, P. J. and P. C. Rosen. 1996. A microcosm study of the effects of an introduced crayfish (*Orconectes virilis*) on aquatic plants, invertebrates, and herpetofauna from Arizona. Final Report, Part II, IIPAM Project No. I9404, Heritage Program, Arizona Game and Fish Department.
- Lang, B. K. 2002. Status of aquatic mollusks of New Mexico. New Mexico Department of Game and Fish, Completion Report (E-20,5-9) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- McDonald, S. F. and S. J. Hamilton. 1995. Fire retardant and foam suppressant chemicals may be toxic to aquatic invertebrates and algae. National Biological Service. NBS Information Bulletin 35.
- Mehlhop, P. 1992. Establishment of a rare mollusc inventory and monitoring program for New Mexico. Progress Report. NMDGF Professional Services Contract 80-519-52.
- Mehlhop, P. 1993. Establishment of a rare mollusc inventory and monitoring program for New Mexico. Year II Progress Report. NMDGF Professional Services Contract No. 80-519-52-Amendment 1.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-301.
- Taylor, D. W. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Service Contract Nos. 519-69-01 and 519-69-01-A.
- Taylor, D. W. 1987. Fresh-water mollusks from New Mexico and vicinity. New Mexico Bureau of Mines & Mineral Resources Bulletin 116.

Star gyro, *Gyraulus crista*

Distribution: This species is widespread throughout northern North America, ranging south into northern New Mexico, where it occurs in emergent wetlands associated with Black Lake and Coyote Creek, Colfax County (Taylor 1983, NMDGF 1988).

Current Status: The star gyro was listed as state threatened in 1983. The status of this species is currently unknown in New Mexico.

Threats: Habitat loss due to any alteration of the wetland complex, pollution, dewatering, or land development within the proximate watershed (Taylor 1983, NMDGF 1988).

Recommendation: No change in listing status is recommended. NMDGF should resurvey known site occurrences and conduct statewide surveys to determine the distribution of this species.

Literature Cited

New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-281.

Taylor, D. T. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Services Contract Nos. 519-69-01 and 519-69-01A.

Ovate vertigo, *Vertigo ovata*

Distribution: The historic range included northern North America, ranging south over most of the United States to México. The occurrence of *Vertigo ovata* in the Western Molluscan Province is sporadic, especially in the Rocky Mountain States (Bequaert and Miller 1973). Fossil specimens of *V. ovata* from spring-related Pleistocene and Holocene deposits chronicle the extirpation of localized populations throughout Arizona, New Mexico, and western Texas (Metcalf 1967, Bequaert and Miller 1973, Metcalf and Smartt 1997). In New Mexico, extant populations are known from mesic habitats of Blue Spring, Eddy County, and from the riparian corridor associated with Alamosa Creek immediately upstream of the Monticello Box, Socorro County (Lang 2001).

Current Status: The ovate vertigo was listed as state threatened in 1991 (NMDGF Regulation 682). Populations at Blue Spring and Alamosa Creek appear stable under current land use practices, with evidence of successful reproduction and recruitment of immature snails into the adult population (Lang 2001).

Threats: In the Desert Southwest, the apparent reduction in habitat suitability for this species is attributable to natural stochastic events (e.g., Holocene warming, arroyo entrenchment; Haynes, 1968) exacerbated by human-related land use activities (e.g., wetland [marsh] drainage and development, stream diversion, grazing) (Metcalf and Smartt 1997). Salt cedar encroachment into the riparian corridor of Alamosa Creek could result in adverse habitat effects. Beryllium ore exploration and mining within the immediate watershed of Alamosa Creek have posed threats to this species (NMDGF 2000, 2002); currently there are no proposals or permits for such activities. Extant populations at Blue Spring are threatened by mineral mining and oil and gas industry operations which can result in local/regional groundwater depletion (Hennighausen 1969, Quarles 1983), diminution of spring flows (NMDGF 1988), and surface and ground water contamination (Jercinovic 1982, 1984; Longmire 1983; Quarles 1983; Boyer 1986; Eisler 1987; Green and Trett 1989). Poor watershed stewardship and natural stochastic events, such as prolonged drought, could adversely impact habitat conditions at Blue Spring by reducing hydrologic discharge through the wetland system; thereby desiccating riparian plant communities and increasing grazing pressure in these areas (Taylor 1983, NMDGF 1988, Mehlhop 1992).

Recommendations: No change in listing status is recommended. Removal of salt cedar from Alamosa Creek is ongoing by the Monticello Community Ditch Association, as funded by the USFWS. NMDGF should continue statewide surveys of marsh habitats while monitoring extant populations. Resource agencies should pursue opportunities to acquire private lands, including mineral and groundwater rights, where future beryllium ore exploration or mining may adversely affect groundwater aquifers that supply spring-fed wetlands of Alamosa Creek upstream of the Monticello Box.

Literature Cited

Bequaert, J. C. and W. B. Miller. 1973. The mollusks of the Arid Southwest with an Arizona checklist. University of Arizona Press, Tucson. 271 pp.

Boyer, D. G. 1986. Differences in produced water contaminants from oil and gas operations in New Mexico – implications for regulatory action. Pp. 291-31, *In* Proceedings of the Conference on Southwestern Groundwater Issues (D. K. Kreamer, Moderator). National Well Water Association, Dublin, Ohio.

Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a syntopic review. U.S. Fish and Wildlife Service. Contaminant Hazard Reviews Report No. 11, Biological Report 85 (1.11).

- Green, J. and M. W. Trett. 1989. The fate and effects of oil in freshwater. Elsevier Science Publishing Co., Inc., New York.
- Haynes, C. V. 1968. Geology of Late-Quaternary alluvium. Pp. 591-631, *In* Means of Correlation of Quaternary Successions (R. B. Morrison and H. E. Wright, Eds.). University of Utah Press, Salt Lake City, UT.
- Hennighausen, F. H. 1969. Meters and their effects in the Roswell Artesian Basin in Chaves and Eddy counties, New Mexico. Pp. 29-33, *In* 14th Annual New Mexico Water Conference (Water Resources Institute).
- Jercinovic, D. E. 1982. Assessment of refined petroleum-product contamination problems in surface and ground waters of New Mexico. Water Pollution Control Bureau, New Mexico Environmental Improvement Division, EID/WPC-82/5.
- Jercinovic, D. E. 1984. Petroleum-product contamination of soil and water in New Mexico. New Mexico Environmental Improvement Division, EID/GWH84/2.
- Lang, B. K. 2001. Status and distribution of terrestrial snails of southern New Mexico. New Mexico Department of Game and Fish, Completion Report (E-36) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Longmire, P. A. 1983. Petroleum-product contamination of ground and surface water: a literature review. Ground Water Section, Water Pollution Control Bureau, New Mexico Environmental Improvement Division. EID/WPC-83/7.
- Mehlhop, P. 1992. Establishment of a rare mollusc inventory and monitoring program for New Mexico. Progress Report. NMDGF Professional Services Contract 80-519-52.
- Metcalf, A. L. 1967. Late Quaternary mollusks of the Rio Grande Valley, Caballo Dam, New Mexico to El Paso, Texas. University of Texas at El Paso, Sci. Ser. 1:1-62.
- Metcalf, A. L. and R. A. Smartt. 1997. Land snails of New Mexico: a systematic review. Pp.1-69, *In* Land Snails of New Mexico. (A. L. Metcalf and R. A. Smartt, Eds.). New Mexico Museum of Natural History and Science Bulletin 10.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-242.
- New Mexico Department of Game and Fish. 2000. Threatened and endangered species of New Mexico: biennial review and recommendations. 116 pp.
- Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.
- Taylor, D. T. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Services Contract Nos. 519-69-01 and 519-69-01A.

Hacheta Grande woodlandsnail, *Ashmunella hebaridi*

Distribution: *Ashmunella hebaridi* is narrowly restricted to dense pine cover along the south wall of Chaney Canyon (6600-7400 ft) on the west-central flank of the Big Hatchet Mountains west of Big Hatchet Peak, Hidalgo County (Metcalf and Smartt 1997, Lang 2005). The species may occur at higher elevations on vertical limestone facies immediately west-northwest of Big Hatchet Peak above 7400 ft.; sampling in this area is limited by access.

Current Status: *Ashmunella hebaridi* was listed as state threatened in 1990, and is considered a federal species of concern (Federal Register 1994). The Hacheta Grande woodlandsnail occurs most commonly at the base of limestone outcrops beneath large rock fragments and rubble piles where litter-soil mold collects. The BLM conducted a prescribed burn in the north-central range of the Big Hatchet Mountains (Thompson Canyon northward to Zeller Peak) in 2005 that did not impact habitat of this species.

Threats: Any form of soil disturbance (e.g., mineral mining) or vegetation removal (e.g. logging, prescribed burn, or grazing) would likely result in adverse impacts to edaphic conditions and direct habitat loss in areas where this species occurs (Lang 2001, 2005). Habitat loss from wildland fire, deciduous woody plant diseases or insect pests, and global warming effects could impact extant populations.

Recommendation: No change in listing status is recommended. Populations monitoring should continue. NMDGF should initiate a conservation plan for this species in collaboration with Federal agencies (BLM, USFWS).

Literature Cited

- Federal Register. 1994. Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species, Proposed Rule. 50 CFR Part 17. Federal Register 59(219):58982-59028
- Lang, B. K. 2005. Taxonomic Assessment of *Ashmunella hebardei* and *Ashmunella mearnsii* of the Big Hatchet Mountains, New Mexico. New Mexico Department of Game and Fish, Completion Report E-57 (1-3) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, NM.
- Metcalf, A. L. and R. A. Smartt. 1997. Land snails of New Mexico: a systematic review. Pp. 1-69, *In* Land Snails of New Mexico. (A. L. Metcalf and R. A. Smartt, Eds.). New Mexico Museum of Natural History and Science Bulletin 10.

Cooke's Peak woodlandsnail, *Ashmunella macromphala*

Distribution: This species was known only from the precipitous north slope of Cooke's Peak, Cooke's Range, Luna County (Vagvolgyi 1974, Metcalf and Smartt 1997). Surveys north and south of Cooke's Peak documented a single isolated population of *Ashmunella macromphala* on a north-facing igneous scree slope in OK Canyon (Lang 2001). While no live snails were observed at this site, recent shell material implies that a viable population may exist there.

Current Status: Cooke's peak woodlandsnail was listed as state threatened in 1990. Both populations of *A. macromphala* occur on BLM land.

Threats: Due to its restricted range, this species is vulnerable to any form of soil disturbance (e.g., mineral mining) or vegetation removal (e.g. logging or grazing) that could result in adverse impacts to edaphic conditions and direct habitat loss in areas where this species occurs. Habitat loss from forest fire, deciduous woody plant diseases or insect pests, and global warming effects could impact extant populations. Localized populations could be susceptible to fire. The short- and long-term return effects of fire on forest ecosystem dynamics are poorly understood, especially with respect to molluscanfaunal recovery periods (Lang 2001, Lang 2004). Surveys in May 2000 documented significant sign of cattle grazing throughout the unnamed canyon leading up to the base of the type locality (Lang 2001). While cattle will likely not venture onto or across a talus slope, intense browsing of deciduous woody vegetation around the perimeter of a scree slope can potentially decrease leaf litter available as food for snails, significantly alter seral succession, and affect plant community composition. Vagvolgyi (1974) discussed the importance of deciduous leaf litter for this species.

Recommendation: No change in listing status is recommended. NMDGF should monitor extant populations, and expand malacological surveys for this species to include potentially suitable habitats in southwestern areas of the Cooke's Range.

Literature Cited

- Lang, B. K. 2001. Status and distribution of terrestrial snails of southern New Mexico. New Mexico Department of Game and Fish, Completion Report (E-36) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Lang, B. K. 2004. Taxonomic Assessment of *Ashmunella hebardei* and *Ashmunella mearnsii* of the Big Hatchet Mountains, New Mexico. New Mexico Department of Game and Fish, Annual Performance Report (E-57-2) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Metcalf, A. L. and R. A. Smartt. 1997. Land snails of New Mexico: a systematic review. Pp. 1-69, *In* Land Snails of New Mexico. (A. L. Metcalf and R. A. Smartt, Eds.). New Mexico Museum of Natural History and Science Bulletin 10.
- Vagvolgyi, J. 1974. Eight new ashmunellas from the southwestern United States (Pulmonata: Polygyridae). *Proceedings of the Biological Society of Washington* 87:152-53.

Mineral Creek mountainsnail, *Oreohelix pilsbryi*

Distribution: *Oreohelix pilsbryi* is endemic to the Black Range, Sierra County (Pilsbry 1939), where it has been reported from two localities near "Oliver's Mine" along Mineral Creek, about 8-10 km west of Chloride (Metcalf

and Smartt 1997). This species was previously known from a 30 m section of limestone outcrop along Mineral Creek (type locality), and from similar habitat located 50 m up-slope (NMDGF 1988, Metcalf and Smartt 1997).

Current Status: Mineral Creek mountainsnail was listed as state threatened in 1990. Lang (2001) found *O. pilsbryi* abundant throughout an approximate 0.3 mile reach of stream that constricts Mineral Creek to a narrow sinuous channel lined by limestone outcrops; several small (5-10 mm *w*) shells confirmed a reproducing population. No empty shells or fragments were observed downstream from this site.

Threats: Considering this species apparent affinity for moist soils on well-shaded north- and east-facing slopes, any form of canopy removal, whether by cutting or forest fire, would likely dry the forest floor and potentially render edaphic condition unsuitable to *O. pilsbryi*. This species is vulnerable to any form of soil disturbance or mining activity within the immediate vicinity of occupied habitat (NMDGF 1988, Lang 2001). While cattle may not graze regularly at the type locality, cows do travel the narrow stream corridor and rest along shaded canyon walls (Lang 2001). Soil disturbance from such foot traffic and trampling could adversely affect *O. pilsbryi* if downstream grazing intensity increases so as to push cattle into marginal habitats upstream in search of forage.

Recommendation: No change in listing status is recommended. NMDGF should continue to monitor extant populations and survey for new populations. Fencing of the type locality would serve to protect this species' limited habitat. NMDGF should pursue development of a state recovery plan.

Literature Cited

- Lang, B. K. 2001. Status and distribution of terrestrial snails of southern New Mexico. New Mexico Department of Game and Fish. Completion Report (E-36) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Metcalf, A. L. and R. A. Smartt. 1997. Land snails of New Mexico: a systematic review. Pp. 1-69, *In* Land Snails of New Mexico. (A. L. Metcalf and R. A. Smartt, Eds.). New Mexico Museum of Natural History and Science Bulletin 10.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-115.
- Pilsbry, H. A. 1939. Land mollusca of North America (north of Mexico). Academy of Natural Sciences of Philadelphia Monograph 3(1):418-419, 514-515.

Doña Ana talussnail, *Sonorella todseni*

Distribution: The Doña Ana talussnail is endemic to Doña Ana Mountains, Doña Ana County (Miller 1976). *Sonorella todseni* is the most geographically restricted of all known species of *Sonorella* in New Mexico (Metcalf and Smartt 1997).

Current Status: *Sonorella todseni* was listed as state threatened in 1990. Lang (2001) reported live *S. todseni* in rivulet-like accumulations of dark rhyolitic talus on the north and east slope of Doña Ana Peak. Total population size appears very small, probably occupying <1.0 acre, collectively (Sullivan 1997).

Threats: Habitat protection is paramount for the conservation of this species, which is vulnerable due to its restricted range, fragile habitat, and easy public land (BLM) access (NMDGF 1988, Lang 2001). The extant population is susceptible to any form of soil disturbance or mining activity in the general vicinity of talus slopes. Surveys revealed sign of shrub removal by digging and a plastic tag tie from a local gardening center (Lang 2001). Removal of woody vegetation not only disturbs talus slopes, but also results in loss of food and cover for snails (Vagvolgyi 1974), increases the potential for slope erosion, and effectively reduces water retention capacity of the soil. Cumulative effects of these activities can have irrevocable impacts, exacerbating habitat desiccation and increasing substrate temperatures, which can dry-out developing egg masses deposited in talus just below the ground surface. Global warming, natural perturbations (fire, rock slides), mining, and related substrate disturbance activities represent threats to this species (NMDGF 1988, Sullivan 1997, Lang 2001).

Recommendation: No change in listing status is recommended. NMDGF should continue efforts with the Bureau of Land Management to monitor extant populations and to secure occupied habitat through a state recovery plan.

Literature Cited

- Lang, B. K. 2001. Status and distribution of terrestrial snails of southern New Mexico. New Mexico Department of Game and Fish, Completion Report (E-36) submitted to the Division of Federal Aid, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Metcalf, A. L. and R. A. Smartt. 1997. Land snails of New Mexico: a systematic review. Pp. 1-69, *In* Land Snails of New Mexico. (A. L. Metcalf and R. A. Smartt, Eds.). New Mexico Museum of Natural History and Science Bulletin 10.
- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Account B-103.
- Miller, W. B. 1976. New species of *Sonorella* (Pulmonata: Helminthoglyptidae) from New Mexico and Texas. *The Nautilus* 90:70-73.
- Sullivan, R. M. 1997. Inventory of some terrestrial snails of southern New Mexico, with emphasis on state listed and federal candidate species of Doña Ana, Otero, and Socorro counties. Final Report submitted to the NMDGF under Professional Services Contract 96-516.64
- Vagvolgyi, J. 1974. Eight new ashmunellas from the southwestern United States (Pulmonata: Polygyridae). *Proceedings of the Biological Society of Washington* 87:152-53.

VERTEBRATES

FISHES

ENDANGERED

Gila chub, *Gila intermedia*

Distribution: Gila chub was historically present in smaller streams and cienegas of the Gila River drainage of southwestern New Mexico (Sublette et al., 1990), southeastern Arizona (Minckley, 1973; Rinne, 1976), and northern Sonora (Varela-Romero et al., 1992). This chub has an affinity for deep pools in slow velocity water and is almost always associated with cover such as undercut banks, rootwads of large woody vegetation, and instream debris piles (Rinne and Minckley, 1991; Weedman et al., 1996). In New Mexico, Gila chub was known from small streams, several of which were associated with cienegas (e.g., San Simon Creek, upper Tularosa River, and Duck Creek). The chub genus *Gila* is taxonomically complex and many questions remain to be resolved regarding the relationships of its species (T.E. Dowling, pers. comm.). Minckley and DeMarais (2000) recently proposed that in the Gila River drainage, the genus is comprised of three species, *G. intermedia*, *G. robusta*, and *G. nigra*.

Current Status: Gila chub was state-listed as endangered in New Mexico in 1978 and was recently federally listed as endangered (USFWS 2005). A state recovery plan for the species has been drafted (Carman 2006) and will be presented to New Mexico State Game Commission for approval in 2006. The Arizona range of the Gila chub has diminished and it is rare in New Mexico (Weedman et al., 1996). Small populations persist in Sonora (Varela-Romero et al., 1992). Based upon Minckley and DeMarais' (2000) interpretation, the chub in Turkey Creek is *Gila intermedia*. Wildfire and associated ash flows during 2003 greatly diminished the Turkey Creek population, but a few individuals, including age 0 chubs, were found in July 2004. The species may persist in canyon-bound portions of Mule Creek, a San Francisco River tributary.

Threats: Loss of stream and cienega habitats and nonnative fishes, such as smallmouth bass (*Micropterus dolomieu*), are probably the primary reasons for the greatly reduced range and abundance of Gila chub. Ash flows and elevated sediment loads remain a threat to the Turkey Creek population.

Recommendation: No change in listing status is recommended. The Turkey Creek population should be periodically sampled (at least biennially) to monitor its status. If wildfire threatens Turkey Creek population, individuals should be evacuated and temporarily held in secure facility until ash and elevated sediment loads no longer threaten population. Surveys should be conducted to accurately characterize its status in New Mexico. If additional populations are found, efforts should be made to protect them by precluding or removing nonnative fishes, habitat enhancement or protection, and restrictive angling regulations (if appropriate). Additional populations, with appropriate protections, should be established in historical New Mexico range of species. The taxonomic relationships among the closely related *Gila* species of the Gila River drainage should be clarified.

Literature Cited:

- Carman, S.M. 2006 (draft). Roundtail and Gila Chubs (*Gila robusta* and *intermedia*) Recovery Plan. Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe, NM.
- Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W. L. and B. D. Maris. 2000. Taxonomy of chubs (Teleostei, Cyprinidae, Genus *Gila*) in the American Southwest with comments on Conservation. *Copeia* 2000:251-256.
- Rinne, J.N. 1976. Cyprinid fishes of the genus *Gila* from the lower Colorado River basin. *Wasmann Journal of Biology* 34:65-107.
- Rinne, J.N., and W.L. Minckley. 1991. Native fishes of arid lands: A dwindling resource of the desert southwest. General Technical Report RM-206. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque, NM.
- Varela-Romero, A.C. Galindo-Duarte, E. Saucedo-Monarque, L.S. Anderson, P. Warren, S. Stefferud, J. Stefferud, S. Rutman, T. Tibbits, and J. Malusa. 1992. Re-discovery of *Gila intermedia* and *Gila purpurea* in the north of Sonora, México. Proceedings of the Desert Fishes Council 22:33-34.
- U.S. Fish and Wildlife Service (USFWS). 2005. Endangered and Threatened Wildlife and Plants; Listing Gila Chub as Endangered with Critical Habitat; Final Rule. Federal Register 70:6663-66721.
- Weedman, D.A., A.L. Girmendonk, and K.L. Young. 1996. Status review of Gila chub, in the United States and Mexico. Nongame and Endangered Wildlife Program Technical Report 91. Arizona Game and Fish Department, Phoenix, AZ.

Chihuahua chub, *Gila nigrescens*

Distribution: The Chihuahua chub is native to the Mimbres, Guzmán, and Bustillos basins of southwest New Mexico and northwest Chihuahua (Smith and Miller, 1986). It generally occurs in stream and cienega habitats and almost always occurs in deep pool habitats associated with instream cover such as uprooted trees (Propst and Stefferud, 1994). In New Mexico, Chihuahua chub is limited mainly to a 15 km reach of the Mimbres River and associated spring habitats (Propst, 1999).

Current Status: Chihuahua chub was state listed as endangered in New Mexico and was federally listed as threatened in 1983 (USFWS 1983). A federal recovery plan for the species has been approved (USFWS, 1986). Chihuahua chub has declined significantly throughout its native range (Propst and Stefferud, 1994). In Chihuahua, it was found mainly in remote stream reaches where there has been little or no modification of habitat by human activities and nonnative predatory fish are absent. Ash-laden flows from the 1995 “Pigeon Fire” reduced Chihuahua chub abundance in the Mimbres River substantially. The surviving river population was probably supplemented by individuals leaving springs associated with Mimbres River

A spring system associated with the Mimbres River supports the largest wild population (ca. 300) of the species in the U.S., and individuals have been taken from this population to maintain a brood and refugial stock at Dexter National Fish Hatchery and Technology Center. The chubs in Mimbres River springs have a heavy infestation of yellow grub (*Clinostomum marginatum*) (J.J. Landye, pers. comm.), and this ectoparasite probably causes elevated mortality of spring inhabitants. In addition, invasion of springs by largemouth bass (*Micropodus salmoides*) necessitated several efforts to remove these nonnative predators. The Nature Conservancy (TNC) and New Mexico Department of Game and Fish have properties on the Mimbres River that are managed, in part, to provide habitat for Chihuahua chub. McKnight Creek, below the Gila trout waterfall barrier, has been stocked with Chihuahua chub (1993 and 1997) to increase abundance of stream populations of the species. Individuals have been in the Mimbres River annually since 1999 to augment extant stream populations. Annual autumn monitoring of the Mimbres River population indicates its numbers have increased slightly in the past 5 years.

Threats: Modification and destruction of riverine habitats (dewatering, channelizing, and removal of woody riparian vegetation) are the greatest threats and impediments to recovery of Chihuahua chub in the Mimbres River. Nonnative fishes, such as rainbow trout (*Oncorhynchus mykiss*), usurp Chihuahua chub habitat and may prey upon them. Longfin dace (*Agosia chrysogaster*) may displace young Chihuahua chub from shoreline habitats. Escapement of nonnative fishes (e.g., largemouth bass) from Bear Canyon Reservoir is a threat to spring and riverine Chihuahua chub populations, but installation of a fish screen at outflow of the reservoir has diminished this threat. The yellow grub infestation of chubs in spring habitats presents a severe health threat to this population.

Recommendations: No change in listing status is recommended. Cooperative efforts with The Nature Conservancy, U.S. Fish and Wildlife Service, and U.S. Forest Service to improve status of the species should continue. Active efforts to remove nonnative salmonids in all accessible areas of the Mimbres River should be undertaken. Lands having suitable, or potential, Chihuahua chub habitat in Mimbres valley should be obtained from willing sellers. The fish barrier at Bear Canyon Reservoir should be maintained to ensure there is no escapement of nonnative fishes, particularly centrarchids, from Bear Canyon Reservoir. The U.S. Fish and Wildlife Service should be encouraged to continue maintenance of captive population and brood stock at Dexter National Fish Hatchery and

Technology Center. Strict regulations regarding use of bait fishes should be adopted and implemented in the Mimbres basin.

Literature Cited:

- Propst, D.L. 1999. Threatened and endangered fishes of New Mexico. Technical Report No. 1, New Mexico Department of Game and Fish, Santa Fe.
- Propst, D.L. and J.A. Stefferud. 1994. Distribution and status of Chihuahua chub (Teleostei: Cyprinidae: *Gila nigrescens*), with notes on its ecology and associated species. *The Southwestern Naturalist* 39:224-234.
- Smith, M.L. and R.R. Miller. 1986. The evolution of the Rio Grande basin as inferred from its fish fauna. Pp. 457-485. In C.H. Hocutt and E.O. Wiley (eds.). *The zoogeography of North American freshwater fishes*. John Wiley & Sons, New York, NY.
- U.S. Fish and Wildlife Service. 1986. Chihuahua chub recovery plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

Roundtail chub, *Gila robusta*

Distribution: Roundtail chub formerly occupied the Colorado River and its tributaries from Wyoming south to the confluence of the Little Colorado River (Arizona), tributaries of the Colorado River downstream of the Little Colorado River, and the ríos Yaqui, Fuerte, and Sinaloa in northwestern Mexico (Minckley, 1973; Hendrickson et al., 1981; Tyus et al., 1982; Hendrickson, 1983; Mueller and Marsh, 2002). Throughout much of its range, the species was historically common (Minckley, 1973; Holden and Stalnaker, 1975). In New Mexico, roundtail chub occurred in the San Juan, Zuni (a Little Colorado River tributary), San Francisco, and Gila River drainages (Baird and Girard, 1853; Koster, 1957; Bestgen and Propst, 1989; Platania, 1990). In these streams, it was most common in moderate-velocity areas near vegetated shorelines and debris piles.

Current Status: Roundtail chub was state listed as threatened in New Mexico in 1975 and uplisted to endangered in 1996. A state recovery plan for 3 species of the genus *Gila*, including *G. robusta*, is currently being drafted. The Navajo Nation lists roundtail chub as endangered, Group 2 (Mikesic et al., 2005). Although roundtail chub remains comparatively common in portions of the upper Colorado River drainage (Tyus et al., 1982), it has declined considerably in the lower portion of the Colorado River drainage (Bestgen and Propst, 1989; Rinne and Minckley, 1991; Mueller and Marsh, 2002). In New Mexico, the species is rare in the San Juan River (Paroz et al., 2005), extirpated from the Zuni River drainage (Propst et al., 2001), extirpated from the San Francisco River drainage (Bestgen and Propst, 1989), and likely eliminated from in the Gila River drainage (Bestgen and Propst, 1989). Based upon Minckley and DeMarais' (2000) reclassification of Gila River drainage *Gila* species, roundtail chub was historically restricted to the mainstem Gila River downstream of Cliff. It has not been collected downstream of Cliff since 1991. Intermediate-elevation streams, such as downstream reaches of Middle and East forks Gila River, are occupied by headwater chub, *Gila nigra*.

Threats: Habitat modification (channelization, dams, removal of woody riparian vegetation, discharge manipulation, and seasonal stream desiccation) and establishment of nonnative predators are the primary factors contributing to the imperiled status of the species.

Recommendations: No change in listing status is recommended. NMDGF has joined with other states (Colorado, Utah, Arizona, Nevada, and Wyoming), Native American tribes (Navajo, Jicarilla, and Southern Ute), and federal agencies (U.S. Bureau of Land Management and U.S. Forest Service) to develop a comprehensive conservation plan for the species. Participation by NMDGF in this endeavor should continue. An active program to restore roundtail chub to San Juan River should be implemented. Nonnative ictalurids, cyprinids, and centrarchids should be removed from San Juan River chub habitats to improve potential for successful restoration of roundtail chub. Information from ongoing studies to clarify the current distribution and taxonomic status of *Gila*-species in the Gila River drainage should be considered in developing and implementing conservation strategies.

Literature Cited:

- Baird, S.F. and C. Girard. 1853. Descriptions of some new fishes from the River Zuni. *Proceedings of the Academy of Natural Sciences, Philadelphia* 6:368-369.

- Bestgen, K.R. and D.L. Propst. 1989. Distribution, status, and notes on the ecology of *Gila robusta* (Cyprinidae) in the Gila River drainage, New Mexico. *The Southwestern Naturalist* 34:402-412.
- Hendrickson, D.A. 1983. Distribution records of native and exotic fishes in Pacific Drainages of northern Mexico. *Arizona-Nevada Academy of Sciences* 18:33-39.
- Hendrickson, D.A., W.L. Minckley, R.R. Miller, D.J. Siebert, and P.H. Minckley. 1981. Fishes of the Río Yaqui Basin, México and United States. *Arizona-Nevada Academy of Science* 15:65-106.
- Holden, P.B. and C.B. Stalnaker. 1975. Distribution and abundance of mainstream fishes of the Middle and Upper Colorado River basins, 1967-1973. *Transactions of the American Fisheries Society* 104:217-231.
- Koster, W.J. 1957. Guide to the fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.
- Mikesic, D., J. Nystedt, and D. Roth. 2005. Navajo Nation Endangered Species List Species Accounts. Navajo Natural Heritage Program, Department of Fish and Wildlife, Window Rock, AZ.
- Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W.L. and B.D. De Maris. 2000. Taxonomy of chubs (Teleostei, Cyprinidae, Genus *Gila*) in the American Southwest with comments on conservation. *Copeia* 2000:251-256.
- Mueller, G.A. and P.C. Marsh. 2002. Lost, a desert river and its native fishes: A historical perspective of the lower Colorado River. U.S. Geological Survey Information Technology Report USGS/BRD/ITR—2002—0010.
- Platania, S.P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah. Ichthyofaunal study of the San Juan River. New Mexico Department of Game and Fish, Santa Fe, NM.
- Paroz, Y.M., D.L. Propst, S.M. Carman, and R.D. Larson. 2005. Small-bodied fishes monitoring, San Juan River (September – October 2005). San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Propst, D.L., A.L. Hobbes, and T.L. Stroh. 2001. Distribution and notes on the biology of Zuni bluehead sucker, *Catostomus discobolus yarrowi*, in New Mexico. *The Southwestern Naturalist* 46:158-170.
- Rinne, J.N. and W.L. Minckley. 1991. Native fishes of arid lands: A dwindling resource of the desert southwest. USDA Forest Service General Technical Report RM-206. U.S. Forest Service, Fort Collins, CO.
- Tyus, H.M., B.D. Burdick, R.A. Valdez, C.M. Haynes, T.A. Lytle, and C.R. Berry. 1982. Fishes of the Upper Colorado River Basin: Distribution, abundance, and status. Pp. 12-70. *In* W.H. Miller, H.M. Tyus, and C.A. Carlson (eds.). *Fishes of the Upper Colorado River System: Present and future*. Western Division of the American Fisheries Society, Bethesda, MD.

Rio Grande silvery minnow, *Hybognathus amarus*

Distribution: The Rio Grande silvery minnow formerly occupied mainstream habitats of the Rio Grande from near its confluence with the Rio Chama in northern New Mexico downstream to the Gulf of Mexico and the Pecos River from near Santa Rosa downstream to its confluence with the Rio Grande (Bestgen and Platania, 1991). In New Mexico, the species was most common in the Rio Grande between Cochiti Pueblo and Elephant Butte Reservoir and in the Pecos River between Fort Sumner and Carlsbad (Bestgen and Platania, 1991). Within these stream reaches, it was most commonly found in main channel run habitats over sand substrates and seasonally in low velocity areas such as backwaters and embayments.

Current Status: Rio Grande silvery minnow was state listed as endangered in New Mexico in 1979. It was federally listed as endangered in 1994 (USFWS, 1994). A recovery plan for the species was approved in 1999 (USFWS, 1999), and a revision is near completion. The species currently occupies less than 10% of its historic range. It no longer occurs in the Pecos River (Bestgen et al., 1989) or the Rio Grande downstream of the upper reaches of Elephant Butte Reservoir (Edwards and Contreras-Balderas, 1991; Bestgen and Propst, 1996). In its current range between Algodones and Elephant Butte Reservoir, it is most common between San Acacia and Elephant Butte Reservoir (Platania and Dudley 2003). Between Albuquerque and Isleta it is rare, and it is uncommon between Isleta and San Acacia. Recent stocking efforts have augmented the Albuquerque reach population (J.E. Brooks, pers. comm.). Where still present, its abundance varies considerably seasonally and annually (Dudley et al., 2005). Since 2001, Rio Grande silvery minnows have been salvaged from drying river reaches. The number of fish salvaged annually has steadily declined (J.E. Brooks, USFWS, pers. comm.) Considerable effort has been expended on behalf of the species by the Middle Rio Grande Endangered Species Act Collaborative Program in the past 7 years. Continued drought and extended seasonal drying of substantial reaches of the river, however, have frustrated efforts of the Program and few fish survive in the wild. During 2005, abundance of Rio Grande silvery minnow was somewhat higher than during preceding several years, but

anticipated low flows and extensive channel drying during summer 2006 likely will negate this brief improvement in status.

Threats: Habitat modification (channelization, stream desiccation, modified thermal regimes, and impoundments), barriers to movement (i.e., diversion dams), and loss of natural flow regimes are the primary factors threatening the persistence of Rio Grande silvery minnow. Nonnative fishes (predators and competitors) also negatively impact surviving Rio Grande silvery minnow populations. Introgressive hybridization with plains minnow, *Hybognathus placitus* may have contributed to extirpation of the species from the Pecos River (Cook et al., 1992). Alternatively, it may have been displaced from the Pecos River by plains minnow. Plains minnow was likely introduced to Pecos River from South Canadian River via bait bucket transfer.

Recommendations: No change in listing status is recommended. NMDGF should continue to actively participate with the U.S. Fish and Wildlife Service and other entities to implement the Rio Grande Silvery Minnow Recovery Plan (USFWS 1999). The Recovery Plan is currently being revised; a primary focus of the revised plan will be to prevent extinction of the species. Surface flows should be maintained permanently in the Rio Grande from Angostura Diversion to Elephant Butte Reservoir. Augmentation of extant wild populations with hatchery-reared Rio Grande silvery minnow should be continued. Hatchery stocks should be managed to ensure sufficient genetic diversity to support augmentation and establishment of wild populations for recovery. Additional populations of Rio Grande silvery minnow should be established within its historical range. Status of Rio Grande silvery minnow should be closely monitored. Strict regulations regarding use of bait fishes should be adopted and implemented for the Rio Grande.

Literature Cited:

- Bestgen, K.R. and S.P. Platania. 1991. Status and conservation of the Rio Grande silvery minnow, *Hybognathus amarus*. The Southwestern Naturalist 36:225-232.
- Bestgen, K.R., S.P. Platania, J.E. Brooks, and D.L. Propst. 1989. Dispersal and life history traits of *Notropis girardi* (Cypriniformes: Cyprinidae) introduced into the Pecos River, New Mexico. American Midland Naturalist 122:228-235.
- Bestgen, K.R. and D.L. Propst. 1996. Redescription, geographic variation, and taxonomic status of Rio Grande silvery minnow, *Hybognathus amarus* (Girard, 1856). Copeia 1996:41-55.
- Cook, J.P., K.R. Bestgen, D.L. Propst, and T.L. Yates. 1992. Allozymic divergence and systematics of the Rio Grande silvery minnow, *Hybognathus amarus* (Teleostei: Cyprinidae). Copeia 1992:36-44.
- Dudley, R.K., S.P. Platania, and S.J. Gottlieb. 2005. Rio Grande silvery minnow population monitoring program results from 2004. Middle Rio Grande Endangered Species Act Collaborative Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Edwards, R.J. and S. Contreras-Balderas. 1991. Historical changes in the ichthyofauna of the lower Rio Grande (Rio Bravo del Norte), Texas and Mexico. The Southwestern Naturalist 36:201-212.
- Platania, S.P. and R.K. Dudley. 2003. Summary of the biology of Rio Grande silvery minnow, an endangered species in the middle Rio Grande, New Mexico. The Rio Grande Silvery Minnow: Science and Policy in the Bosque Symposium.
- U.S. Fish and Wildlife Service. 1999. Rio Grande silvery minnow (*Hybognathus amarus*) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

Arkansas River shiner, *Notropis girardi*

Distribution: The historic range of this shiner included plains streams in the Arkansas River drainage of New Mexico, Texas, Oklahoma, Kansas, and Arkansas (Cross and Collins, 1975; Gilbert, 1980; Matthews and Hill, 1980). In New Mexico, it occurred in the South Canadian River drainage from the vicinity of Sabinoso downstream to the New Mexico/Texas border (Sublette et al., 1990; Pittenger and Schiffmiller, 1997). It inhabits stream reaches characterized by extremes in discharge and is found most commonly in main channel runs over shifting sand and small gravel substrates (Cross and Moss, 1987). Spawning by Arkansas River shiner occurs from late spring through early autumn and is closely linked to increases in flow (Platania and Altenbach, 1998; Platania et al., 2005.).

Current Status: Arkansas River shiner was state listed as endangered in New Mexico in 1976. It was federally listed as threatened by USFWS in 1998. Arkansas River shiner is absent or declining in much of its historic range

(Cross et al., 1983; Larson, 1988). In New Mexico, it is currently found only in the South Canadian River downstream of Ute Dam and Revuelto Creek (Larson, 1988). This shiner was established in the Pecos River during the past 20 years, probably via bait bucket transfer, and it is moderately common in the river between Fort Sumner and Brantley Reservoir (Bestgen et al., 1989, Platania et al., 2005). The population of Arkansas River shiner in the Pecos River is not protected by NMDGF or by the U.S. Fish and Wildlife Service.

Threats: Desiccation of occupied habitat by water diversions and withdrawals and loss of flow spikes are probably the major threats to the species. Degradation of water quality also presents a threat to the species.

Recommendation: No change in listing status is recommended. Studies to characterize the life history of the species (based on specimens from Pecos River) were recently completed (Platania et al., 2005). A multi-year study to characterize status of South Canadian River drainage fishes, including Arkansas River shiner, was initiated during 2004 and will be completed during 2006. Because funding to support that work was limited, additional funding should be made available to enable more intensive surveys and multiple sampling at key sites to document population dynamics. Efforts should be made to restore Arkansas River shiner to areas of historical occupancy, particularly reaches of the South Canadian River upstream of Ute Reservoir. Strict regulations regarding use of bait fishes should be adopted and implemented for the Canadian River basin.

Literature Cited:

- Bestgen, K.R., S.P. Platania, J.E. Brooks, and D.L. Propst. 1989. Dispersal and life history traits of *Notropis girardi* (Cypriniformes: Cyprinidae), introduced into the Pecos River, New Mexico. *American Midland Naturalist* 122:228-235.
- Cross, F.B. and J.T. Collins. 1975. Fishes in Kansas. Public Education Series No. 3, The University of Kansas Museum of Natural History, Lawrence, KS.
- Cross, F.B., O.T. Gorman, and S.G. Huloeur. 1983. The Red River shiner, *Notropis bairdi*, in Kansas with notes on depletion of its Arkansas River cognate, *Notropis girardi*. *Transactions of the Kansas Academy of Science* 86:93-98.
- Cross, F.B. and R.E. Moss. 1987. Historic changes in fish communities and aquatic habitats in plains streams of Kansas. pp. 155-165. In W.J. Matthews and D.C. Heins (eds.). *Community and evolutionary ecology of North American stream fishes*. The University of Oklahoma Press, Norman, OK.
- Gilbert, C.R. 1980. *Notropis girardi* Hubbs and Ortenburger, Arkansas River shiner. P.268 In D.S. Lee, C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer, Jr. (eds.). *Atlas of North American freshwater fishes*. North Carolina State Museum of Natural History, Raleigh, NC.
- Larson, R.D. 1988. Present status and distribution of the Arkansas River shiner, *Notropis girardi*, (Pisces: Cyprinidae), and possible causes for its decline. Unpubl. MS thesis. Oklahoma State University, Stillwater, OK.
- Matthews, W.J. and L.G. Hill. 1980. Habitat partitioning in the fish community of a southwestern river. *The Southwestern Naturalist* 25:51-66.
- Pittenger, J.S. and G. Schiffmiller. Ichthyofaunal decline in Ute Creek, South Canadian River drainage, New Mexico. *The Southwestern Naturalist* 42:112-117.
- Platania, S.P. and C.S. Altenbach. 1998. Reproductive strategies and egg types of seven Rio Grande basin Platania, cyprinids. *Copeia* 1998:559-569.
- Platania, S.P., K.B. Gido, and W.H. Brandenburg. 2005. Life history and ecology of an introduced population of Arkansas River shiner. Final Report. Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe, NM.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. *The fishes of New Mexico*. The University of New Mexico Press, Albuquerque, NM.
- U.S. Fish and Wildlife Service. 1998. Endangered and threatened wildlife and plants: Final rule to list the Arkansas River basin population of the Arkansas River shiner (*Notropis girardi*) as threatened; Final rule. *Federal Register* 63:64772-64799.

Southern redbelly dace, *Phoxinus erythrogaster*

Distribution: Southern redbelly dace naturally occurs in the upper and middle Mississippi River drainage, Great Lakes drainages, and Ohio River drainage (Becker, 1983). Disjunct native populations also occur in Kansas (Cross

and Collins, 1975), Oklahoma (Miller and Robison, 1973), Arkansas (Robison and Buchanan, 1988), Colorado (Woodling, 1985), and New Mexico (Sublette et al., 1990). In New Mexico, the species occurs mainly in spring habitats associated with the upper Mora River, Coyote Creek, and tributaries to Black Lake (Sublette et al., 1990). The species prefers spring-fed systems with dense aquatic vegetation and clear water (Pfleiger, 1971). Within its limited New Mexico range, it is common in suitable habitats.

Current status: Southern redbelly dace was listed as state endangered in New Mexico in 1975. Populations within its historic New Mexico range appear to be stable; however, no systematic surveys to accurately characterize its status have been recently accomplished. Surveys completed during 2001 found the species persisting in portions of Coyote Creek, but absent from the Mora River near the Village of Mora (S.P. Platania, UNM, pers. comm.)

Threats: Excessive grazing probably impacted historic range of this species. Currently, modification of spring systems for water development and introduction of nonnative predators, particularly brown trout (*Salmo trutta*), are the primary threats to southern redbelly dace in New Mexico.

Recommendation: No change in listing is recommended. Recently initiated studies to characterize status of fishes in the South Canadian River drainage will provide an accurate and updated assessment of the status of southern redbelly dace in New Mexico. In addition, a New Mexico Share with Wildlife funded study to characterize the life history of southern redbelly dace was recently initiated. The potential for NMDGF to purchase habitats occupied by southern redbelly dace in Mora River valley should be explored, and if available, purchased. Strict regulations regarding use of bait fishes should be adopted and implemented in the Canadian River basin.

Literature Cited:

- Becker, G.C. 1983. Fishes of Wisconsin. The University of Wisconsin Press, Madison, WI.
- Cross, F.B. and J.T. Collins. 1975. Fishes in Kansas. Public Education Series No. 3, The University of Kansas Museum of Natural History, Lawrence, KS.
- Miller, R.J. and H.W. Robison. 1973. The fishes of Oklahoma. Oklahoma State University Press, Stillwater, OK.
- Pfleiger, W.L. 1975. The fishes of Missouri. Missouri Department of Conservation, Jefferson City, MO.
- Robison, H.W. and T.M. Buchanan. 1988. Fishes of Arkansas. The University of Arkansas Press, Fayetteville, AR.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.
- Woodling, J. 1985. Colorado's little fish: A guide to the minnows and other lesser known fishes in the State of Colorado. Colorado Division of Wildlife, Denver, CO.

Colorado pikeminnow, *Ptychocheilus lucius*

Distribution: Colorado pikeminnow formerly inhabited the Colorado River system from its mouth in Baja California upstream to Wyoming (Minckley et al., 1986; Mueller and Marsh, 2002). Seasonal migrations of the species have been documented (Tyus and McAda, 1984). A large-bodied fish, growing to lengths greater than 1.5 m, it was the largest native predator in the system. Historically, it was moderately common to abundant in much of the Colorado River system (Minckley, 1973). In New Mexico, its native range included at least the San Juan River (Koster, 1960; Platania et al., 1991) and perhaps the Gila River (LaBounty and Minckley, 1972).

Current Status: Colorado pikeminnow was listed state listed as endangered in New Mexico in 1975 and as endangered by U.S. Fish and Wildlife Service in 1967. The Navajo Nation lists Colorado pikeminnow as endangered, group 2 (Mikesic et al., 2005). Currently, Colorado pikeminnow persists mainly in the Green River in Utah (Holden and Stalnaker, 1975), and Yampa, Gunnison, and Colorado rivers in Colorado (Tyus and Karp, 1989; Osmundson and Kaeting, 1989). A small population of the species persists in the San Juan River in New Mexico and Utah (Platania et al., 1991). In 1996 through 1999, age-0 Colorado pikeminnow were stocked in the San Juan River; survival of individuals from these stockings for several months was documented (Trammell, 2000). After a 2 year hiatus, stocking of age-0 Colorado pikeminnow resumed in 2002, and has continued through 2005. Individuals from these stockings survived at least 1 year (Golden and Holden, 2005), but it is uncertain that they will recruit to the adult population. A recovery plan for the species has been approved (USFWS, 1991) and recovery efforts in the San Juan River are accomplished under the auspices of the San Juan River Basin Recovery

Implementation Program (SJRRIP). The common name of the species was recently changed from Colorado squawfish to Colorado pikeminnow (Nelson, et al., 1998).

Threats: Fragmentation of range, water depletion, modification of natural flows, contaminants, competition and predation by nonnative fishes, and loss of prey base are the primary threats to Colorado pikeminnow.

Recommendations: No change in listing status is recommended. NMDGF should continue to work through the SJRRIP to support and implement actions to recover Colorado pikeminnow. Efforts to remove or suppress nonnative fish populations in the San Juan River drainage, focusing on those that prey upon Colorado pikeminnow, should continue. Augmentation of San Juan River Colorado pikeminnow population should continue. Because it was likely an important prey of Colorado pikeminnow, efforts to restore roundtail chub to San Juan River should be undertaken. Studies to determine reasons for low survivorship of stocked Colorado pikeminnow should be undertaken. Strict regulations regarding use of bait fishes should be adopted and implemented in the San Juan River basin.

Literature Cited:

- Golden, M.E. and P.B. Holden. 2005. Retention, growth, and habitat use of stocked Colorado pikeminnow in the San Juan River: 2003-2004 annual report. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Holden, P.B. and C.B. Stalnaker. 1975. Distribution and abundance of mainstream fishes of the Middle and Upper Colorado River basins, 1967-1973. *Transactions of the American Fisheries Society* 104:217-231.
- Koster, W.J. 1960. *Ptychocheilus lucius* (Cyprinidae) in the San Juan River, New Mexico. *The Southwestern Naturalist* 5:174-175.
- LaBounty, J.F. and W.L. Minckley. 1972. Native fishes of the upper Gila River system, New Mexico. pp. 134-146. *In* Symposium on rare and endangered wildlife of the southwestern United States. New Mexico Department of Game and Fish, Santa Fe, NM.
- Minckley, W.L. 1973. *Fishes of Arizona*. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W.L., D.A. Hendrickson, and C.E. Bond. 1986. Geography of western American freshwater fishes: Description and relationships to intracontinental tectonism. Pp. 519-613. *In* C.H. Hocutt and E.O. Wiley (eds.). *Zoogeography of North American freshwater fishes*. John Wiley & Sons, New York, NY.
- Nelson, J.S., E. J. Crossman, H. Espinoza-Perez, C.R. Gilbert, N.N. Lea, and J.D Williams. 1998. Recommended changes in common fish names. *Fisheries* 23:37.
- Osmundson, D.B. and L.R. Kaeting. 1989. Studies of Colorado squawfish and razorback Sucker use of the "15 mile reach" of the upper Colorado River as part of conservation measures for the Green Mountain and Ruedi Reservoir watersheds. Colorado River Fishery Project, U.S. Fish and Wildlife Service, Grand Junction, CO.
- Platania, S.P., K.R. Bestgen, M.A. Moretti, D.L. Propst, and J.E. Brooks. 1991. Status of Colorado squawfish and razorback sucker in the San Juan River, New Mexico and Utah. *The Southwestern Naturalist* 36:147-150.
- Trammell, M. 2000. Evaluation of reintroduction of young of year Colorado pikeminnow in the San Juan River: 1999 annual report. San Juan River Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, NM.
- Tyus, H.M. and C.A. Karp. 1989. Habitat use and streamflow needs of rare and endangered fishes, Yampa River, Colorado. U.S. Fish and Wildlife Service Biological Report 89:1-27.
- Tyus, H.M. and C.W. McAda. 1984. Migration, movement, and habitat preferences of Colorado squawfish, *Ptychocheilus lucius* (Cyprinidae) in the Green, White, and Yampa rivers, Colorado and Utah. *The Southwestern Naturalist* 29:289-299.
- U.S. Fish and U.S. Fish and Wildlife Service. 1991. Colorado squawfish recovery plan. U.S. Fish and Wildlife Service, Denver, CO.

(Zuni) bluehead sucker, *Catostomus discobolus yarrowi*

Distribution: Zuni bluehead sucker historically inhabited headwater streams of the Little Colorado River in east-central Arizona and west-central New Mexico (Smith et al., 1983; Crabtree and Buth, 1987). The species most frequently occurs in streams reaches with cobble and bedrock substrates with slow to moderate velocity water (Propst et al., 2001).

Current Status: Zuni bluehead sucker was state listed as endangered in New Mexico in 1975. A state-sponsored recovery for the species was approved by New Mexico State Game Commission in December 2004 (Carman, 2004). Currently, the species is limited to the upper reaches of the Río Nutria drainage, a headwater tributary of the Zuni River in New Mexico (Hanson, 1980; Propst et al., 2001). Its status in Arizona is unknown (K. Young, AZGFD pers. comm.). Poor watershed management (mainly excessive grazing, timber harvest, and road construction) and introduction of several nonnative piscivorous fish species (e.g., green sunfish, *Lepomis cyanellus*, and northern pike, *Esox lucius*) are the primary reasons for its decline and imperiled status. During the 1960s, piscicides were applied to streams of the upper Zuni River drainage in an effort to enhance establishment of nonnative rainbow trout (*Oncorhynchus mykiss*). These activities also diminished Zuni bluehead sucker distribution and abundance.

Threats: Habitat degradation, mainly excessive siltation of streams, is the primary threat to the species. Nonnative predators, such as green sunfish (*Lepomis cyanellus*) also limit opportunities to expand the range and abundance of Zuni bluehead sucker. The presence and increasing abundance of crayfish might reduce habitat suitability for Zuni bluehead sucker.

Recommendations: No change in listing status is recommended. A Zuni Bluehead Sucker Conservation and Recovery Plan, per guidelines of New Mexico Wildlife Conservation Act, has been developed with participation of various stakeholders (e.g., Pueblo of Zuni, U.S. Forest Service, The Nature Conservancy, and private landowners). Efforts should be made to improve Zuni River watershed conditions (primarily to reduce sediment introduction to streams), and to provide long-term security for Zuni bluehead sucker habitats. The effects of groundwater pumping on surface flows in Zuni River drainage need elucidation. Nonnative fishes, particularly green sunfish, should be removed from historical Zuni bluehead sucker habitats. Monitoring of extant populations should continue.

Literature Cited:

- Carman, S.M. 2004. Zuni bluehead sucker (*Catostomus discobolus yarrowi*) recovery plan. Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe.
- Crabtree, C.B. and D.G. Buth. 1987. Biochemical systematics of the catostomid genus *Catostomus*: an assessment of *C. clarki*, *C. plebeius*, and *C. discobolus* including the Zuni sucker, *C.d. yarrowi*. Copeia 1987:843-854.
- Hanson, B. 1980. Fish survey of the streams in the Zuni River drainage, New Mexico. U.S. Fish and Wildlife Service, Albuquerque, NM.
- Propst, D.L., A.L. Hobbes, and T.L. Stroh. 2001. Distribution and notes on the biology of Zuni bluehead sucker, *Catostomus discobolus yarrowi*, in New Mexico. The Southwestern Naturalist 46:158-170.
- Smith G.R., J.G. Hall, R.K. Koehn, and D.J. Innes. 1983. Taxonomic relationships of the Zuni Mountain sucker, *Catostomus discobolus yarrowi*. Copeia 1983:37-48.

Blue sucker, *Cycleptus elongatus*

Distribution: The blue sucker occurs in larger rivers throughout much of the Mississippi-Missouri River and Gulf Coastal drainages (Gilbert, 1980). The historical range of the species in New Mexico was the Pecos River from just north of Carlsbad downstream to the New Mexico/Texas border and the lower reaches of the Black River (Sublette et al., 1990). Archaeological evidence suggests that the species also occupied the Rio Grande in New Mexico (Gehlbach and Miller, 1961), but no specimens exist to confirm its existence there. Blue sucker is most common in streams with moderately fast flowing water and deep pools (Moss et al., 1983).

Current Status: The blue sucker was state listed as endangered in New Mexico in 1976. Blue sucker has declined throughout much of its native range (Moss et al., 1983). In New Mexico, it was regularly found in the Pecos River only between Brantley Dam and Avalon Reservoir, a 15 km river reach (J.E. Brooks, USFWS, pers. comm.). It is rarely found in the Black River and the Pecos River downstream of Avalon Dam. Burr and Mayden (1999) provided evidence that the form of *Cycleptus* inhabiting the Rio Grande drainage (including Pecos River) warranted recognition as a species but did not formally describe it.

Threats: Range fragmentation by dams, loss of high water velocity habitats, contaminants, and stranding in canals are the primary threats to the species in New Mexico. Recently, outbreaks of golden algae have killed blue suckers in the Brantley Dam to Avalon Reservoir reach of the Pecos River (Larson, 2004).

Recommendations: No change in listing status is recommended. Permanent flows in Pecos River between Brantley Dam and Avalon reservoir should be maintained. The causes of golden algae blooms in lower Pecos River system need to be determined and efforts made to preclude such conditions from occurring in the future. The taxonomic relationship of Pecos River blue sucker with congeners needs elucidation. Following cessation of irrigation releases, blue suckers in canals of Carlsbad Irrigation District should be rescued and stocked in Black River or Pecos River between Brantley Dam and Avalon Reservoir.

Literature Cited:

- Burr, B.M. and R.L. Mayden, 1999. A new species of *Cycleptus* (Cypriniformes: Catostomidae) from Gulf Slope drainages of Alabama, Mississippi, and Louisiana, with a review of the distribution, biology, and conservation status of the genus. *Bulletin of the Alabama Museum of Natural History* 20:19-57.
- Gelbach, F.R. and R.R. Miller, 1961. Fishes from archaeological sites in northern New Mexico. *The Southwestern Naturalist* 9:2-8.
- Gilbert, C.R. 1980. *Cycleptus elongatus* (Lesueur), blue sucker. P. 396. In D.S. Lee, C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer, Jr. (eds.). *Atlas of North American freshwater fishes*. North Carolina Museum of Natural History, Raleigh, NC.
- Larson, R.D. 2004. Ecology of blue sucker and gray redbone in the lower Pecos River, New Mexico. Performance Report (E-46-4). Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe.
- Moss, R.E., J.W. Scanlan, and C.S. Anderson. 1983. Observations on the natural history of the blue sucker (*Cycleptus elongatus*) in the Neosho River. *American Midland Naturalist* 109:15-22.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. *The fishes of New Mexico*. The University of New Mexico Press, Albuquerque, NM.

Pecos gambusia, *Gambusia nobilis*

Distribution: Pecos gambusia is endemic to springs and spring systems of the Pecos River valley of southeast New Mexico and Trans-Pecos Texas (Hubbs and Springer, 1957). Springs and gypsum sinkholes on Bitter Lake National Wildlife Refuge and Blue Spring and its outflow are the only documented areas of historical occurrence in New Mexico (Bednarz, 1979; Echelle and Echelle, 1980). Pecos gambusia occurs almost exclusively in springs and spring-run habitats with lithic or vegetative cover (Echelle et al., 1989).

Current Status: Pecos gambusia was federally listed as endangered in 1970. It was state listed as endangered in New Mexico in 1975. A recovery plan for the species was finalized in 1983 (USFWS, 1983). The range of Pecos gambusia has diminished in Texas (Echelle and Echelle, 1980), but it still occupies its historical New Mexico range.

Threats: Groundwater mining, habitat modification by excessive grazing or spring run dredging, and nonnative predators present the greatest threats to Pecos gambusia.

Recommendations: No change in listing status is recommended. Rattlesnake Springs on Carlsbad Caverns National Park lands should be considered for stocking with Pecos gambusia.

Literature Cited:

- Bednarz, J. 1979. Ecology and status of the Pecos gambusia, *Gambusia nobilis* (Poeciliidae), in New Mexico. *The Southwestern Naturalist* 24:311-322.
- Echelle, A.A. and A.F. Echelle. 1980. Status of the Pecos gambusia (*Gambusia nobilis*). *Endangered Species Report* No. 10, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Echelle, A.A., A.F. Echelle, and D.R. Edds. 1989. Conservation genetics of a spring-dwelling desert fish, the Pecos gambusia (*Gambusia nobilis*, Poeciliidae). *Conservation Biology* 3:159-169.
- Hubbs, C. and V.G. Springer. 1957. A revision of the *G. nobilis* species group, with descriptions of three new species and notes on their variation, ecology, and evolution. *The Texas Journal of Science* 9:279-327.
- USFWS. 1983. *Recovery Plan for Pecos Gambusia (Gambusia nobilis)*. U.S. Fish and Wildlife Service, Region 2, Albuquerque, NM.

THREATENED

Gila trout, *Oncorhynchus gilae*

Distribution: Historically, Gila trout inhabited cool and coldwater reaches of the Gila (including the San Francisco River) and Verde river drainages in southwest New Mexico and eastern and central Arizona (Miller, 1950; Minckley, 1973, Behnke, 1992). In New Mexico, Gila trout formerly occurred in the Gila River from its confluence with Mogollon Creek upstream through its headwaters and in tributaries of the San Francisco River (Propst et al., 1992). Although Gila trout historically inhabited a variety of stream habitats, it now occurs mainly in small headwater streams (Propst et al., 1992); in such streams availability of pool habitat appears to be critical to abundance (Rinne and Medina, 1988; Propst and Stefferud, 1997).

Current Status: Gila trout was listed as endangered by U.S. Fish and Wildlife Service in 1967 and has been proposed for downlisting to threatened. In New Mexico, Gila trout were state listed as endangered in 1975 and downlisted it to threatened in 1988. The Gila Trout Recovery Plan was recently revised (USFWS 2003) and provides detail on what must be accomplished for its downlisting from federally endangered to threatened. The revised plan also specifies what must be accomplished for its federal delisting. Gila trout occupies about 3 km of its historical Arizona range and currently occurs in about 90 km of mainly small headwater habitats in New Mexico. Renovation of upper West Fork Gila River will, when completed, increase occupied habitat by about 22 stream km. Abundance in occupied habitats is variable, ranging from less than 100 adults in the smallest to 2,000 or 3,000 adults in the largest (Propst and Stefferud, 1997). Contamination of extant populations by nonnative rainbow trout and elimination of populations by wildfires reduced wild populations of Gila trout substantially between 1989 and 2004. Maintenance of wild populations requires concerted efforts by cooperating agencies.

Threats: Contamination of extant populations by nonnative rainbow and brown trouts, wildfire, and habitat degradation are the primary threats to the species.

Recommendations: No change in listing status is recommended. Cooperative efforts with Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and U.S. Forest Service to restore species to its historical range should continue. In particular, removal of nonnative trout from upper West Fork Gila River drainage should be completed and removal of nonnative salmonids from West Fork Mogollon Creek, and Rain Creek in New Mexico, and suitable streams in Blue River drainage in Arizona should be initiated. As soon as nonnative trout are fully removed from each renovated stream, Gila trout of appropriate lineage should be repatriated. Because of limited distribution and abundance, all reasonable efforts should be undertaken to protect extant Gila trout populations from effects of wildfire and fire-induced ash flows. Stocking of nonnative salmonids in historical range of Gila trout should cease. Once appropriate provisions are in place (i.e., Endangered Species Act section 4(d) rule), opportunities for controlled angling of Gila trout should be implemented.

Literature Cited:

- Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. American Fisheries Society, Bethesda, MD.
- Miller, R.R. 1950. Notes on the cutthroat and rainbow trouts with the description of a new species from the Gila River, New Mexico. Occasional Papers of the Museum of Zoology, University of Michigan 529:1-42.
- Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Propst, D.L. and J.A. Stefferud. 1997. Population dynamics of Gila trout in the Gila River drainage of the south-western United States. Journal of Fish Biology 51:1137-1154.
- Propst, D.L., J.A. Stefferud, and P.R. Turner. 1992. Conservation and status of Gila trout, *Oncorhynchus gilae*. The Southwestern Naturalist 37:117-125.
- Rinne, J.N. and A.L. Medina. 1988. Factors influencing salmonid populations in six headwater streams, central Arizona, USA. Polskie Archiwum Hydrobiologii 35:515-532.
- U.S. Fish and Wildlife Service. 2003. Gila (*Oncorhynchus gilae*) Trout Recovery Plan (third revision). Albuquerque, NM.

Mexican tetra, *Astyanax mexicanus*

Distribution: The native range of Mexican tetra extends from Gulf Coastal drainages of eastern and central Mexico northward to the Nueces River of Texas (Birkhead, 1980). It occurs in the Rio Grande from its mouth upstream to the Big Bend region and in the Pecos River upstream to near Santa Rosa (Koster, 1957). Mexican tetra tends to be more common in low-velocity pool habitats in small streams and spring systems.

Current Status: Mexican tetra was state listed as threatened in New Mexico in 1976. The New Mexico range of Mexican tetra is limited mainly to small streams and spring systems from about Bitter Lake National Wildlife Refuge downstream in the Pecos River drainage. It is rare in mainstream Pecos River habitats, but is locally common in small streams (Cottonwood Creek and Delaware River) and off-channel habitats such as Blue Spring (C.W. Hoagstrom, pers. comm; NMDGF files).

Threats: Loss of habitat by groundwater mining and diversion of flows from small streams appear to be the main threats to the species in New Mexico.

Recommendations: No change in listing status is recommended. Surveys to document the current distribution and status of the species in New Mexico should be undertaken. Strict regulations regarding use of bait fishes should be adopted and implemented for the entire Pecos River drainage.

Literature Cited:

- Birkhead, W.S. 1980. *Astyanax mexicanus*, Mexican tetra (Filippi). P. 139. In D.S. Lee, C. R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer, Jr. (eds.). Atlas of North American freshwater fishes. North Carolina State Museum of Natural History, Raleigh, NC.
- Koster, W.J. 1957. Guide to the fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.

Peppered chub (formerly Arkansas River speckled chub), *Macrhybopsis tetranema*

Distribution: The Arkansas River speckled chub is native to the Arkansas River drainage of New Mexico, Colorado, Kansas, Oklahoma, Texas, and Arkansas (Wallace, 1980). In New Mexico, it historically occurred in the South Canadian River drainage downstream of the confluence of Ute Creek and in Ute Creek (Sublette et al., 1990; Pittenger and Schiffmiller, 1997). The species is found mainly in shallow, permanently flowing plains streams where the bottom is clean sand and small gravel (Miller and Robison, 1973). It is found most frequently in moderate-velocity habitats and apparently avoids areas with low to zero water velocity (Cross and Collins, 1975).

Current Status: In New Mexico, Arkansas River speckled chub was state listed as threatened in 1978. Arkansas River speckled chub has disappeared from about 90% of its historical range (Luttrell, et al. 1999). It no longer occurs in Colorado (Luttrell et al., 1993) or Arkansas (Robison and Buchanan, 1988) and its range in Kansas has contracted considerably (Cross et al., 1985). In Oklahoma, it is now limited mainly to the north-central portion of the state (Luttrell et al., 1993). The New Mexico range of Arkansas speckled chub is now restricted to the South Canadian River downstream of Ute Dam. Within this reach it was moderately common in the early 1990s, but no recent surveys have been conducted to accurately characterize its New Mexico status. A recently initiated multi-year survey of the South Canadian River drainage will clarify the current status of the species within its New Mexico range. The *Macrhybopsis aestivalis* complex is comprised of six nominal species. In a recent review of the systematics of the complex, Arkansas River speckled chub was elevated to species, *Macrhybopsis tetranema* (Eisenhour, 1999). The American Fisheries Society recognizes the genus as *Macrhybopsis* (Nelson et al., 2004), but Sublette et al. (1990) use *Extrarius* as the generic epithet. With its elevation to species, the common name of the Arkansas River form of *Macrhybopsis* was changed to “peppered chub” (Nelson et al., 2004).

Threats: Habitat loss through water diversion, groundwater pumping, and regulated reservoir releases are the primary threats to the Arkansas River speckled chub.

Recommendations: No change in listing status is recommended. It is recommended, however, that the common name of *Macrhybopsis tetranema* be formally changed to “peppered chub.” Systematic inventories of South Canadian River drainage should be completed to accurately document distribution and status of Arkansas River

speckled chub. Permanent flows in South Canadian River downstream of Ute Dam should be maintained, and these flows should minimally mimic a natural hydrograph. Efforts should be made to restore the species to its historical range upstream of Ute Reservoir. Strict regulations regarding use of bait fishes should be adopted and implemented in the Canadian River basin.

Literature Cited:

- Cross, F.B. and J.T. Collins. 1975. Fishes in Kansas. Public Education Series No. 3, The University of Kansas Museum of Natural History, Lawrence, KS.
- Cross, F.B., R.E. Moss, and J.T. Collins. 1985. Assessment of dewatering impacts on stream fisheries in the Arkansas and Cimarron rivers. University of Kansas Museum of Natural History, Lawrence, KS.
- Eisenhour, D.J. 1999. Systematics of *Macrhybopsis tetranema* (Cypriniformes: Cyprinidae). *Copeia* 1999:969-980.
- Luttrell, G.R., A.A. Echelle, and A.V. Zale. 1993. Status of the speckled chub in the Arkansas River basin. Oklahoma Department of Wildlife Conservation, Oklahoma City, OK.
- Luttrell, G.R., A.A. Echelle, W.L. Fisher, and D. J. Eisenhour. 1999. Declining status of two species of the *Macrhybopsis aestivalis* complex (Teleostei: Cyprinidae) in the Arkansas River basin and related effects of reservoirs as barriers to dispersal. *Copeia* 1999:981-989.
- Miller, R.J. and H.W. Robison. 1973. The fishes of Oklahoma. Oklahoma State University Press, Stillwater, OK.
- Nelson, J.S., E.J. Crossman, H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, and J.D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society Special Publication 29, Bethesda, MD.
- Pittenger, J.S. and G. Schiffmiller. 1997. Ichthyofaunal decline in Ute Creek, South Canadian River drainage, New Mexico. *The Southwestern Naturalist* 42:112-117.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. Special Publication 20, American Fisheries Society, Bethesda, MD.
- Robison, H.W. and T.M. Buchanan. 1988. Fishes of Arkansas. The University of Arkansas Press, Fayetteville, AR.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.
- Wallace, R.K. 1980. *Hybopsis aestivalis* (Girard), speckled chub. P. 180. In D.S. Lee, C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer, Jr. (eds.). Atlas of North American freshwater fishes. North Carolina State Museum of Natural History, Raleigh, NC.

Spikedace, *Meda fulgida*

Distribution: The spikedace is endemic to the Gila River drainage of southwest New Mexico, southeast and central Arizona, and perhaps northern-most Sonora (Koster, 1957; Minckley, 1973; Miller and Winn, 1951). It was found in low- to moderate-gradient warmwater streams in shallow runs with moderate velocity water over sand and small gravel substrates (Minckley, 1973; Propst et al., 1986). In preferred habitats, it is occasionally found in large aggregations.

Current Status: Spikedace was federally listed as threatened in 1986. In New Mexico, it was state listed as a threatened species in 1975. A federal recovery plan for spikedace was finalized in 1991. Spikedace has been eliminated from most (>90%) of its historical Arizona range and persists there only in Aravaipa Creek (Minckley, 1973; Barber and Minckley, 1966). No spikedace specimen has been found in Eagle Creek since the late 1980s (Marsh et al., 1990). It has not been found in the upper Verde River for at least 5 years (Rinne, 1999; M. Richardson, USFWS, Phoenix, AZ, pers. comm.). In New Mexico, spikedace has been eliminated from the San Francisco River drainage (Anderson, 1978; Propst et al., 1986). The range of the species in the Gila River drainage in New Mexico is fragmented; it is currently found mainly in the Cliff-Gila Valley reach of the Gila River and lowermost reaches of West Fork Gila River. In both the Cliff-Gila Valley reach and lower West Fork Gila River, however, its abundance during the past 4-5 years is 25% of what it was from the late 1980s through the mid 1990s (Paroz et al. 2006; NMDGF files). It has not been found in East Fork Gila River since 2000 (Paroz et al. 2006; NMDGF files). Apparently it has been eliminated from Middle Fork Gila River (last collected in 1995), likely a consequence of predation by nonnative yellow bullhead, *Ameiurus natalis*, and smallmouth bass, *Micropterus dolomieu*. Spikedace is frequently found near the mouth of the Middle Box upstream of Redrock (Propst et al.,

1986; Paroz et al., 2006). Overall, the status of spikedace in New Mexico has declined markedly, both in range and abundance, in the past 6 to 8 years.

Threats: Dewatering of riverine habitats, ash and sediment flows associated with wildfires, modification of occupied habitats (channelization and removal of woody debris), and nonnative predators are the primary threats to the species. Range fragmentation (by artificial barriers and stream desiccation) limits the ability of the species to repopulate areas adversely modified by human activity. Drought for the past 10 years has exacerbated intensity of aforementioned human-caused threats.

Recommendations: Uplisting of spikedace to endangered under the WCA is recommended. The recently completed compilation and synthesis of data from long-term monitoring sites in the Gila San Francisco River drainage (Paroz et al., 2006) documents the rapid and substantial decline of spikedace in past 6 to 8 years. A natural flow regime in Gila River should be maintained; additional depletions or diversion of the Gila River within occupied or potential spikedace habitats should not occur. Removal of nonnative fishes, particularly predators, should be conducted within currently occupied and potential habitats of spikedace. Stocking of nonnative fishes should not occur in Gila River drainage. Spikedace should be restored to San Francisco River. Cooperative efforts with the Arizona Game and Fish Department, as well as several federal agencies, to conserve spikedace should continue. Recently adopted bait fish regulations should be strictly enforced.

Literature Cited:

- Anderson, R.M. 1978. The distribution and aspects of life history of *Meda fulgida* in New Mexico. Unpubl. MS thesis, New Mexico State University, Las Cruces, NM.
- Barber, W.E. and W.L. Minckley. 1966. Fishes of Aravaipa Creek, Graham and Pinal counties, Arizona. The Southwestern Naturalist 11:313-324.
- Koster, W.J. 1957. Guide to the fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.
- Marsh, P.C., J.E. Brooks, D.A. Hendrickson, and W.L. Minckley. 1990. Fishes of Eagle Creek, Arizona, with records for threatened spikedace and loach minnow (Cyprinidae). Journal of the Arizona-Nevada Academy of Science 23: 107-116.
- Miller, R.R. and W.E. Winn. 1951. Additions to the known fish fauna of Mexico: three species and one subspecies from Sonora. Journal of the Washington Academy of Science 41:83-84.
- Minckley, W.L. 1973. The fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Paroz, Y.M., D.L. Propst, and J.A. Stefferud. 2006. Long-term monitoring of fish assemblages in the Gila River drainage, New Mexico. New Mexico Department of Game and Fish, Santa Fe.
- Propst, D.L., K.R. Bestgen, and C.W. Painter. 1986. Distribution, status, biology, and conservation of the spikedace (*Meda fulgida*) in New Mexico. Endangered Species Report No. 15, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Rinne, J.N. 1999. The status of spikedace (*Meda fulgida*) in the Verde River, 1999: Implications for management and research. Hydrology and Water Resources of Arizona
- U.S. Fish and Wildlife Service. 2000. Endangered and threatened wildlife and plants; final designation of critical habitat for the spikedace and the loach minnow; final rule. Federal Register 65:24327-24372.

Pecos bluntnose shiner, *Notropis simus pecosensis*

Distribution: Pecos bluntnose shiner formerly inhabited the Pecos River from near Santa Rosa downstream to Major Johnson Springs near Carlsbad (Hatch et al., 1985). Its historic occurrence in the Texas portion of the Pecos River is doubtful (Platania, 1995). The species mainly occupies shallow runs with moderate-velocity water over sand and small gravel substrates (Hoagstrom, 2002).

Current Status: Pecos bluntnose shiner was federally listed as threatened in 1987. It was state listed as threatened in New Mexico in 1976. The species has an approved recovery plan (USFWS 1992). Currently, Pecos bluntnose shiner is found in the Pecos River from near Old Fort State Park (near Fort Sumner) downstream to the inflow area of Brantley Reservoir near Carlsbad (Brooks et al., 1991). Within this river reach, the fish tends to be most common upstream of Roswell (Hoagstrom, 2003). Systematic monitoring efforts indicate diminishing numbers beginning in 2002, associated with drought and dessication of the Pecos River upstream of Roswell. A recent report to the U.S. Army Corps of Engineers showed Pecos bluntnose shiner within one study area with a population index (CPUE:

catch per unit effort for 100 m² sampled) of >40 fish during the first sampling period of 2002, and >30 fish in the third (last) sampling period of 2002. By 2004, the CPUE had dropped to <5 fish for both the first and third sampling periods. Despite ongoing recovery efforts, abundance has now declined to historically low levels (Davenport 2006). Although results of monitoring efforts have been questioned by some entities, and independent review of fish population data collected since 1992 confirmed that the precipitous decline since 2002 reported by NMDGF and USFWS was real and not an artifact of sampling vagaries (Fagan, 2005).

Threats: Primary threats to Pecos bluntnose shiner include large volume, extended block releases from reservoirs during the summer reproductive season, seasonal dewatering, artificially depressed river flows, channelization, diminished habitat diversity, non-point pollution from agricultural sources, and range fragmentation. Displacement of eggs and larvae into unsuitable habitats by extended large volume reservoir releases was questioned by Kehmeier et al. (2004), but their study used artificial eggs that decomposed too rapidly for accurate estimation of total displacement. The generally accepted study on effects of reservoir releases on egg and larva displacement is that of Platania and Dudley (1998), which documented that large volume reservoir releases during summer spawning season displaced large numbers of artificial eggs and larvae into unsuitable habitats. Drought conditions are currently forecast to persist (Agency Technical Workgroup 2005; National Weather Service 2006), threatening to exacerbate stress from habitat constriction. Although the lower habitat reach (downstream of Roswell) experiences relatively better flow during dry periods, it appears to support an unbalanced age structure with few individuals in larger, adult size classes (Hoagstrom 2002).

Recommendations: Based on the precipitous decline in abundance and anticipated increased threats to habitat due to drought and other factors (mainly river drying), uplisting to endangered status is recommended. Multi-agency efforts to manage flows in the Pecos River to meet irrigation needs without imperiling surviving populations of Pecos bluntnose shiner should incorporate restoration or mimicry of natural flows. Permanent surface flows should be maintained throughout currently occupied range of Pecos bluntnose shiner, and additional water acquisition options should be identified. Short-term, emergency actions such as rescue, salvage, and re-release of fish to the river following drying events should be considered to prevent extirpation of the species in the wild. Efforts to restore the river channel downstream of Artesia to a more natural configuration should be initiated. The potential to restore Pecos bluntnose shiner to formerly occupied habitat in the Pecos River upstream of Sumner Reservoir should be investigated. Strict enforcement of bait fish regulations should be followed throughout the Pecos River drainage.

Literature Cited:

- Agency Technical Workgroup. 2005. Potential effects of climate change on New Mexico. State of New Mexico.
- Brooks, J.E., S.P. Platania, and D.L. Propst. 1991. Effects of Pecos River reservoir operation on the distribution and status of Pecos bluntnose shiner (*Notropis simus pecosensis*): Preliminary finding. U.S. Bureau of Reclamation, Salt Lake City, UT and U.S. Fish and Wildlife Service, Albuquerque, NM.
- Davenport, S.R. 2006. Pecos bluntnose shiner status and trends report, Pecos River, New Mexico, October 2002 through August 2004. Report to U.S. Army Corps of Engineers (Albuquerque), U.S. Fish and Wildlife Service, New Mexico Fishery Resources Office, Albuquerque, NM.
- Hatch, MD., W.H. Baltosser, and C.G. Schmitt. 1985. Life history and ecology of the bluntnose shiner (*Notropis simus pecosensis*) in the Pecos River, New Mexico. *The Southwestern Naturalist* 30:555-562.
- Fagan, W.F. 2005. Peer review of Pecos bluntnose shiner database and sampling protocol. Final report submitted to U.S. Fish and Wildlife Service, Albuquerque, NM.
- Hoagstrom, C.W. 2002. Pecos bluntnose shiner depth and velocity preference, Pecos River, NM, 1992 to 1999. U.S. Fish and Wildlife Service, NM Fisheries Resource Office, Albuquerque, NM.
- Hoagstrom, C.W. 2003. Pecos bluntnose shiner population dynamics, Pecos River, New Mexico, February 2002 through August 2002. Final Report submitted to U.S. Bureau of Reclamation (Albuquerque). U.S. Fish and Wildlife Service, Albuquerque, NM.
- Kehmeier, J.W., C.N. Medley, and O.B. Myers. 2004. Assessment of Pecos bluntnose shiner egg and larval drift potential in the Pecos River. New Mexico Interstate Stream Commission, Santa Fe, NM.
- National Weather Service. 2006. Seasonal outlooks. http://www.cpc.ncep.noaa.gov/products/predictions/long_range (accessed 2/20/2006).
- Platania, S.P. 1995. Distribution, relative abundance, and conservation status of Pecos bluntnose shiner, *Notropis simus pecosensis*. New Mexico Department of Game and Fish, Santa Fe, NM.

- Platania, S.P., and R.K. Dudley. 1998. Downstream transport rates of drifting semibuoyant cyprinid eggs and larvae in the Pecos River, New Mexico. Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM.
- U.S. Fish and Wildlife Service. 1992. Pecos bluntnose shiner recovery plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

Suckermouth minnow, *Phenacobius mirabilis*

Distribution: Suckermouth minnow occurs throughout much of the central and lower Mississippi River system, including the Missouri and Ohio river drainages (Becker, 1983) and rivers tributary to the Gulf of Mexico in Texas (Hubbs et al., 1991). In New Mexico, the native range of the species includes only the South Canadian and Dry Cimarron rivers (Sublette et al., 1990). It was introduced, probably via baitbucket, to the Pecos River near Fort Sumner (J.E. Brooks, USFWS, pers. comm.). Suckermouth minnow most commonly occupies shallow, moderate-velocity runs over sand and pea gravel bottoms (Minckley, 1959; Deacon, 1961).

Current Status: Suckermouth minnow was state listed as threatened in New Mexico in 1976. Although suckermouth minnow is apparently relatively common in the central portion of its range, it has declined considerably on the periphery of its range (Cross et al., 1985; T.P. Nesler, CDOW pers. comm.). In New Mexico, it is rare in the South Canadian River upstream of Conchas Reservoir and may be extirpated from the Dry Cimarron River. A recently initiated multi-year inventory of the South Canadian River drainage will provide more current information on its status in New Mexico. Surveys during 2005 found it moderately common in the Mills Canyon reach of the South Canadian River (W.H. Brandenburg, UNM-MSB, pers. comm.).

Threats: The primary threats to suckermouth minnow are probably excessive sedimentation of run habitats, habitat desiccation, and habitat fragmentation.

Recommendations: No change in listing status is recommended. Strict regulations regarding use of bait fishes should be adopted and implemented in the South Canadian River basin.

Literature Cited:

- Becker, G.C. 1983. Fishes of Wisconsin. The University of Wisconsin Press, Madison, WI.
- Cross, F.B., R.E. Moss, and J.T. Collins. 1985. Assessment of dewatering impacts on stream fisheries on the Arkansas and Cimarron rivers. University of Kansas Museum of Natural History, Lawrence, KS.
- Deacon, J.E. 1961. Fish populations following a drought, in the Neosho and Marias des Cygnes rivers of Kansas. University of Kansas Museum of Natural History Publications 13:359-427.
- Hubbs, C., R.J. Edwards, and G.P. Garrett. 1991. An annotated checklist of the freshwater fishes of Texas, with keys to identification of species. The Texas Journal of Science 43:1-56.
- Minckley, W.L. 1959. Fishes of the Big Blue River basin, Kansas. University of Kansas Museum of Natural History Publications 11:401-442.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.

Loach minnow, *Tiaroga cobitis*

Distribution: The loach minnow is endemic to the Gila River drainage of southwest New Mexico, southeast and east-central Arizona, and northeast Sonora (Miller and Winn, 1951; Koster, 1957; Minckley, 1973). In New Mexico, the minnow was historically found throughout warmwater reaches of the San Francisco and Gila rivers, and major tributaries of each (Koster, 1957; Propst et al., 1988). Loach minnow is found almost exclusively among cobble in riffle habitats where water velocity is rapid (Propst and Bestgen, 1991).

Current Status: Loach minnow was federally listed as threatened in 1986 and state listed as threatened in 1975. A federal recovery plan for the species was finalized in 1991. Loach minnow has been eliminated from Sonora and much of its historical range in Arizona (Minckley, 1973; Marsh et al., 1990; Rinne and Minckley, 1991). In New Mexico, its range in the Gila and San Francisco drainages is fragmented (Propst et al., 1988). Currently, it is

moderately common only in a short reach (<10 km) of the San Francisco River near Glenwood. Small populations in the Cliff-Gila Valley and upstream have declined in the past 10 years (NMDGF files). Loach minnow has not been found at a site on the Tularosa River, where it was formerly common, for 5 years. It has apparently been eliminated from Middle Fork Gila River (likely consequence of predation by nonnative yellow bullhead, *Ameiurus natalis*, and smallmouth bass, *Micropterus dolomieu*) and occurs irregularly in portions of East Fork Gila River.

Threats: Range fragmentation, stream desiccation, habitat degradation (channelization and sedimentation), and nonnative fishes (e.g., channel catfish, *Ictalurus punctatus*, yellow bullhead, *Ameiurus natalis*, and red shiner, *Cyprinella lutrensis*) are the primary threats to the species.

Recommendations: No change in listing status is recommended. A thorough systematic inventory of the historical range of the species in New Mexico is needed to better define its current status. A natural flow regime in Gila River (including San Francisco River) should be maintained; additional water depletions or diversions within occupied or potential loach minnow habitat should not be allowed. Nonnative fishes should be removed, or suppressed. No stocking of warmwater nonnative fishes in or near occupied habitats should occur. Cooperative efforts with the Arizona Game and Fish Department, as well as federal agencies, to conserve loach minnow should continue. Strict regulations regarding use of bait fishes should be adopted and implemented by NMDGF.

Literature Cited:

- Koster, W.J. 1957. Guide to the fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.
- Marsh, P.C., J.E. Brooks, D.A. Hendrickson, and W.L. Minckley. 1990. Fishes of Eagle Creek, Arizona, with records for threatened spikedace and loach minnow (Cyprinidae). *Journal of Arizona-Nevada Academy of Science* 23:107-116.
- Miller, R.R. and W.E. Winn. 1951. Additions to the known fish fauna of Mexico: Three species and one subspecies from Sonora. *Journal of the Washington Academy of Science* 41:83-84.
- Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Propst, D.L. and K.R. Bestgen. 1991. Habitat and biology of the loach minnow, *Tiaroga cobitis*, in New Mexico. *Copeia* 1991: 29-39.
- Propst, D.L., K.R. Bestgen, and C.W. Painter. 1988. Distribution, status, biology, and conservation of the loach minnow (*Tiaroga cobitis*) in New Mexico. *Endangered Species Report No. 17*, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Rinne, J.N. and W.L. Minckley. 1991. Native fishes of arid lands: A dwindling resource of the desert southwest. *USDA Forest Service General Technical Report RM-206*. U.S. Forest Service, Fort Collins, CO.
- U.S. Fish and Wildlife Service. 2000. *Endangered and threatened wildlife and plants; final designation of critical habitat for the spikedace and the loach minnow; final rule*. *Federal Register* 65:2437-24372.

Gray redhorse, *Moxostoma* (formerly *Scartomyzon*) *congestum*

Distribution: The historical range of gray redhorse included Gulf Coastal drainages of central and west Texas, the Pecos River, the Rio Grande in southern New Mexico and Texas, and Mexican tributaries to the Rio Grande (Jenkins, 1980). In New Mexico, it historically occurred in the Rio Grande downstream of Socorro and in the Pecos River (including the Black River) from about Roswell downstream to the Texas/New Mexico border (Sublette et al., 1990). In addition to riverine habitats, gray redhorse also occupies several lower Pecos River impoundments (e.g., Six Mile and Ten-Mile reservoirs). Gray redhorse is most commonly found in deep, slow-velocity water over a variety of substrates.

Current Status: Gray redhorse was state listed as threatened in New Mexico in 1976. Gray redhorse currently occurs only in the Pecos River downstream of Brantley Reservoir and lower reaches of the Black River in New Mexico (Cowley and Sublette, 1987, Sublette et al., 1990). It is not common in riverine habitats in New Mexico, but is moderately common in at least Six-Mile Reservoir. Recently The American Fisheries Society accepted the arguments of Harris and Mayden (2001) and resurrected *Moxostoma* as the genus nomen for gray redhorse (Nelson et al, 2004).

Threats: Range fragmentation (by dams), stream dewatering, modified flow regimes, and

contaminants are probably the primary threats to the species in New Mexico. Golden algae blooms in the lower Pecos killed gray redhorse, but effects on status of population are undetermined (Larson, 2004). The impact of introduced grass carp on the population of gray redhorse in Carlsbad Municipal Reservoir is unknown.

Recommendations: No change in listing status is recommended. Permanent flows in Pecos River between Brantley Dam and Avalon Reservoir should be maintained. Causes of golden algae blooms in lower Pecos River system should be determined, and measures to prevent, or limit, their outbreaks in future should be undertaken. Effects of water quality on recruitment and survival of gray redhorse in Six-mile, Ten-mile, and Black River confluence impoundments should be determined, and if deleterious constituents found, their effects ameliorated or eliminated.

Literature Cited:

- Cowley, D.E. and J.E. Sublette. 1987. Distribution of fishes in the Black River drainage, Eddy County, New Mexico. *The Southwestern Naturalist* 32:213-222.
- Harris, R.M., and R.L. Mayden. 2001. Phylogenetic relationships of major clades of Catostomidae (Teleostei: Cypriniformes) as inferred from mitochondrial SSU and rDNA sequences. *Molecular Phylogenetics and Evolution* 20: 225-237.
- Jenkins, R.E. 1980. *Moxostoma congestum*, gray redhorse (Baird and Girard). P. 418. In D.S. Lee, C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer, Jr. (eds.). *Atlas of North American freshwater fishes*. North Carolina State Museum of Natural History, Raleigh, NC.
- Larson, R.D. 2004. Ecology of blue sucker and gray redhorse in the lower Pecos River, New Mexico. Performance Report (E-46-4). Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe.
- Nelson, J.S., E.J. Crossman, H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, and J.D. Williams. 2004. *Common and Scientific Names of Fishes from the United States, Canada, and Mexico*. American Fisheries Society Special Publication 29, Bethesda, MD.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. *The fishes of New Mexico*. The University of New Mexico Press, Albuquerque, NM.

Pecos pupfish, *Cyprinodon pecosensis*

Distribution: The Pecos pupfish formerly occupied the Pecos River, and associated floodplain habitats, from Bitter Lake National Wildlife Refuge in New Mexico downstream to the confluence of Independence Creek in Texas (Echelle and Echelle; 1978, Hoagstrom and Brooks, 1999). The species is tolerant of saline conditions and is usually associated with low- to moderate-velocity run and pool habitats (including backwaters) in streams and floodplain gypsum sinkholes (Echelle and Echelle, 1978; Hoagstrom and Brooks, 1999).

Current Status: Pecos pupfish was previously proposed for federal listing as endangered (Federal Register 63:4608). However, the proposal was withdrawn and a conservation agreement for Pecos pupfish was adopted and implemented. The species was state listed as threatened in 1988 in New Mexico. Strict baitfish regulations were adopted by the State Game Commission in 1998 and a public information brochure on these regulations was published and disseminated in 1999. Pecos pupfish has been eliminated from all of its Texas range except Salt Creek, artificial impoundments used for commercial rearing of shrimp, and off-channel gravel pits near Grandfalls (Wilde and Echelle, 1992; G.P. Garrett, TPWD, pers. comm.). In New Mexico, it currently occurs mainly in habitats on Bitter Lake National Wildlife Refuge and Bottomless Lakes State Park (Hoagstrom and Brooks, 1999). It is irregularly found in the mainstem Pecos River (C.W. Hoagstrom, pers. comm.).

Threats: Nonnative sheepshead minnow, which hybridizes with Pecos pupfish, is the primary threat to the species. This nonnative is largely responsible for the elimination of the species from much of its Texas range (Echelle and Conner, 1989) and has become established in the Pecos River of New Mexico downstream of Loving (Echelle et al., 1997). Sheepshead minnow was probably established in the Pecos River by bait introduction. Modification of off-channel habitats, groundwater depletion, seasonal stream dewatering, and contaminants from oil and gas extraction activities also threaten the persistence of the species.

Recommendations: No change in listing status is recommended. Baitfish regulations for Pecos River need to be rigorously enforced to prevent the further spread of sheepshead minnow and other nonnative fish species. New Mexico bait fish regulations need to be revised to allow the sale and use of only red shiner and fathead minnow as baitfish in the Pecos River Valley. Effects of groundwater pumping on sinkhole habitats of Pecos pupfish need to be determined and evaluated. Proposed oil and gas development activities in vicinity of Pecos pupfish habitat should be carefully scrutinized and modified, if necessary, to avoid introduction of contaminants to occupied or potential Pecos pupfish habitats. Neither native nor nonnative sportfishes should be stocked in habitats supporting Pecos pupfish. Pecos pupfish should be established in unoccupied, but suitable, habitats in Pecos River drainage. Active participation in the Pecos pupfish conservation agreement should continue, and a conservation/recovery plan for should be developed.

Literature Cited:

- Echelle, A.A. and P.J. Conner. 1989. Rapid, geographically extensive genetic introgression after secondary contact between two pupfish species (*Cyprinodon*, Cyprinodontidae). *Evolution* 43:717-727.
- Echelle, A.A. and A.F. Echelle. 1978. The Pecos River pupfish, *Cyprinodon pecosensis* n.sp. (Cyprinodontidae), with comments on its evolutionary origin. *Copeia* 1978:569-582.
- Echelle, A.A., C.W. Hoagstrom, A.F. Echelle, and J.E. Brooks, 1997. Expanded occurrence of genetically introgressed pupfish (Cyprinodontidae: *Cyprinodon pecosensis* x *variegatus*) in New Mexico. *The Southwestern Naturalist* 42:336-339.
- Hoagstrom C.W. and J.E. Brooks. 1999. Distribution, status, and conservation of the Pecos pupfish, *Cyprinodon pecosensis*. Technical Report No. 2, New Mexico Department of Game and Fish, Santa Fe, NM.
- Wilde, G.R. and A.A. Echelle. 1992. Genetic status of Pecos pupfish populations after establishment of a hybrid swarm involving an introduced congener. *Transactions of the American Fisheries Society* 121:277-286.

White Sands pupfish, *Cyprinodon tularosa*

Distribution: White Sands pupfish is endemic to the endorheic Tularosa Basin of southcentral New Mexico (Miller and Echelle, 1975). Although it was formerly believed to have naturally occurred in Mound Spring and possibly Lost River (Miller and Echelle, 1975; Jester and Suminski, 1982), it historically occurred only in Malpais Spring (and associated playa habitats) and Salt Creek (Pittenger and Springer, 1999). Within occupied habitats, White Sands pupfish is common (Pittenger and Springer, 1996, Carman, 2004).

Current Status: White Sands pupfish was originally state listed as an endangered species in New Mexico before being downlisted to its current state status as threatened. White Sands pupfish occupies its entire, but limited, historical habitat in the Tularosa Basin. Additional populations were established in Mound Spring and Malone Draw (also in Tularosa Basin; Pittenger and Springer, 1999). A Cooperative Agreement for the Conservation of White Sands Pupfish provides for its protection and monitoring of its status. NMDGF, U.S. Fish and Wildlife Service, White Sands Missile Range, and Holloman Air Force Base, and White Sands National Monument are signatory to the agreement.

Threats: Habitat degradation by military activities, weapons testing, and introduction of crayfish and nonnative fishes (particularly predators) are primary threats to the species. Previously, feral horses degraded habitats of White Sands pupfish, but all have been removed from White Sands Missile Range.

Recommendations: No change in listing status is recommended. The recently revised and updated Cooperative Agreement for the Conservation of White Sands Pupfish should be signed by all potential signatories and implemented. Any establishment of new White Sands pupfish populations should be carefully considered to ensure the integrity of the species within each evolutionary significant unit.

Literature Cited:

- Carman, S.M. 2004. Status of White Sands pupfish conservation. Abstract, Desert Fishes Council Annual Symposium, 11-15 November 2004, Tucson, AZ.
- Jester, D.B. and R.R. Suminski. 1982. Age and growth, abundance, and biomass production of White Sands pupfish, *Cyprinodon tularosa* (Cyprinodontidae), in a desert pond. *The Southwestern Naturalist* 27:43-54.

- Miller, R.R. and A.A. Echelle. 1975. *Cyprinodon tularosa*, a new cyprinodontid fish from the Tularosa Basin, New Mexico. *The Southwestern Naturalist* 19:365-377.
- Pittenger, J.S. and C.L. Springer. 1996. White Sands pupfish status report: 1995. New Mexico Department of Game and Fish, Santa Fe, NM.
- Pittenger, J.S. and C.L. Springer. 1999. Native range and conservation of White Sands pupfish (*Cyprinodon tularosa*). *The Southwestern Naturalist* 44:157-165.

Gila topminnow, *Poeciliopsis occidentalis*

Distribution: The Gila topminnow historically was one of the most common and widespread fishes in lower elevation streams of the Gila River drainage in Arizona (Hubbs and Miller, 1941; Minckley, 1973). The only documented historical location of Gila topminnow in New Mexico was a series of stenothermal warm springs along the San Francisco River near Pleasanton (Koster, 1957), but it is likely the species occurred elsewhere in suitable habitats in and along the Gila and San Francisco rivers. Gila topminnow typically occupied vegetated shoreline habitats of streams where water velocities were slow, springs, and spring runs (Minckley et al., 1977).

Current Status: Gila topminnow was federally listed as endangered in 1967. It was state listed as a threatened species in New Mexico in 1990. The Gila topminnow has been eliminated from almost all of its historical range. It currently persists as several scattered locations in Arizona, and the security of these is variable (Weedman and Young, 1997). The New Mexico San Francisco River population was eliminated by drought or floods during the 1950s. In 1989, Gila topminnow was stocked in a pond on the NMDGF Red Rock Wildlife Management Area. That effort was not successful. Gila topminnow was again stocked in Red Rock Wildlife Management Area pond in 2005, and that population has persisted. NMDGF is planning to increase and improve wetland habitats on Red Rock Wildlife Management Area to benefit Gila topminnow.

Threats: Habitat loss by groundwater mining, stream channelization, stream desiccation, removal of shoreline vegetation, and nonnative western mosquitofish and other nonnative predators, are the primary threats to Gila topminnow.

Recommendations: No change in listing status is recommended. The pond and associated wetlands on the NMDGF Red Rock Wildlife Management Area should be enlarged, enhanced, and augmented with additional topminnow if needed. Other suitable sites for repatriation of the species should be located.

Literature Cited:

- Hubbs, C.L. and R.R. Miller. 1941. Studies of the fishes of the order Cyprinodontes. XVII. Genera and species of the Colorado River system. *Occasional Papers of the Museum of Zoology, University of Michigan* 433:1-9.
- Koster, W.J. 1957. Guide to the fishes of New Mexico. The University of New Mexico Press, Albuquerque, NM.
- Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W.L., J.N. Rinne, and J.E. Johnson. 1977. Status of the Gila topminnow and its co-occurrence with mosquitofish. USDA Forest Service Research Paper RM-198. USDA Forest Service Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Weedman, D.A. and K.L. Young. 1997. Status of the Gila topminnow and desert pupfish in Arizona. Nongame and Endangered Wildlife Program Technical Report 118. Arizona Game and Fish Department, Phoenix, AZ.

Greenthroat darter, *Etheostoma lepidum*

Distribution: Greenthroat darter occurs in two disjunct areas: the Edwards Plateau of south-central Texas and the lower Pecos River drainage of New Mexico (Echelle et al., 1984). In New Mexico, the species occurred in mainstream and tributary habitats in the Pecos River valley from Bitter Lake National Wildlife Refuge downstream to the Texas/New Mexico border (Sublette et al., 1990). Greenthroat darter is found mainly in small stream and spring habitats having clear water, dense aquatic vegetation, and clean gravel and cobble substrates (Page, 1983).

Current Status: Greenthroat darter was state listed as threatened in New Mexico in 1975. Although the species remains relatively common in preferred habitats in Texas, its overall range there has declined (Anderson et al., 1995). In New Mexico, greenthroat darter persists primarily in four separate areas: the springs, spring runs, and several impoundments on Bitter Lake National Wildlife Refuge, Blue Spring, and Rattlesnake Spring. The Rattlesnake Spring population was established in the late 1980s as a joint effort of the National Park Service, U.S. Fish and Wildlife Service, and NMDGF.

Threats: Any pumping that lowers groundwater water levels, diversion of spring runs, and elevated sediments are the primary threats to greenthroat darter.

Recommendations: No change in listing status is recommended. Systematic surveys to document current status of the species in New Mexico should be undertaken. The life history of this species in New Mexico needs documentation.

Literature Cited:

- Anderson, A.A., C.Hubbs, K.O. Winemiller, and R.J. Edwards. 1995. Texas freshwater fish assemblages following three decades of environmental change. *The Southwestern Naturalist* 40:314-321.
- Echelle, A.F., A.A. Echelle, and C. Hubbs. 1984. Systematic review of the percid fish, *Etheostoma lepidum*. Pp. 243-255. In R.A. Seigel, L.E. Hunt, J.L. Knight, L. Malaret, and N.L. Zuschlag (eds.). *Vertebrate ecology and systematics, a tribute to Henry S. Fitch*. Museum of Natural History, The University of Kansas, Lawrence, KS.
- Page, L.M. 1983. *Handbook of darters*. TFH Publications Inc., Neptune City, NJ.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. *The fishes of New Mexico*. The University of New Mexico Press, Albuquerque, NM.

Bigscale logperch, *Percina macrolepida*

Distribution: The historical range of bigscale logperch consisted of Texas Gulf Coastal drainages, the Red River of Texas and Oklahoma, and the Pecos River of Texas and New Mexico (Kuehne and Barbour, 1983). In New Mexico, the native range of the species was the Pecos River from the vicinity of Santa Rosa to Fort Sumner, the Pecos River near Carlsbad, and the Black River (Sublette et al., 1990). Bigscale logperch are most commonly found in fast-flowing, non-turbulent, moderately-deep water with large cobble substrata (Stevenson, 1971).

Current status: Bigscale logperch was state listed as threatened in New Mexico in 1975. The species likely occupies much of its historical New Mexico range, but its abundance has apparently declined. It also inhabits Santa Rosa, Sumner, and Brantley reservoirs and has been introduced (probably via baitbucket transfer) to Ute Reservoir on the South Canadian River (the South Canadian population is not protected).

Threats: Reduced flows, loss of moderate- to high-velocity reaches by diversion, and reduced water quality are probably the primary threats to bigscale logperch.

Recommendations: No change in listing status is recommended. Systematic surveys to document current status of the species in New Mexico should be undertaken. The life history of this species in New Mexico needs documentation.

Literature Cited:

- Kuehne, R.A. and R.W. Barbour. 1983. *The American darters*. The University of Kentucky Press, Lexington, KY.
- Stevenson, M.M. 1971. *Percina macrolepida* (Pisces, Percidae, Etheostominae), a new percid fish of the subgenus *Percina* from Texas. *The Southwestern Naturalist* 16:65-93.
- Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. *The fishes of New Mexico*. The University of New Mexico Press, Albuquerque, NM.

AMPHIBIANS

ENDANGERED

Jemez Mountains salamander, *Plethodon neomexicanus*

Distribution: *Plethodon neomexicanus* is endemic to north-central New Mexico where it is found only in the Jemez Mountains in Sandoval, Rio Arriba, and Los Alamos counties. It occurs from 7,200-11,256 ft elevation in mixed conifer habitat with abundant rotted logs and surface rocks. This habitat is dominated by Douglas fir, blue spruce, Engelmann spruce, ponderosa pine, and white fir with occasional aspen, Rocky Mountain maple, New Mexico locust, oceanspray, and various shrubby oaks (Degenhardt et al. 1996, Williams 1973, Whitford 1976). *Plethodon neomexicanus* is rarely observed on the surface or encountered under surface litter or aspen logs. It is most often encountered under and inside well-rotted Douglas-fir logs or under rocks.

Current Status: *Plethodon neomexicanus* was uplisted for state threatened to endangered in 2004. It is listed as a species of concern by Region 2 USFWS (USFWS 1994, 1996). The New Mexico Endemic Salamander Team has completed the Jemez Mountains Salamander Management Plan. This plan was approved and signed by NMDGF, U.S. Fish and Wildlife Service, and U.S. Forest Service (USFS) during January 2000, and was designed to provide guidance for management of the Jemez Mountains salamander on USFS lands.

Because there is so much inherent variability in monitoring secretive species where only an unknown percentage is surface active at any given time, as in *P. neomexicanus*, hard data is lacking to conclude whether the species is declining throughout its known range. However, antidotal evidence strongly suggests this is the case. For example *P. neomexicanus* were found at only 19 (38%) of 50 historically occupied sites surveyed during 2001-03. Based on numerous recent surveys, *P. neomexicanus* appear to be extinct at the type locality where numerous early investigators found the species to be very abundant. Additionally, Cummer et al. (2003; 2004) reported the absence of *P. neomexicanus* at a site on the Valles Caldera National Preserve where the species was once abundant (Whitford 1976).

Threats: Current threats to the already fragmented populations of Jemez Mountains salamander are numerous. The cumulative effects of recent actions are reflected in concerns for the species persistence, including: 1) the findings of significantly elevated microhabitat temperatures on the habitat severely burned during the Cerro Grande and Dome fires, 2) the proposed widening of NM Hwy 126 into occupied habitat, 3) the low recapture rates at historic sites, and 4) the detection of a fungal infection from specimens on the Valles Caldera (Cummer et al. 2005), have caused concern among those familiar with the habitat requirements of the Jemez Mountains salamander.

Wildfire: There is a continued threat of additional negative impacts to populations of Jemez Mountains salamanders from natural wildfire and management ignited fire. Salamander populations are known to be susceptible to fire-related effects, including decreased forest humidity, desiccation of habitat, loss of microhabitat (such as downed logs and litter), erosion, and filling in (by runoff) of subterranean habitat utilized by salamanders. Post-fire management actions that have negatively impacted Jemez Mountains salamanders and their habitat include the mulching and reseeded of occupied habitat with soil-binding, non-native grasses.

Logging: Since 1980, increases in timber harvest by the USFS have prompted concern about the effects of logging on *P. neomexicanus* (USFWS 1986, 1987). A large percentage of the range of *P. neomexicanus* occurs on National Forest lands and the close association of *P. neomexicanus* with mixed coniferous forests makes them vulnerable to many forest management practices (Ramotnik and Scott 1988). Wiltenmuth (1996) suggested that *P. neomexicanus* might not be able to withstand the additional stress of drying environmental conditions associated with activities such as logging. Historically, the effects of logging were considered to be a major threat to *P. neomexicanus*, however, the recent reduction of timber harvesting in the Jemez Mountains has somewhat diminished that threat. Silvicultural activity today in the habitat of *P. neomexicanus* is generally restricted to post-fire salvage logging and tree thinning in the urban-forest interface zones.

Road Construction: Roads and other development (residential, recreational, or commercial) would have negative effects on *P. neomexicanus* if constructed in their habitat, via direct take, habitat and population fragmentation and loss, and soil compaction. The current alternative chosen to widen and resurface NM Hwy 126 will cause population fragmentation and direct take of salamanders. The current alignment transects known occupied salamander habitat just north of the town of Seven Springs.

Disease: Disease has been implicated in the decline of many amphibians, and it is an unknown, but credible threat to *P. neomexicanus*. Cumber et al. (2005) reported the chytridiomycete fungus (*Batrachochytrium dendrobatidis*) from an individual *P. neomexicanus* from Sierra Toledo on the Valles Caldera in Sandoval County. However, Cumber (2006) tested 66 *P. neomexicanus* from the same area and all results were negative for *B. dendrobatidis*.

Recommendations: *Plethodon neomexicanus* should maintain its listing as endangered. NMDGF should continue to provide support for the New Mexico Endemic Salamander Team and the implementation of the Jemez Mountains Salamander Management Plan. NMDGF should continue monitoring *P. neomexicanus* within areas burned by the Dome fire and the Cerro Grande Fire. Investigations of the population on the Valles Caldera and elsewhere for the presence of the chytridiomycete fungus (*Batrachochytrium dendrobatidis*) should be continued.

Literature Cited:

- Cumber, M.R. 2006. Prevalence of amphibian disease in the Jemez Mountains Salamander (*Plethodon neomexicanus*) and other sympatric amphibians in the Jemez Mountains of northcentral New Mexico. Unpubl. Rept. to New Mexico Dept. Game and Fish, Santa Fe, NM. 18 pp.
- Cumber, M.R., B.L. Christman, and M.A. Wright. 2003. Investigations of the status and distribution of amphibians and reptiles on the Valles Caldera National Preserve, Sandoval County, New Mexico 2002. Unpubl. Rept. submitted to Valles Caldera Trust, Los Alamos, NM 13 p. + 3 appendices.
- Cumber, M.R., B.L. Christman, and M.A. Wright. 2004. Investigations of the status and distribution of amphibians and reptiles on the Valles Caldera National Preserve, Sandoval County, New Mexico 2003. Unpubl. Rept. submitted to Valles Caldera Trust, Los Alamos, NM.
- Cumber, M. R., D. E. Green, and E. M. O'Neill. 2005. Aquatic chytrid pathogen detected in terrestrial plethodontid salamander. *Herpetol. Rev.* 36(3):248 - 249.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Ramotnik, C.A. and N.J. Scott. 1988. Habitat requirements of New Mexico's endemic salamanders. Pp. 54-63 in R. C. Szaro, K. E. Severson, and D. R. Patton (eds.). Management of Amphibians, Reptiles, and Small Mammals in North America. USDA Forest Serv., Rocky Mt. Forest Range Exp. Stat. Gen. Tech. Rept. RM-166, Ft. Collins, CO. 458 p.
- U.S. Fish and Wildlife Service. 1986. Distribution and ecological requirements of endemic salamanders in relation to forestry management. Summary of 1986 activities. Part 2: Santa Fe National Forest. Unpubl. Rept. U.S. Forest Service, Albuquerque, NM. 40 p.
- U.S. Fish and Wildlife Service. 1987. Distribution and ecological requirements of endemic salamanders in relation to forestry management. Summary of 1987 activities. Part 2: Santa Fe National Forest. Unpubl. Rept. U.S. Forest Service, Albuquerque, NM. 40 p.
- U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened; Proposed rule. Federal Register 59(219):58982-58082.
- U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. Federal Register 61:7596-7613.
- Whitford, W.G. 1976. The biota of the Baca Geothermal site. Unpubl. Rept.
- Williams, S.R. 1973. *Plethodon neomexicanus*. *Cat. Amer. Amphib. Rept.*:131.1-131.2.
- Wiltenmuth, E. 1996. Effects of hydration on a plethodontid salamander endemic to the Southwestern U.S. Unpubl. Rept. NM Dept. Game and Fish, Santa Fe, NM. 4 p.

Lowland leopard frog, *Rana yavapaiensis*

Distribution: In New Mexico, *R. yavapaiensis* is known from 3700-5575 ft in western Catron, Hidalgo, and Grant counties. This is a frog of permanent to semi-permanent streams and ponds; most populations occupy small streams and rivers, springs, and associated pools at low elevations in desert scrub localities. *Rana yavapaiensis* reaches the

extreme eastern edge of its range in southwest New Mexico (Platz 1988). The species is abundant in select tributaries of Canon Bonito in Sonora, Mexico

Current Status: *Rana yavapaiensis* was listed as state endangered in New Mexico in 1988. It is listed as a species of concern by USFWS (USFWS 1994, 1996), and is listed as a species of wildlife of special concern in Arizona (AGFD 1996). Herpetologists in Arizona have documented the extinction of several populations in recent years and viable populations at all known historic localities in New Mexico no longer exist (Jennings 1987, 1995). During August 2000, a single individual was observed in the New Mexico portion of Guadalupe Canyon in extreme southwest Hidalgo County approximately 1.1 air miles upstream of the New Mexico/Arizona border. This is the first and only specimen reported from New Mexico since April 1985 (Degenhardt et al. 1996). No reproduction of this species, i.e., neither egg masses nor tadpoles, have been reported from New Mexico. *Rana yavapaiensis* is considered very rare and perhaps extirpated in New Mexico.

Threats: The causative agents for the decline of this species and other frogs, toads, and salamanders worldwide are largely unknown (Blaustein and Wake 1995, Blaustein et al. 1994). Several factors, including acid rain, air quality, stress-related bacterial infections, and introduced predators (i.e., bullfrogs, crayfish, and predatory game fish) have been suggested (Rosen et al. 1994). Berger et al. (1998) identified epidermal changes caused by a chytridiomycete fungus (*Batrachochytrium dendrobatidis*) as being the agent responsible for mass frog dieoffs and significant population declines in the rainforests of Australia and Central America. This same fungal infection has been implicated in dieoffs of lowland leopard frogs in southeast Arizona (Bradley et al. 2002), and is known to be present in New Mexico populations of leopard frogs (C.W. Painter and R.D. Jennings *unpubl data*). Jennings and Hayes (1994) reviewed the decline of *R. yavapaiensis* in the desert southwest.

Recommendations: *Rana yavapaiensis* should maintain its current listing as endangered. Museum specimens of this species from New Mexico should be examined for the presence of the chytridiomycete fungus. Landowner permission should be requested to routinely monitor the suitability of habitat at the single known site where the species occurs in New Mexico.

Literature Cited:

- Arizona Game and Fish Dept. 1996. Wildlife of Special Concern in Arizona. (Public Review Draft). Arizona Game and Fish Dept. Phoenix, AZ. 40 p.
- Berger, L., R. Speare, P. Daszak, D.E. Green, A.A. Cunningham, C.L. Goggin, R. Slocombe, M.A. Ragan, A.D. Hyatt, K.R. McDonald, H.B. Hines, K.R. Lips, G. Marantelli, and H. Parkes. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. *Proc. Nat'l. Acad. Sci.* 95:9031-9036.
- Blaustein, A. R. and D. B. Wake. 1995. The puzzle of declining amphibian populations. *Scientific American* April 1995:52-57.
- Blaustein, A.R., D.B. Wake, and W.P. Sousa. 1994. Amphibian declines: judging stability, persistence, and susceptibility of populations to local and global extinction. *Cons. Biology* 8(1):60-70.
- Bradley, G.A., P.C. Rosen, M.J. Sredl, T.R. Jones, and J.E. Longcore. 2002. Chytridiomycosis in native Arizona frogs. *J. Wildlife Diseases* 38(1):206-2.2
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. *Amphibians and Reptiles of New Mexico*. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Jennings, M.R. and M.P. Hayes. 1994. Decline of native ranid frogs in the desert southwest. Pp. 183-211 in Brown, P. R. and J. W. Wright (eds.). *Herpetology of the North American Deserts. Proceedings of a Symposium. Southwest. Herpetol. Soc. Spec. Publ. (5):iv + 311 p.*
- Jennings, R.D. 1987. The status of *Rana berlandieri*, the Rio Grande leopard frog, and *Rana yavapaiensis*, the lowland leopard frog in New Mexico. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe, NM. iv + 44 p.
- Jennings, R.D. 1995. Investigations of recently viable leopard frog populations in New Mexico, *Rana chiricahuensis* and *Rana yavapaiensis*. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe, NM. 36 p.
- Platz, J.E. 1988. *Rana yavapaiensis*. *Cat. Amer. Amphib. Rept.*:418.1-418.2.
- Rosen, P.C., C.R. Schwalbe, D.A. Parizek, Jr., P.A. Holm, and C.H. Lowe. 1994. Introduced aquatic vertebrates in the Chiricahua region: effects on declining native ranid frogs. Pp. 251-261 in *Biodiversity and Management of the Madrean Archipelago: The Sky Islands of Southwestern United States and Mexico*. USDI. Rocky Mt. Forest & Range Exp. Stat., Ft. Collins, Co. GTM RM-GTR-264.

U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened; Proposed rule. Federal Register 59(219):58982-58082.

U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. Federal Register 61:7596-7613.

Mountain toad, *Bufo boreas* complex

Distribution: In New Mexico, *B. boreas* is known only from north-central Rio Arriba County between 9100-10,500 ft in the San Juan Mountains at Canjilon Lakes, Trout Lakes, and Lagunitas Lakes (Stuart and Painter 1994). It lives in high mountain ponds, slow-moving streams, or low wet meadows. Dominant vegetation where *B. boreas* occurs in New Mexico includes corkbark fir, Engelmann spruce, aspen, willows, and various grasses and sedges. The species reaches its southern edge of its range in northcentral New Mexico.

Current Status: *Bufo boreas* was first listed under the WCA in 1976. The southern Rocky Mountain form of *Bufo boreas* was classified as a “warranted but precluded” candidate species for federal listing (USFWS 2001). USFWS (2005) reversed this decision and found the species “not warranted” for federal listing based on the lack of sufficient genetic evidence to designate this form as a distinct population segment. Mountain toad (also known as boreal toad) is listed as endangered in Colorado (Goettl 1997; Hammerson 1999), and as a species of special concern in Utah (UDWR 1997). The distribution and abundance of *B. boreas* have declined approximately 80% (Colorado) and 94% (Wyoming) in the last 20 years (Nesler and Goettl 1994). Although not reported from New Mexico until June 1966 (Campbell and Degenhardt 1971), *B. boreas* is currently thought to be extinct in New Mexico (Carey 1993). Jones (1978) estimated a population of 327 toads occurred at Upper Lagunitas Lake during 1978 whereas Woodward and Mitchell (1985) surveyed 139 ponds in known or expected *B. boreas* habitat in Rio Arriba County and located adults or tadpoles in only two ponds. During July-August, 1993, J.P. Hubbard and J.N. Stuart (*pers. comm.*) visited known localities and were unable to confirm the continued existence of *B. boreas* in New Mexico. During September 1996 retired USFWS personnel reported an unconfirmed sighting of *B. boreas* from Bobo Lake, a site ca 7 mi. ESE of Chama. Visits to this site in 1997 and 1998 failed to locate *B. boreas*. Surveys conducted during 2002 at historic sites in New Mexico were also negative, as were surveys of potential habitat in the Cruces Basin Wilderness. A New Mexico state recovery plan for *B. boreas* is currently being written.

Threats: Several factors have contributed to the decline of *B. boreas* and other montane amphibians in western North America, including the damaging effects of increased ultraviolet (UV-B) light on embryos; acidification and heavy-metal contamination of water, habitat destruction and degradation, such as may result from water, minerals, and livestock management, road construction, timber and fire management, recreation; impact of introduced trout; infectious fungal disease; pathogen-induced mortality resulting from suppressed immune systems caused by some undetermined environmental stressors; climate change; and predation (Hammerson 1999). A combination of these factors is likely involved in dieoffs of the mountain toad. However the chytridiomycete fungus (*Batrachochytrium dendrobatidis*) has been implicated in mass dieoffs and significant population declines of the species in Colorado (Muths et al. 2003). Any resource management activities that degrade alpine wetlands will negatively affect breeding habitat for mountain toads. Surveys for the chytridiomycete fungus should be conducted at historic localities and other habitats considered suitable for translocation of the mountain toad.

Recommendations: *Bufo boreas* should maintain its current listing as endangered. NMDGF should continue work with the Colorado Division of Wildlife and USFS to initiate a feasibility study to translocate mountain toads into historic habitat. Tissue samples of all species of amphibians occurring at historic sites of the mountain toad should be collected and tested for the presence of *B. dendrobatidis* prior to consideration of translocation. Additional surveys that concentrate on locating eggs, tadpoles, and new metamorphs should be carried out. All of the above actions should be evaluated and compiled within a comprehensive state recovery plan to ensure conservation of the mountain toad in New Mexico.

Goebel (1996) examined mtDNA variation in toads of the *B. boreas* complex throughout western North America and found that various populations in the southern Rocky Mountain region are genetically distinctive and may warrant recognition as one or more different species. Based on this work, the Department recommends the common name of this species be considered as mountain toad and the taxa be referred to as *Bufo boreas* complex until a final decision is made regards the distinctiveness of this species (see Hammerson 1999).

Literature Cited:

- Campbell, J.B. and W.G. Degenhardt. 1971. *Bufo boreas boreas* in New Mexico. Southwest. Nat. 16(1):219.
- Carey, C. 1993. Hypothesis concerning the causes of the disappearance of boreal toads from the mountains of Colorado. Conser. Biol. 7(2):355-362.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Goebel, A.M. 1996. Systematics and conservation of bufonids in North America and in the *Bufo boreas* species group. Ph.D. Dissertation, Univ. Colorado, Boulder.
- Goettl, J.P. [ed.] and the Boreal Toad Recovery Team. 1997. Boreal Toad Recovery Plan. Colorado Division of Wildlife. 56 p. + Appendix.
- Hammerson, G.A. 1999. Amphibians and Reptiles in Colorado: A Colorado Field Guide. 2nd Ed. University Press of Colorado, Niwot, Colorado xxvi + 484 p.
- Jones, K.L. 1978. Status of *Bufo boreas* in New Mexico project. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe, NM. 9 p.
- Muths, E., P.S. Corn, A.P. Pessier, and D.E. Green. 2003. Evidence for disease-related amphibian decline in Colorado. Biological Conservation 110(2003):357-365.
- Nesler, T.P. and J.P. Goettl. 1994. State of Colorado, Boreal Toad, *Bufo boreas boreas* Recovery Plan. Colorado Div. of Wildlife, Denver. v + 34 p.
- Stuart, J.N. and C.W. Painter. 1994. A review of the distribution and status of the boreal toad, *Bufo boreas boreas*, in New Mexico. Bull. Chicago Herpetol. Soc. 29(6):113-116.
- U.S. Fish and Wildlife Service. 1995. Endangered and Threatened wildlife and plants; 12 month finding for a petition to list the southern Rocky Mountain population of the boreal toad as endangered. Federal Register 60:15282-15283.
- U.S. Fish and Wildlife Service. 2001. Endangered and Threatened wildlife and plants; Review of plant and animal species that are candidates or proposed for listing as Endangered or Threatened, Annual notice of findings on recycled petitions, and Annual description of progress on listing actions; Proposed rule. Federal Register 66(210):54808-54832.
- U.S. Fish and Wildlife Service. 2005. Endangered and Threatened wildlife and plants; Revised 12-month finding of the southern Rocky Mountains distinct population segment of the Boreal Toad (*Bufo boreas boreas*). Federal Register 70(188):56880-56884.
- Utah Division of Wildlife Resources (UDWR). 1997. Utah sensitive species list. From Internet <http://www.nr.state.ut.us/dwr/sensspl.htm>
- Woodward, B.W. and S. Mitchell. 1985. The distribution of *Bufo boreas* in New Mexico. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe, NM. 26 p.

Great Plains narrow-mouthed toad, *Gastrophryne olivacea*

Distribution: In New Mexico, populations of this small toad-like frog are known from two highly disjunct localities: 1) along NM Hwy 9 near Hermanas in southern Luna County near the U.S.-Mexican border (Degenhardt 1986; Stuart and Painter 1996), and 2) Kiowa National Grasslands just north of Clayton, Union County (Moriarty et al. 2000). Based on locality records from Texas (Dixon 1987), *G. olivacea* may occur in Lea County in southeastern New Mexico as well. The Great Plains narrow-mouthed toad is active above ground only after torrential rains when it is easily detected by its distinctive call. Ants are the primary prey (Fitch 1956).

Current Status: *Gastrophryne olivacea* was listed as state endangered in New Mexico in 1988. It is a wildlife species of special concern in Arizona (AGFD 1996). The Republic of Mexico lists this species as rare (SDS 1994). Populations in Colorado are small and geographically limited, although they appear secure (Hammerson 1999). The species was not discovered in New Mexico until June 1986 (Degenhardt 1986), and to date only a small number of observations have been documented. All specimens known from New Mexico have been collected in low-lying, flooded roadside ditches in desert scrub habitat dominated by mesquite, creosotebush, and various arid-land grasses or in flooded grasslands.

Threats: Habitat modifications resulting from excessive grazing pressure, draining or filling low-lying areas, or other factors are the primary threats to this species. Pesticide application is a potential threat, due to possible toxicity to eggs and larvae and impacts on adult food sources.

Recommendations: *Gastrophryne olivacea* should maintain its current listing as endangered. Habitat of the few known populations in New Mexico should be routinely monitored for any changes due to excessive grazing pressure or other anthropogenic modifications. Additional suitable habitat should be surveyed for the presence of this species during summer monsoon rains.

Literature Cited:

- Arizona Game and Fish Dept. 1996. Wildlife of Special Concern in Arizona. (Public Review Draft). Arizona Game and Fish Dept. Phoenix, AZ. 40 p.
- Black, J.H. and G. Sievert. 1989. A Field Guide to Amphibians of Oklahoma. Oklahoma Dept. Wildlife Cons. Oklahoma City. 80 p.
- Moriarty, E.C., S.L. Collins, and J.T. Collins. 2000. Geographic Distribution: *Gastrophryne olivacea* (Great Plains narrowmouth toad). Herpetol. Rev. 31(1):50.
- Degenhardt, W.G. 1986. Geographic Distribution: *Gastrophryne olivacea* (Great Plains narrowmouth toad). Herpetol. Rev. 17(4):91.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Dixon, J.R. 1987. Amphibians and Reptiles of Texas, with Keys, Taxonomic Synopses, Bibliography, and Distribution Maps. Texas A&M. Univ. Press. College Station. xii + 434 p.
- Fitch, H.S. 1956. A field study of the Kansas ant-eating frog, *Gastrophryne olivacea*. Univ. Kansas Publ. Mus. Nat. Hist. 8(4):275-306.
- Hammerson, G.A. 1982. Amphibians and Reptiles in Colorado. Colorado Div. Wild. Publ. DOW-M-I-27-82. vii + 131 p.
- Hammerson, G.A. 1999. Amphibians and reptiles in Colorado: A Colorado field guide. 2nd Ed. University Press of Colorado, Niwot, Colorado xxvi + 484 p.
- Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. Diario Oficial De La Federación, Mexico CDLXXXVII(10):2-60.
- Stuart, J.N. and C.W. Painter. 1996. Natural history notes on the Great Plains narrowmouth toad, *Gastrophryne olivacea* in New Mexico. Bull. Chicago Herpetol. Soc. 31(3):44-47.

THREATENED

Sacramento mountain salamander, *Aneides hardii*

Distribution: *Aneides hardii* is endemic to south-central New Mexico where it is found only in the White, Capitan, and Sacramento mountains in Otero and Lincoln counties. It is generally associated with Douglas fir and spruce at elevations from 7850-11,700 ft where it is found under large woody debris or rocks (Degenhardt et al. 1996; Ramotnik 1997). Dominant overstory includes Douglas fir and white fir with lesser amounts of Engelmann spruce and southwestern white pine. Rocky Mountain maple, gooseberry, and oceanspray share the understory with seedling conifers and downed logs in various stages of decay. There are usually limestone rocks and boulders exposed on the surface (Scott and Ramotnik 1992).

Current Status: The Sacramento Mountain salamander was state listed as threatened in New Mexico in 1975. It is listed as a species of concern by USFWS (USFWS 1994, 1996), and as sensitive by the USFS (USFS 1999). *Aneides hardii* may be locally abundant where essential microhabitat characteristics are available.

Preliminary results from an ongoing study to investigate the impact of wildfire on the Sacramento mountain salamander have shown that salamander abundance, prey density, and soil characteristics differ between severely burned, low-burned, and unburned sites (Ramotnik et al. 2004). Immediately (within 2 months) after the fire the numbers of salamanders on burned sites outnumbered those found on unburned sites. This is likely a sampling

artifact that reflects survey protocol to search for salamanders under available surface cover and the physiological response of salamanders to aggregate under the few remaining logs in order to conserve moisture. However after 2 years the number of salamanders on burned sites have decreased while those on unburned sites have remained the same. Soil pH increased sharply on the burned sites immediately after the fire but after 3 years pH has begun to decrease due to the dilution effect caused by precipitation. Organic matter content and water-holding capacity are significantly lower on burned sites than on unburned sites. These soil characteristics are important because they are associated with soil moisture and can influence the ability of salamanders to repopulate burned sites. The relative proportion of prey items (primarily ants, springtails, harvestman spiders, and dipteran flies) to non-prey items is highest on the low-burn and unburned sites. The response of arthropods to fire, however, can be expected to change seasonally and annually as a function of climatic variation, recovery rate of the vegetation and forest floor, and differences in life history patterns of individual arthropods.

Threats: Logging and other disturbance that cause desiccation of the habitat remain the primary threat to *A. hardii*. The possible effects of pesticide application need investigation (Ramotnik 1997).

Ramotnik and Scott (1988) suggested that intensive logging, slash removal, and burning may reduce or eliminate populations of *A. hardii*. Ramotnik (1996) reported that smaller, presumably juvenile, salamanders comprise 47% of the total salamanders collected on unlogged plots while only 30% of the total on logged plots. Reasons for this difference may include lower reproductive rates or lower survival rates of eggs, hatchlings, or juveniles on logged plots and may indicate that logged plots represent less than optimal habitat. Borg (2001) found that Sacramento mountain salamanders were more limited by the availability of cool microhabitats in logged sites than in forested sites and that juvenile salamanders on logged sites had significantly poorer body condition than those on unlogged sites.

Recommendations: This species should maintain its current listing as threatened. All logging and other ground disturbing silvicultural activities within occupied or potential sites where *A. hardii* occur should be coordinated with and approved by the New Mexico Endemic Salamander Team. A Management Plan should be drafted and implemented to guide the management of this species. NMDGF should continue to provide support for the New Mexico Endemic Salamander Team.

Literature Cited:

- Borg, C.K. 2001. Impacts of timber harvest on the endemic Sacramento Mountain salamander, *Aneides hardii* (Caudata: Plethodontidae), in the southern Rocky Mountains of New Mexico, USA. Unpubl. MS thesis. New Mexico State University, Las Cruces, NM. 46 p.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Ramotnik, C. A. 1996. Studies of the effects of forest management practices on the Sacramento mountain salamander, *Aneides hardii*. Unpubl. Rept. U.S. Forest Service. Alamogordo, NM. 8 p.
- Ramotnik, C.A. 1997. Conservation assessment of the Sacramento Mountain Salamander. Gen. Tech. Rept. RM-GTR-293. Ft. Collins, CO: USDA, USFS Rocky Mt. Forest and Range Exp. Station. 19 p.
- Ramotnik, C.A., I. Murray, and D. Alba. 2004. Impact of the Scott Able Fire on salamander abundance and arthropod prey base: Year Three. Annual report to the U.S. Forest Service, Alamogordo, NM.
- Ramotnik, C. A. and N. J. Scott. 1988. Habitat requirements of New Mexico's endemic salamanders. Pp. 54-63 in R. C. Szaro, K. E. Severson, and D. R. Patton (eds.). Management of Amphibians, Reptiles, and Small Mammals in North America. USDA Forest Serv., Rocky Mt. Forest Range Exp. Station. Gen. Tech. Rept. RM-166, Ft. Collins, Colorado. 458 p.
- Scott, N. J. and C. A. Ramotnik. 1992. Does the Sacramento mountain salamander require old-growth forests? Pp. 170-178 in M. R. Kaufmann, W. H. Moir, and R. L. Bassett (eds.). Old-growth forests in the Southwest and Rocky Mountain regions. Proceedings of a Workshop. USDA Forest Service., Rocky Mt. Forest Range Exp. Station. Gen. Tech. Rept. RM-213, Ft. Collins, CO. 201 p.
- U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened; Proposed rule. Federal Register 59(219):58982-58082.
- U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. Federal Register 61:7596-7613.
- U.S. Forest Service. 1999. Regional forester's sensitive species list for the southwestern region.

Sonoran desert toad, *Bufo alvarius*

Distribution: In New Mexico, *B. alvarius* is an uncommon species that occurs only in southwest Hidalgo County in the vicinity of Rodeo and in scattered localities in the adjacent Peloncillo Mountains at elevations of 4100-4950 ft (Degenhardt et al. 1996). It reaches the extreme eastern limit of its range in southwest New Mexico. This large toad spends most of the summer months in rodent holes and generally emerges only during the summer rains to breed.

Current Status: *Bufo alvarius* was state listed as threatened in New Mexico in 1975. It does not receive any formal protection elsewhere. *Bufo alvarius* was not collected in New Mexico until the summer of 1961 (Cole 1962), and not reported in New Mexico east of the Peloncillo Mountains until 1978 (Peters and McCoy 1978). Important areas for *B. alvarius* in New Mexico may include Guadalupe Canyon and the Cloverdale vicinity. Surface activity of *B. alvarius* is generally restricted conditions of high humidity, and the timing and frequency of observations of this species are therefore influenced by rainfall or other conditions. Fouquette (1970) characterized this species as one of the least known of all American toads.

Threats: Habitat modification and overcollecting are possible threats to this species in southwest New Mexico. Draining or filling in of cattle watering tanks poses a threat to the species, as does the diversion of roadside silt and runoff into known breeding ponds. Roadway mortality is often observed.

Recommendations: *Bufo alvarius* should maintain its current listing as threatened. The common name should be considered as Sonoran desert toad (Crother et al. 2003). Regular monitoring of the habitat known to be occupied by this toad should occur for toad presence and any evidence of unauthorized collecting. Additionally, surveys in suitable habitat should be conducted during the summer breeding season to locate new occupied sites.

Literature Cited:

- Cole, C. J. 1962. Notes on the distribution and food habits of *Bufo alvarius* at the eastern edge of its range. *Herpetologica* 18(3):172-175.
- Crother, B.I., J. Boundy, J.A. Campbell, K. DeQuiroz, D. Frost, D.M. Green, R. Highton, J.B. Iverson, R.W. McDiarmid, P.A. Meylan, T.W. Reeder, M.E. Seidel, J.W. Sites, Jr., S.G. Tilley, and D.B. Wake. 2003. Scientific and standard English names of amphibians and reptiles of North America north of Mexico: Update. *Herpetol. Rev.* 34(3):196-203.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. *Amphibians and Reptiles of New Mexico*. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Fouquette, M. J. 1970. *Bufo alvarius*. *Cat. Amer. Amphib. Rept.*:93.1-93.4.
- Peters, E. L. and C. J. McCoy. 1978. Geographic distribution; *Bufo alvarius* (Colorado River toad). *Herpetol. Rev.* 9(3):107.

REPTILES

ENDANGERED

Gila monster, *Heloderma suspectum*

Distribution: *Heloderma suspectum* is peripheral in New Mexico, reaching the eastern edge of its range in southwest New Mexico where there are only a few isolated records from Hidalgo, Grant, Luna, and perhaps Doña Ana counties at elevations of 6100-6400 ft (Degenhardt et al. 1996).

Heloderma suspectum is the largest lizard native to the United States and the only venomous one. The seasonal activity period extends from March-November although *H. suspectum* spends as much as 96% of its time in sub-surface refugia (Beck and Lowe 1994). Beck and Jennings (2003) investigated shelter use in Gila monsters in southwest New Mexico for six years. Their results suggest that the availability of suitable refugia played an important role in habitat selection by Gila monsters and thus influenced the pattern of local dispersal. Beck (2005) provided a thorough review of the species throughout its range.

Current Status: *Heloderma suspectum* was listed as state endangered in New Mexico in 1975. *Heloderma s. suspectum* is listed as threatened by the Republic of Mexico (SDS 1994). The population in New Mexico appears stable, although the species is commercially valuable and therefore susceptible to illegal collecting. The reticulated Gila monster, *H. s. suspectum*, occurs in New Mexico.

Heloderma suspectum was first reported from New Mexico in 1950 (Shaw 1950) and is common only at Red Rock Wildlife Area in Grant County (Beck 1994; 2005) and at Granite Gap in Hidalgo County. Records of occurrence at Kilbourne Hole in Doña County and other areas east of a line drawn from Silver City southward to Animas may represent displaced, released, or escaped captive individuals.

Threats: Threats to *H. suspectum* are largely from habitat loss and fragmentation, and illegal collection. Individuals are often killed by lay public who believe they are dangerous and present a hazard to the public. Highway mortality is often observed.

Recommendations: *Heloderma suspectum* should maintain its current listing as endangered. Habitat known to be occupied by Gila monsters should be regularly monitored, and any loss or fragmentation or evidence of unauthorized collecting should be investigated to determine impacts to local populations of Gila monster. Information on identification and legal status should be distributed to the public within the range of the Gila monster in New Mexico. Strict protection from illegal collecting should be strictly enforced.

Literature Cited:

- Beck, D.D. 1994. A field study of the Gila monster in southwestern New Mexico. Unpubl. Progress Rept. NM Dept. Game & Fish, Santa Fe. 8 p.
- Beck, D.D. 2005. Biology of Gila Monsters and Beaded Lizards. Univ. California Press, Berkeley and Los Angeles. xii + 211 pp.
- Beck, D.D. and R.D. Jennings. 2003. Habitat use by Gila monsters: the importance of shelters. Herpetol. Monographs 17:111-129.
- Beck, D.D. and C.H. Lowe. 1994. Resting metabolism of helodermatid lizards: allometric and ecological considerations. J. Comp. Physiol. B 164(2):124-129.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, ABQ. xix + 431 p.
- Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. Diario Oficial De La Federación, Mexico CDLXXXVII(10):2-60.
- Shaw, C.E. 1950. The Gila monster in New Mexico. Herpetologica 6(2):37-39.

Sand dune lizard, *Sceloporus arenicolus*

Distribution: *Sceloporus arenicolus* is endemic to southeast New Mexico and a small area of adjacent Texas. In New Mexico, it occurs only in portions of Chaves, Eddy, Lea, and southern Roosevelt counties (Degenhardt et al. 1996). *Sceloporus arenicolus* is confined to areas of shinnery oak - sand dunes and their peripheries, where the uneven sandy terrain and wind-created blowouts are essential habitat requirements. Within this habitat, populations of *S. arenicolus* are localized and fragmented by areas of unsuitable habitat (Fitzgerald et al. 1995, 1997).

Current Status: *Sceloporus arenicolus* was uplisted from state threatened to endangered in 2005. It is classified as a candidate species for federal listing (USFWS 2001). These species are species that the USFWS has on file sufficient information on biological vulnerability and threats to support proposals to list them as endangered or threatened. *Sceloporus arenicolus* receives no formal protection in Texas, where the distribution and the extent of habitat modification is largely unknown.

The range of the sand dune lizard is a crescent-shaped area that varies from approximately 1-16 miles in width. Within this area, there is an estimated 655 mi.² of occupied or potential habitat (Painter et al. 1999). Ongoing studies have documented dispersal within ~200 m from sand dune blowouts where lizards were originally captured. Oil and gas exploration and extraction activities have a local effect on populations of *S. arenicolus* in the vicinity of oil well pads, reducing these populations by an average of 37% when compared to control areas approximately 200 m distant from the pad (Sias and Snell 1996). Sias and Snell (1998) using data from additional studies, found a negative relationship between well density and the abundance of *S. arenicolus*.

Threats: Primary threats to the habitat of *S. arenicolus* are from chemical brush control programs on BLM and private lands that eliminate shinnery oak on and around the shinnery oak - sand dune areas (Gorum 1995; Snell et al. 1993, 1994). The current BLM Roswell Resource Area Resource Management Plan states that chemical treatment of the shinnery oak-dune community is not to occur in suitable or occupied habitat of the sand dune lizard, as long as the species remains state-listed. However, it is clear that sand dune blowouts are patches in a shinnery oak matrix, and the shinnery oak matrix must exist in order for blowouts to form and persist.

An additional important threat includes oil and gas exploration and extraction. The sand dune lizard receives no protection from habitat degradation as a result of oil and gas exploration and extraction on New Mexico State Trust lands. Since the 2002 there has been extensive development on occupied habitat along the Eddy/Lea county line just east of Loco Hills on state lands. This population of sand dune lizards represents the densest population known from throughout its range in New Mexico. Currently oil field development in this area far exceeds the NMDGF recommended maximum of 13 wells/sq. mi and additional development is planned at this site.

Recommendations: *Sceloporus arenicolus* should maintain its listing as endangered. Intensive research designed to help in an understanding of habitat use, including in developed oil and gas fields should be continued. Additional research should address dispersal, establishment of corridors through the shinnery oak matrix, microhabitat use, and genetic characteristics of the population throughout its range in New Mexico and Texas. NMDGF should closely monitor activities in the range of *S. arenicolus* and recommend to all land management agencies and private consumptive industry (ranchers and oil/gas development) that the newly developed collaborative conservation strategies (New Mexico LPC/SDL Working Group 2005) for *S. arenicolus* in New Mexico are strictly adhered to.

Literature Cited:

- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Fitzgerald, L.A., C.W. Painter, D.S. Sias, and H.L. Snell. 1997. The range, distribution, and habitat of *Sceloporus arenicolus* in New Mexico. Final Rept. Submitted to New Mexico Dept. Game and Fish, Santa Fe, NM. 31 p + Appendix 1-4.
- Fitzgerald, L.A., D.S. Sias, H.L. Snell, and C.W. Painter. 1995. Distribution survey of the dunes sagebrush lizard, *Sceloporus arenicolus* in New Mexico. Unpubl. Progress Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 8 p.
- Gorum, L.W., H.L. Snell, L.J.S. Pierce, and T.J. McBride. 1995. Results from the fourth year (1994) research on the effect of shinnery oak removal on the Dunes sagebrush lizard, *Sceloporus graciosus arenicolous*, in New Mexico. Unpubl. Progress Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 12 p.

- New Mexico LPC/SDL Working Group. 2005. Collaborative Conservation Strategies for the Lesser Prairie-Chicken and Sand Dune Lizard in New Mexico. Findings and recommendations of the New Mexico LPC/SDL Working Group. xii +177 pp.
- Painter, C.W., D.S. Sias, L.A. Fitzgerald, L.J.S. Pierce, and H.L. Snell. 1999. Management plan for the sand dune lizard, *Sceloporus arenicolus* in New Mexico. Fed. Aid Completion Rept. Submitted to USFWS by NM Dept. Game and Fish, Endangered Species Program, Santa Fe, NM. 45 pp + 10 appendices.
- Sias, D.S. and H.L. Snell. 1996. The dunes sagebrush lizard *Sceloporus arenicolus* and sympatric reptile species in the vicinity of oil and gas wells in southeastern New Mexico. Final report for 1995 activities. Unpubl. Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 76 p.
- Sias, D.S. and H.L. Snell. 1998. The sand dune lizard *Sceloporus arenicolus* and oil and gas development in southeastern New Mexico. Final report of field studies 1995-1997. Rept. submitted to New Mexico Dept. Game and Fish, Santa Fe, NM. 27 p + 8 fig., 6 tables, and 1 appendix.
- Snell, H.L., L.W. Gorum, and A. Landwer. 1993. Results of second years research on the effect of shinnery oak removal on the Dunes sagebrush lizard, *Sceloporus graciosus arenicolous*, in New Mexico. Unpubl. Progress Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 16 p.
- Snell, H.L., L.W. Gorum, M.W. Doles, and C.K. Anderson. 1994. Results of third years (1993) research on the effect of shinnery oak removal on the Dunes sagebrush lizard, *Sceloporus arenicolus*, in New Mexico. Unpubl. Progress Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 13 p.
- U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. Federal Register 61:7596-7613.
- U.S. Fish and Wildlife Service. 2001. Endangered and Threatened wildlife and plants; Review of plant and animal species that are candidates or proposed for listing as Endangered or Threatened, Annual notice of findings on recycled petitions, and Annual description of progress on listing actions; Proposed rule. Federal Register 66(210):54808-54832.

Gray checkered whiptail, *Aspidoscelis dixonii*

Distribution: This asexually reproducing lizard is known from only two areas; a small area in Trans-Pecos Texas and in the vicinity of Antelope Pass in Hidalgo County, New Mexico (Scudday 1973). The total range of *Aspidoscelis dixonii* in New Mexico is only 3 x 5 miles, where populations are fragmented by patches of unsuitable habitat. In New Mexico, *A. dixonii* is found on creosotebush flats with little or no shrubby undergrowth on sandy to gravelly soils. It has not been found in the sandy arroyo bottoms of Antelope Pass nor in the surrounding desert grasslands. Overall, *A. dixonii* is a rare lizard, although it may be locally common at elevations of 4265-4760 ft where suitable habitat occurs (Painter 1991, 1992).

Current Status: *Aspidoscelis dixonii* was state listed as threatened in New Mexico in 1979. It is listed as a species of concern by USFWS (USFWS 1994, 1996). The species receives no formal protection in Texas. Based on reproductive traits and morphometrics, Walker et al. (1994) suggested that the New Mexico population of *A. dixonii* is distinct from those in Trans-Pecos, Texas. Additionally, current studies of this species by the American Museum of Natural History also suggest the form at Antelope Pass may be genetically distinct from that in Trans-Pecos, Texas (Jay Cole, Curator of Herpetology, American Museum of Natural History, *pers. comm.* 2000).

From 1987-1993, NMDGF biologists conducted mark-recapture trapping for this species throughout its range at Antelope Pass. During that time 28 "+" arrays and two large pitfall grids were established and regularly monitored. These traps were operated for 417,366 trap days and caught 8,554 individual amphibians and reptiles with 8,288 lizards of 18 species, 177 snakes of 21 species, and 89 amphibians of 6 species. In 8,288 lizard captures, 409 (ca. 5%) were *A. dixonii* (Sias and Painter 2001).

Threats: Potential threats to this species include habitat alternation from excessive grazing, chemical brush control, and mining; and unregulated overcollecting.

Recommendations: This species should maintain its current listing as endangered. Following Reeder et al. (2002) and Crother et al. (2003) North American species in the genus *Cnemidophorus* should be referred to the genus *Aspidoscelis*. Habitat of the species in Hidalgo County should be regularly monitored for fragmentation and degradation through anthropogenic causes. Further surveys should be conducted in the range of *A. dixonii* in New

Mexico. Recent data and unverified observations suggest the species has declined since an extensive status review was conducted during 1987-1993 (Cole et al. *in prep.*; Tomberlin *pers comm.*). Collecting should be strictly controlled.

Literature Cited:

- Cole, C.J., C.W. Painter, H.C. Dessauer, and H.L. Taylor. *In Prep.* Destabilizing hybridization and the endangered unisexual Gray Checkered Whiptail Lizard (*Aspidoscelis dixonii*; Teiidae, Squamata) in southwestern New Mexico. American Museum Novitates.
- Crother, B.I., J. Boundy, J.A. Campbell, K. DeQuiroz, D. Frost, D.M. Green, R. Highton, J.B. Iverson, R.W. McDiarmid, P.A. Meylan, T.W. Reeder, M.E. Seidel, J.W. Sites, Jr., S.G. Tilley, and D.B. Wake. 2003. Scientific and standard English names of amphibians and reptiles of North America north of Mexico: Update. Herpetol. Rev. 34(3):196-203.
- Painter, C. W. 1991. Interim Report: Results of the 1990 survey for the gray-checked whiptail (*Cnemidophorus dixonii*) on Bureau of Land Management lands in southwestern New Mexico. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe, NM. 20 p.
- Painter, C. W. 1992. Interim Report: Results of the 1991 survey for the gray-checked whiptail (*Cnemidophorus dixonii*) on Bureau of Land Management lands in southwestern New Mexico. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe. NM. 32 p.
- Reeder, T.W., C.J. Cole, and H.C. Dessauer. 2002. Phylogenetic relationships of whiptail lizards of the genus *Cnemidophorus* (Squamata: Teiidae): A test of monophyly, reevaluation of karyotypic evolution, and review of hybrid origins. Amer. Mus. Novitates (3365):1-61.
- Scudday, J. F. 1973. A new species of lizard of the *Cnemidophorus tessellatus* group from Texas. J. Herpetol. 7(4):363-371.
- Sias, D.S. and C.W. Painter 2001. Natural history data from reptile and amphibians trapping at Antelope Pass in southwestern New Mexico. Unpubl. Report submitted to NMDGF Share with Wildlife Program, Santa Fe, NM. 12 p + 18 tables.
- U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened; Proposed rule. Federal Register 59(219):58982-58082.
- U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. Federal Register 61:7596-7613.
- Walker, J. M., J. E. Cordes, C. C. Cohn, H. L. Taylor, R. V. Kilambi, and R. L. Meyer. 1994. Life history characteristics of three morphotypes in the parthenogenetic *Cnemidophorus dixonii* complex (Sauria: Teiidae) in Texas and New Mexico. Texas J. Sci. 46(1):27-33.

Gray-banded kingsnake, *Lampropeltis alterna*

Distribution and Biology: *Lampropeltis alterna* is a medium-sized colubrid snake found in the United States from the Balcones Escarpment of the Edward's Plateau in central Texas westward through Trans-Pecos Texas to the Hueco Mountains in El Paso County (Miller 1979; Merker and Merker 2005). In New Mexico, *L. alterna* is known only from Eddy County where it occurs in the southern end of the Guadalupe Mountains (Degenhardt et al. 1996, Hakkila 1994). Painter et al. (1992) first reported the species from New Mexico.

Lampropeltis alterna is a secretive and nocturnal inhabitant of the Chihuahuan Desert. It occurs on desert hills and dry mountain slopes in rocky limestone areas associated with various xeric-adapted plants including sotol, lechuguilla, acacia, mesquite, ocotillo, creosotebush, and various cacti. Elevation in these areas range from 1460 – 5850 feet (Merker and Merker 2005). Small rodents and lizards are the primary prey, although small treefrogs (*Hyla arenicolor*) have also been reported in the diet. Very little is known regards reproduction in the wild; clutch size of captive females averages eight and varies from 3-13 eggs; neonates average ca. 10 inches total length.

Current Status: *Lampropeltis alterna* was state listed as endangered in New Mexico in 2000, thereby regulating collection and possession of the species within the state for the first time. Depending upon the number of specimens taken and/or the ultimate disposition of the specimens, collection of *L. alterna* in Texas requires either a Nongame Dealer Permit or a Nongame Collection Permit (letter in NMDGF files from Wildlife Permits Coordinator, TPWD, 8 March 1999). The species is listed as threatened by the Republic of Mexico (SDS 1994). The subspecies *L. a. alterna*, the gray-banded kingsnake, occurs in New Mexico.

The gray banded kingsnake reaches the periphery of its range in southeastern New Mexico. The first specimen from New Mexico was not obtained until 1991. To date, only 3 specimens from the wild have been documented in New Mexico, although collectors have likely found others. All 3 documented specimens have been from the Guadalupe Mountains.

Threats: Due to the presumed very small population size, the primary threat to this species in New Mexico is overcollecting. It is believed that the removal of even a small number of females from a population could significantly affect the population size. Disclosure of site specific information on the area of occurrence could increase the pressure from overcollecting. Highway mortality may also contribute to population declines.

Recommendations: *Lampropeltis alterna* should maintain its current listing as endangered. NMDGF should monitor the effectiveness of the conservation recovery actions in the final Recovery Plan. Areas known to be occupied by *L. alterna* should be regularly patrolled for illegal collecting activities.

Literature Cited:

- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, ABQ. xix + 431 p.
- Hakkila, M. 1994. An assessment of potential habitat and distribution of the gray-banded kingsnake (*Lampropeltis alterna*) in New Mexico. Unpubl. Rept. To NM Dept. Game and Fish. Santa Fe, NM. 12 p + 3 maps.
- Merker, G. and W. Merker. 2005. *Alterna* The Gray-Banded Kingsnake. LM Digital. 80 pp.
- Miller, D.J. 1979. A life history study of the gray-banded kingsnake, *Lampropeltis mexicana alterna* in Texas. Chihuahuan Desert Research Inst. Cont. No. 87. Alpine, Texas. 48 p.
- Painter, C.W., C.L. Hayes, and J.N. Stuart. 2002. Recovery and conservation of the Gray-banded Kingsnake: Final Plan. NM Dept. Game and Fish, Conservation Services Div., Santa Fe, NM.
- Painter, C.W., P.W. Hyder, and G. Swinford. 1992. Three species new to the herpetofauna of New Mexico. *Herp. Review* 23(2):62.
- Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. *Diario Oficial De La Federación*, Mexico CDLXXXVII(10):2-60.

Mexican gartersnake, *Thamnophis eques*

Distribution: In New Mexico, *Thamnophis eques* occurs from 3690-5420 ft in western Grant and Hidalgo counties, where it is known from single localities at and near Mule Creek and along the Gila River near Virden (Fitzgerald 1986). There is a single, century-old record from Duck Creek in Grant County near Cliff but populations no longer exist at that locality (Degenhardt et al. 1996). The species is known from adjacent Arizona (Cochise County at San Bernardino NWR), although populations at that site are declining with the introduction of non-native bullfrogs implicated for the decline (Rosen and Schwalbe 1988, Schwalbe and Rosen 1988). The subspecies *T. e. megalops* occurs in New Mexico.

Current Status: *Thamnophis eques* was first listed under the WCA in 1983. It is listed as a species of concern by USFWS (USFWS 1994, 1996). *Thamnophis eques* is a species of wildlife of special concern in Arizona (AGFD 1996) and is listed as threatened by the Republic of Mexico (SDS 1994). The subspecies *T. eques megalops* was recently petitioned for federal listing by the Center for Biological Diversity (2003), and the USFWS initiated a status review to determine if listing this species is warranted (USFWS 2006). The basis of this petition was cited as documented population declines, decreased range, and local extinction. Current status of *T. eques* at historic localities in New Mexico is not able to be confirmed due to lack of access to these areas.

Threats: Threats throughout the range of this subspecies include loss of wetlands, urbanization, habitat alteration, pollution, excessive grazing pressure, loss of native prey species, exotic species predation (including bullfrogs and non-native predatory fishes), and possibly overcollecting.

Recommendations: *Thamnophis eques* should maintain its current listing as endangered, and permits for collection should be limited to research that aids in conservation of the species or wetlands where they occur. Permission to conduct surveys on private lands should be applied for and further surveys should be conducted at historic localities. Research projects designed for conservation of the species and reestablishment of wetlands within the historic range of the species should be initiated.

Literature Cited:

- Arizona Game and Fish Dept. 1996. Wildlife of Special Concern in Arizona. (Public Review Draft). Arizona Game and Fish Dept. Phoenix, AZ. 40 p.
- Center for Biological Diversity. 2003. Petition to list the Mexican Garter Snake, *Thamnophis eques megalops*, as an endangered or threatened species under the Endangered Species Act. Unpubl. Rept. submitted to Gale Norton, Secretary of the Interior, Washington D.C. 42 p.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. xix + 431 p.
- Fitzgerald, L. A. 1986. A preliminary status survey of *Thamnophis rufipunctatus* and *Thamnophis eques* in New Mexico. Unpubl. Rept. New Mexico Dept. Game & Fish, Santa Fe, NM. 12 p.
- 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. Rept. U.S. Fish & Wildlife Service, Albuquerque, NM. 69 p.
- Schwalbe, C. R. and P. C. Rosen. 1988. Preliminary report on the effect of bullfrogs on wetland herpetofaunas in southeastern Arizona. Pp. 166-173 in R. C. Szaro, K. E. Severson, and D. R. Patton (eds.). Management of Amphibians, Reptiles, and Small Mammals in North America. USDA Forest Serv., Rocky Mt. Forest Range Exp. Station. Gen. Tech. Rept. RM-166, Ft. Collins, CO. 458 p.
- Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. Diario Oficial De La Federación, Mexico CDLXXXVII(10):2-60.
- U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened; Proposed rule. Federal Register 59(219):58982-58082.
- U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. Federal Register 61:7596-7613.
- U.S. Fish and Wildlife Service. 2006. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the Northern Mexican Gartersnake as threatened or endangered with critical habitat. Federal Register 71(2):315-324.

Plain-bellied watersnake, *Nerodia erythrogaster*

Distribution: *Nerodia erythrogaster* occurs from the Atlantic Ocean to southeast New Mexico. In New Mexico, it is confined to the lower Pecos River drainage, including along the Black and Delaware rivers. It is a rare, nocturnal, and little observed species that requires permanent water where it forages for fish and frogs. *Nerodia erythrogaster* reaches the extreme western extent of its range in southeast New Mexico (Degenhardt et al. 1996). The blotched watersnake, *N. e. transversa*, occurs in New Mexico.

Current Status: *Nerodia erythrogaster* was state listed as threatened in 1975, and uplisted to endangered in 1994. No protection is afforded this species in Texas. It is listed as threatened by the Republic of Mexico (SDS 1994). Populations in Mexico are rapidly declining due to alteration of aquatic habitat (Conant 1977; Scudday 1977). Despite numerous surveys along the lower Pecos River drainage since 1988, fewer than 10 individuals of this species have been located (Painter 1991, 1993). A contract for surveys of *N. erythrogaster* has been initiated, and should provide more updated information on the status of the species in New Mexico.

Threats: Primary threats are from direct take and alteration of current water use practices. Populations that exist in areas of high human impact, e.g., 6-Mile Dam, 10-Mile Dam, and ditches in the Carlsbad area are particularly susceptible to take (NMDGF files). *Nerodia erythrogaster* is often killed by uninformed fishermen who believe it to be venomous and injurious to game fish populations (West 1992).

Recommendations: *Nerodia erythrogaster* should retain its current status as endangered. An educational program designed to provide public information, (especially to the local anglers) on the natural history, status, and distribution of this species around Carlsbad should be initiated. The common name of this species should be considered as plain-bellied watersnake (Crother 2000).

Literature Cited:

- Conant, R. 1977. Semiaquatic reptiles and amphibians of the Chihuahuan Desert and their relationships to drainage patterns of the region. Pp. 455-491 in R. H. Wauer, and D. H. Riskind (eds.). Transactions of the Symposium on the Biological Resources of the Chihuahuan Desert Region, United States and Mexico. U.S. Dept. Interior, Natl. Park Serv., Trans. Proc. Ser. (3):xxii + 658 p.
- Crother, B.I. (ed.). (2000) 2001. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. SSAR Herpetol. Circular 29. iii + 82 p.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, ABQ. xix + 431 p.
- Painter, C. W. 1991. Summary of Field Work - 1991. Blotched water snake (*Nerodia erythrogaster transversa*). New Mexico Dept. Game and Fish Unpubl. Rept. Submitted to BLM Carlsbad Resource Area, Carlsbad, NM. 7 p.
- Painter, C. W. 1993. Preliminary investigations of the distribution and natural history of the blotched water snake (*Nerodia erythrogaster transversa*) in New Mexico. New Mexico Dept. Game and Fish Unpubl. Rept. Submitted to BLM Carlsbad Resource Area, Carlsbad, NM. 16 p.
- Scudday, 1977. Some recent changes in the herpetofauna of the northern Chihuahuan Desert. Pp. 513-522 in R. H. Wauer, and D. H. Riskind (eds.). Transactions of the Symposium on the Biological Resources of the Chihuahuan Desert Region, United States and Mexico. U.S. Dept. Interior, Natl. Park Serv., Trans. Proc. Ser. (3):xxii + 658 p.
- Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. Diario Oficial De La Federación, Mexico CDLXXXVII(10):2-60.
- West, S. 1992. Eddy County water moccasins. The Phainopepla 1(3):3-4.

(New Mexico) ridgenosed rattlesnake, *Crotalus willardi obscurus*

Distribution: The total known range of this federally threatened subspecies of *C. willardi* includes the high elevations of the Animas Mountains (5970-8500 ft) and Peloncillo Mountains (5600-6200 ft) (SW Hidalgo County, New Mexico), and the northern Sierra San Luis (extreme NE Sonora and NW Chihuahua, Mexico) (Barker 1991). The species was not reported from the Peloncillo Mountains in Arizona until 1997 (Holycross and Smith 1997). Recent genetic work demonstrates that the three mountain ranges harbor isolated populations that should be regarded as evolutionarily significant units. Multiple lines of evidence suggest an exceptionally small population is harbored in the Peloncillo Mountains, and the Peloncillo population tested positive for genetic bottlenecks in several statistical tests (A.T. Holycross *pers. comm.*).

This is a montane species, restricted to rocky hillsides, canyon bottoms, and talus slopes. Dominant vegetation in the habitat of *C. willardi* includes various oaks, Apache and Chihuahua pine, alligator bark juniper, manzanita, and various grasses (Degenhardt et al. 1996).

Current Status: *Crotalus willardi obscurus* was state listed as endangered in New Mexico in 1975. It is listed as threatened by the USFWS (USDI 1991) and as a species of special concern in Arizona. A federal recovery plan was approved in 1985 (USFWS 1985). The Animas Mountains population is protected by current land stewardship and appears fairly secure (Holycross 1995), although there is the continued threat of catastrophic wildfire. In the Peloncillo Mountains a total of only 26 specimens are known to science. Eighteen of these were collected by A.T. Holycross (Arizona State Univ.) with funding provided by NMDGF, Arizona Game and Fish Department, and USFWS between 1995 and 2001 (Holycross 1999; Holycross, *pers. comm.*).

Threats: The most prominent threat to *Crotalus willardi obscurus* is habitat loss (i.e., type conversion of woodland habitat) and direct take resulting from wildfire or prescribed management-ignited fires. Additionally, changes in land ownership or land use practices that result in habitat modification could negatively affect populations. Prescribed fire may pose a threat to marginal and fragmented habitat for this species in the Peloncillo Mountains. Seasonal variation of the threat imposed by fire deserves additional research.

The species is commercially valuable and much sought after by private herpetoculturists. While investigating the status of *C. willardi* in the Animas Mountains, Harris and Simmons (1975) reported encountering 15 collectors from 6 states during late August 1974, and they felt that the species could not withstand such overexploitation.

Recommendations: *Crotalus willardi obscurus* should maintain its current listing as endangered. NMDGF should cooperate with USFWS and form an Advisory Team to review the Recovery Plan (USFWS 1985), which is over 20 years old and outdated. Staff biologists from NMDGF and USFS should work together to help design a program of prescribed fire. The primary goal should be to develop a fire management program which emphasizes the need for cool-season, low-intensity fires to reduce the buildup of woody fuels and thus the chance for catastrophic wildfire within the montane habitat of *C. willardi obscurus*. Where fires do occur, active rehabilitation such as reseeded with fast-growing grasses (often non-native) should not be conducted.

Literature Cited:

- Baker, D. G. 1991. An investigation of the natural history of the New Mexico ridgenose rattlesnake, *Crotalus willardi obscurus*. Unpubl. Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 100 p.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. xix + 431 p.
- Harris, H. S., Jr. and R. S. Simmons. 1975. An endangered species, the New Mexican ridge-nose rattlesnake. Bull Maryland Herpetol. Soc. 11(1):1-7.
- Holycross, A. H. 1995. Status of the Animas Mountains Population of *Crotalus willardi obscurus*. Unpubl. Preliminary Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 14 p.
- Holycross, A.H. 1999. A map of potential core habitat for *Crotalus willardi obscurus* on Coronado National Forest lands in the Peloncillo Mountains. Unpubl. Rept. submitted to Malpais Borderlands Group, Douglas, Arizona. 144 p.
- Holycross, A. T. and S. W. Smith. 1997. Geographic Distribution: *Crotalus willardi obscurus*. Herpetol. Rev. 28(2):97.
- United States Department of the Interior (USDI). 1991. Title 50-Wildlife and Fisheries. Part 17: Endangered and threatened wildlife and plants, Subpart B: Lists, endangered and threatened wildlife (CFR 17.11 and 17.12). U.S. Govt. Printing Office, Washington, D.C. 37 p.
- U.S. Fish and Wildlife Service (USFWS). 1985. New Mexico Ridgenose Rattlesnake Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

THREATENED

Western river cooter, *Pseudemys gorzugi*

Distribution: In New Mexico, *P. gorzugi* is confined to the Pecos River drainage, including the Pecos, Black, and Delaware rivers below Brantley Dam in Eddy County. Historic records of *P. gorzugi* from Bitter Lake NWR in Chaves County (Bundy 1951) are questionable (Painter 1991). The species is primarily herbivorous, although it is easily collected using sardines as bait.

Current Status: *Pseudemys gorzugi* was state listed as threatened in 1975. It is one of the least-known freshwater turtles in North America (Ernst 1995, Ernst et al. 1994). Populations of *P. gorzugi* in Texas are declining, due primarily to take for the pet trade (Mike Forstner 2001 *in litt.*). It is listed as Rare by the Republic of Mexico (SDS 1994). *Pseudemys gorzugi* is often an abundant turtle within its limited habitat, preferring river systems with deep pools and generally avoiding shallow riffles (Degenhardt et al. 1996). A contract for surveys of *P. gorzugi* has been initiated, and should provide more updated information on the status of the species in New Mexico.

Threats: The primary threat to *P. gorzugi* is from weekend recreationists and fishermen who use it for target practice. Fishermen often take it on trotlines set for catfish or while fishing for other species with live or dead animal bait. Water-use practices in the lower Pecos River are determined by a large number of factors so that the water required for this species is likely guaranteed.

Recommendations: *Pseudemys gorzugi* should maintain its current listing as threatened, although NMDGF should partner with Texas and seek funding to investigate its current status throughout its known range. A program of public awareness should be initiated and informative signs should be posted around the commonly used fishing areas in the lower Pecos River drainage.

Literature Cited:

- Bundy, R. E. 1951. New locality records of reptiles in New Mexico. *Copeia* 1951(4):314.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. *Amphibians and Reptiles of New Mexico*. Univ. New Mexico Press, ABQ. xix + 431 p.
- Ernst, C. H. 1995. Freshwater and terrestrial turtles of the United States: Status and prognosis. *Bull. Chicago Herp. Soc.* 30(11):225-230.
- Ernst, C. H., J. E. Lovich, and R. W. Barbour. 1994. *Turtles of the United States and Canada*. Smithsonian Inst. Press. Washington, D.C. xxxviii + 578 p.
- Painter, C. W. 1991. Preliminary investigations of the distribution and natural history of the Rio Grande river cooter (*Pseudemys concinna gorzugi*) in New Mexico. New Mexico Dept. Game and Fish Unpubl. Rept. submitted to Bureau of Land Management, Carlsbad Resource District. Carlsbad, New Mexico. 27 p.
- Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. *Diario Oficial De La Federación*, Mexico CDLXXXVII(10):2-60.

Slevin's bunchgrass lizard, *Sceloporus slevini*

Distribution: *Sceloporus slevini*, primarily a Mexican species, is peripheral in New Mexico, reaching the northern and eastern edge of its range in southwest New Mexico. It is known only from extreme southwest Hidalgo County in the grasslands and adjacent foothills in the Animas Valley at elevations of 5100-5300 ft (Degenhardt et al. 1996). Dixon and Medica (1965) first reported the species from New Mexico. As the common name suggests, *S. slevini* occurs in areas of dense bunch grass, usually on hillsides within the ponderosa pine zone. The specimens from New Mexico are enigmatic because of their grassland origin, although research suggests this was once a widespread grassland species that has only recently retreated to the mountain slopes to escape the alternation of the grasslands brought about by excessive grazing pressure (Bock et al. 1990).

Current Status: *Sceloporus slevini* was state listed as threatened in New Mexico in 1975, uplisted to endangered and then downlisted again the threatened in 1996 based on the commitment from the Malpai Borderlands Group to promote sound range management and biological diversity. Other than in New Mexico, *S. slevini* receives no formal protection anywhere throughout its range. Within its limited habitat in southeast Arizona, many populations are suffering significant declines because of severe overgrazing (Congdon 1994). Prior to 1994, *S. slevini* had not been collected in New Mexico since 1967 when it was known from only 6 specimens. During 1994-97 however, trapping efforts in suitable habitat in the Animas Valley have shown *S. slevini* to be more abundant and widespread than previously known.

Threats: The primary threat to *S. slevini* is habitat degradation or modification from excessive grazing. Unregulated, excessive collecting may cause localized reductions in populations.

Recommendations: *Sceloporus slevini* should retain its status as threatened. Routine monitoring of the small New Mexico population should be implemented to ensure that grazing management, especially in times of severe drought, do not cause declines. In addition, strict regulations regarding collecting should continue to be enforced. Based on recommendations of Smith et al. (1996) the *Sceloporus slevini* in New Mexico should be conferred a full species rank with the common name Slevin's bunchgrass lizard (Crother 2000)

Literature Cited:

- Bock, C.E., H.M. Smith, and J.H. Bock. 1990. The effect of livestock grazing upon abundance of the lizard, *Sceloporus scalaris*, in southeastern Arizona. *J. Herpetol.* 24(4):445-446.
- Congdon, J.D. 1994. Letter addressed to USFS, Douglas Ranger District. Data provided on 100% decline of some *S. scalaris* populations in SE Arizona. Letter on file with NMGF, Endangered Species Program. Santa Fe, New Mexico.
- Crother, B.I. (ed.). (2000) 2001. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. *SSAR Herpetol. Circular* 29. iii + 82 p.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. *Amphibians and Reptiles of New Mexico*. Univ. New Mexico Press, Albuquerque. xix + 431 p.
- Dixon, J.R. and P.A. Medica. 1965. Noteworthy records of reptiles from New Mexico. *Herpetologica* 21(1):72-75.
- Smith, H.M., G.J. Watkins-Colwell, E.A. Liner, and D. Chiszar. 1996. *Sceloporus scalaris* auctorum a superspecies (Reptilia: Sauria). *Bull. Maryland Herpetol. Soc.* 32(2):70-74.

Canyon spotted whiptail, *Aspidoscelis burti*

Distribution: The range of this large lizard extends southward into Mexico to at least southern Sonora. It reaches the extreme eastern and northern edge of its range in southwest New Mexico. In New Mexico, it occurs only in Guadalupe Canyon in southwest Hidalgo County where it is common in its limited habitat at 4330-4520 ft (Degenhardt et al. 1996). Records from the Peloncillo Mountains along Geronimo Trail and from the Alamo Hueco Mountains (Hayward et al. 1977) are questionable and have not been verified. This is the largest member of the genus *Aspidoscelis* in North America. It is an active diurnal species that depends upon a mosaic of open spaces and cover where it forages for insects, its primary prey. The giant spotted whiptail, *A. b. stictogramma*, occurs in New Mexico.

Current Status: *Aspidoscelis burti* was state listed as threatened in New Mexico in 1975, uplisted to endangered and then downlisted again the threatened in 1996 based on the commitment from the Malpai Borderlands Group to promote sound range management and biological diversity. It is listed as a species of concern by USFWS (USFWS 1994, 1996). *Aspidoscelis burti* receives no formal protection in Arizona or Mexico. Populations of *A. burti* in Guadalupe Canyon are healthy and stable (Painter and Tomberlin 1996).

Threats: Habitat alteration and overcollecting are the only major perceived threats to this species in New Mexico. Extant populations could be impacted by uncontrolled wildfire or by excessive grazing of the riparian vegetation in their limited habitats.

Recommendations: *Aspidoscelis burti* should be retained as threatened. NMDGF biologists should coordinate with land owners within the habitat of *A. burti* to help design a program of prescribed fire. The primary goal should be to develop a fire management program which emphasizes the need for cool-season, low-intensity fires to reduce the buildup of woody fuels and thus the chance for catastrophic wildfire within the riparian habitat of *A. burti*. Routine monitoring of the small New Mexico population should be implemented to ensure that grazing management, especially in times of severe drought, do not cause declines. In addition, strict regulations regarding collecting should continue to be enforced. Following Reeder et al. (2002) and Crother et al. (2003) North American species in the genus *Cnemidophorus* should be referred to the genus *Aspidoscelis*, and the subspecies should be considered as *stictogramma*.

Literature Cited:

- Crother, B.I., J. Boundy, J.A. Campbell, K. DeQuiroz, D. Frost, D.M. Green, R. Highton, J.B. Iverson, R.W. McDiarmid, P.A. Meylan, T.W. Reeder, M.E. Seidel, J.W. Sites, Jr., S.G. Tilley, and D.B. Wake. 2003. Scientific and standard English names of amphibians and reptiles of North America north of Mexico: Update. *Herpetol. Rev.* 34(3):196-203.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. *Amphibians and Reptiles of New Mexico*. Univ. New Mexico Press, Albuquerque. xix + 431 p.
- Hayward, B. J., T. C. Heiner, and R. F. Miller. 1977. Resource inventory of the Alamo Hueco-Big Hatchet-Sierra Rica mountain complex. Unpubl. Rept. BLM, Las Cruces District, Contract No. YA-512-CT6-201. 155 p.

- Painter, C. W. and B. R. Tomberlin. 1996. Status of Guadalupe Canyon herpetofauna, Hidalgo County, New Mexico. Summary of 1995 studies. Unpubl. Rept. BLM, Las Cruces District, NM. 12 p.
- Reeder, T.W., C.J. Cole, and H.C. Dessauer. 2002. Phylogenetic relationships of whiptail lizards of the genus *Cnemidophorus* (Squamata: Teiidae): A test of monophyly, reevaluation of karyotypic evolution, and review of hybrid origins. *Amer. Mus. Novitates* (3365):1-61.
- U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened; Proposed rule. *Federal Register* 59(219):58982-58082.
- U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. *Federal Register* 61:7596-7613.

Mountain skink, *Eumeces callicephalus*

Distribution: In New Mexico, *Eumeces callicephalus* occurs only in the southern Peloncillo Mountains of southwest Hidalgo County. It is known from 4300-6400 ft in Guadalupe Canyon and along Geronimo Trail, where it is uncommon in its limited habitat (Degenhardt et al. 1996). *Eumeces callicephalus* requires abundant and well-rotted leaf litter for forage areas and sites for egg-laying.

Current Status: *Eumeces callicephalus* was state listed as threatened in New Mexico in 1975. No protection is afforded *E. callicephalus* in Arizona or Mexico. *Eumeces callicephalus* is peripheral in New Mexico, where it reaches the eastern and northern edges of its range. It is secretive and rarely observed, although it is easily captured using pitfall traps set in its riparian habitat. Populations of *E. callicephalus* in Guadalupe Canyon are healthy and stable (Painter and Tomberlin 1996).

Threats: Habitat alteration and overcollecting are the only perceived threats to this species in New Mexico. Extant populations could be impacted by uncontrolled wildfire or by excessive riparian grazing within its limited habitat.

Recommendations: This species should maintain its current listing as threatened. NMDGF should coordinate with land owners and federal land management agencies within the habitat of *E. callicephalus* to help design a program of prescribed fire. The primary goal should be to develop a fire management program which emphasizes the need for cool-season, low-intensity fires to reduce the buildup of woody fuels and thus the chance for catastrophic wildfire within the riparian habitat of *E. callicephalus*. Routine monitoring of the small New Mexico population should be implemented to ensure that grazing management, especially in times of severe drought, do not cause declines. In addition, strict regulations regarding collecting should continue to be enforced. Based on Crother (2000) the populations in New Mexico should be considered as *E. callicephalus*.

Literature Cited:

- Crother, B.I. (ed.). (2000) 2001. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. *SSAR Herpetol. Circular* 29. iii + 82 p.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. *Amphibians and Reptiles of New Mexico*. Univ. New Mexico Press, Albuquerque. xix + 431 p.
- Painter, C. W. and B. R. Tomberlin. 1996. Status of Guadalupe Canyon herpetofauna, Hidalgo Co., New Mexico. Summary of 1995 studies. Unpubl. Rept. BLM, Las Cruces District, 12 p.

Green ratsnake, *Senticolis triaspis*

Distribution: *Senticolis triaspis* occurs from southwest New Mexico and southern Arizona south to Costa Rica. It reaches the extreme eastern edge of its range in southwest New Mexico where it is very rare and seldom encountered. The northern green ratsnake, *S. t. intermedia*, occurs in New Mexico.

Current Status: *Senticolis triaspis* was listed as state threatened in New Mexico in 1983. It receives no formal protection in Mexico. It is protected from unregulated take in Arizona (AGFD 1996). In New Mexico, it is known from only 3 museum specimens from far southwestern New Mexico (Degenhardt et al. 1996, Garrett and Painter 1992, Painter and Tomberlin 1996).

Threats: This beautiful species is very desirable and valuable in the pet trade and is therefore threatened by overcollecting. Habitat alteration through uncontrolled wildfire or increased grazing pressure is also a threat.

Recommendations: *Senticolis triaspis* should maintain its current listing as threatened. NMDGF should coordinate with federal land management agencies and private landowners within the habitat of *S. triaspis* to help design a program of prescribed fire. The primary goal should be to develop a fire management program which emphasizes the need for cool-season, low-intensity fires to reduce the buildup of woody fuels and thus the chance for catastrophic wildfire within the riparian habitat of *S. triaspis*. Routine monitoring of the habitat that supports the small New Mexico population should be implemented to ensure that grazing management, especially in times of severe drought, do not cause declines. In addition, strict regulations regarding collecting should continue to be enforced.

Literature Cited:

- Arizona Game and Fish Dept. 1996. Arizona reptile and amphibian regulations. Commission Order 41 and 42. Arizona Game and Fish Dept. Phoenix, AZ.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. xix + 431 p.
- Garrett, C.M. and C.W. Painter. 1992. Geographic Distribution: *Senticolis triaspis intermedia*. Herpetol. Review 23(4):124.
- Painter, C.W. and B.R. Tomberlin. 1996. Status of Guadalupe Canyon herpetofauna, Hidalgo County, New Mexico. Summary of 1995 studies. Unpubl. Rept. BLM, Las Cruces District, 12 p.

Narrow-headed gartersnake, *Thamnophis rufipunctatus*

Distribution: In New Mexico, *Thamnophis rufipunctatus* is confined to Catron, Grant, and Hidalgo counties where it reaches the eastern edge of its distribution. It is a habitat specialist, occurring only in shallow, swift-flowing, rocky rivers and streams of the San Francisco and Gila River drainages (Fitzgerald 1986, Degenhardt et al. 1996). Interstitial spaces between submerged or partially submerged rocks along stream or river bottoms may be important habitat features for *T. rufipunctatus* (Rosen and Schwalbe 1988). It feeds almost exclusively on fish (Flehart 1967).

Current Status: *Thamnophis rufipunctatus* was listed as state threatened under the WCA in New Mexico in 1975. It is listed as a species of special concern by USFWS (USFWS 1994, 1996). It is a species of wildlife of special concern in Arizona (AGFD 1996). Extensive surveys by NMDGF during 2004-05 suggest a disappearance of the species from the area of the San Francisco Hot Springs in Catron County near Glenwood, the site of a previously robust population.

Threats: Major threats to this species are changes in water-use practices and heavy grazing pressure on streamside vegetation that results in alteration of habitat, including heavy siltation and the elimination of undercut banks. There is indirect evidence that the introduction of bullfrogs has eliminated *T. rufipunctatus* from its native habitat in some areas, e.g., Wall Lake in Catron County (Flehart 1967, Schwalbe and Rosen 1988). Nowak and Santana-Bendix (2002; 2003a, 2003b) reported declines of this species in central Arizona based on the presence of non-native "spiny-rayed" fishes (i.e., the sunfishes *Micropterus* and *Lepomis*, family Centrarchidae), habitat destruction and modification due to increased recreation and siltation, and localized mortality due to channel-altering flood events, direct predation by humans, and roadkills.

Recommendations: *Thamnophis rufipunctatus* should maintain its current listing as threatened. NMDGF should seek funding to complete a study of the current status of this species in southwest New Mexico, including participation in a range wide phylogenetic study of the species. Although the population at San Francisco Hot Springs is believed to be extirpated, efforts should continue at this and nearby sites to obtain specimens for disease testing. Microhabitat characteristics of the San Francisco Hot Springs site should be compared to those collected during earlier studies at the same site. In addition, strict regulations regarding collecting should continue to be enforced.

Literature Cited:

- Arizona Game and Fish Dept. 1996. Wildlife of Special Concern in Arizona. (Public Review Draft). Arizona Game and Fish Dept. Phoenix, AZ. 40 p.
- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. xix + 431 p.
- Fitzgerald, L.A. 1986. A preliminary status survey of *Thamnophis rufipunctatus* and *Thamnophis eques* in New Mexico. Unpubl. Rept. New Mexico Dept. Game and Fish, Santa Fe, NM. 12 p.
- Fleharty, E.D. 1967. Comparative ecology of *Thamnophis elegans*, *T. cyrtopsis*, and *T. rufipunctatus* in New Mexico. Southwest. Nat. 12(3):207-230.
- Nowak, E.M. and M.A. Santana-Bendix. 2002. Status, distribution, and management recommendations for the narrow-headed gartersnake (*Thamnophis rufipunctatus*) in Oak Creek, Arizona. Unpubl. Rept submitted to Arizona Game and Fish Dept., Heritage Grant I99007. 56 p.
- Nowak, E.M. and M.A. Santana-Bendix. 2003a. Distribution, ecology, and management recommendations for the narrow-headed gartersnake (*Thamnophis rufipunctatus*) in Oak Creek, Arizona – part 1 of 2. Sonoran Herpetologist 16(10):86-89.
- Nowak, E.M. and M.A. Santana-Bendix. 2003b. Distribution, ecology, and management recommendations for the narrow-headed gartersnake (*Thamnophis rufipunctatus*) in Oak Creek, Arizona – part 2 of 2. Sonoran Herpetologist 16(11):98-101.
- 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. Arizona Game and Fish Dept. Unpubl. Rep. submitted to U.S. Fish and Wildlife Service, Albuquerque, NM. 69 p.
- Schwalbe, C.R. and P.C. Rosen. 1988. Preliminary report on the effect of bullfrogs on wetland herpetofaunas in southeastern Arizona. Pp. 166-173 in R. C. Szaro, K. E. Severson, and D. R. Patton (eds.). Management of Amphibians, Reptiles, and Small Mammals in North America. USDA Forest Serv., Rocky Mt. Forest Range Exp. Station. Gen. Tech. Rept. RM-166, Ft. Collins, CO. 458 p.
- U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened; Proposed rule. Federal Register 59(219):58982-58082.
- U.S. Fish and Wildlife Service. 1996. Endangered and threatened species, plant and animal taxa, proposed rule. Federal Register 61:7596-7613.

Western ribbonsnake, *Thamnophis proximus*

Distribution: In New Mexico, *Thamnophis proximus* occurs as isolated and disjunct populations mostly east of the Pecos River. It is uncommon where it occurs, with the possible exception of Bitter Lakes National Wildlife Refuge near Roswell. The species reaches the western limit of its range in eastern New Mexico and is one of the least-known snakes in the state (Degenhardt et al. 1996). The Arid Land Ribbonsnake, *T. p. diabolicus*, occurs in New Mexico.

Current Status: *Thamnophis proximus* was listed as state threatened in New Mexico in 1975. It does not receive formal protection in Texas, although it is listed as threatened by the Republic of Mexico (SDS 1994). A mark-recapture study of this species initiated at Bitter Lake National Wildlife Refuge during 1997 has shown the species to be abundant on the refuge (G. Warrick, Refuge Biologist data files).

Threats: Major threats to *T. proximus* are changes in water use practices that could result in alteration of habitat. Illegal take may be of concern in the Spring River area near Roswell. Road-killed individuals are occasionally encountered on the tour loop roads at Bitter Lake National Wildlife Refuge.

Recommendations: *Thamnophis proximus* should maintain its current listing as threatened. A public awareness program should be initiated at Bitter Lakes National Wildlife Refuge to alert people of the presence of this species and the potential of the species to be encountered on the roadways. In addition, strict regulations regarding collecting should continue to be enforced.

Literature Cited:

- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.

Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. Diario Oficial De La Federación, Mexico CDLXXXVII(10):2-60.

(Mottled) rock rattlesnake, *Crotalus lepidus lepidus*

Distribution and Biology: In New Mexico, this montane rattlesnake is known only from the Guadalupe Mountains in Eddy County and extreme eastern Otero County where it reaches the northern edge of its range in New Mexico (Degenhardt et al. 1966). Two subspecies of Rock Rattlesnake, *C. l. lepidus* and *C. l. klauberi*, occur in New Mexico; only *C. l. lepidus* is protected. A zone of intergradation between these poorly diagnosed subspecies may occur in the San Andres Mountains on White Sands Missile Range in Sierra and Doña Ana counties.

Current Status: *Crotalus l. lepidus* was listed as state threatened in New Mexico in 1975. It does not receive formal protection in Texas, although it is a Species Subject to Special Protection in the Republic of Mexico (SDS 1994). *Crotalus l. lepidus* is a localized inhabitant of the Guadalupe Mountains, rarely found away from rocky canyons or hillsides (Swinford 1992). Much of the habitat for *C. l. lepidus* in New Mexico occurs in Carlsbad Caverns National Park, therefore populations there appear to be secure except for illegal take within the park.

Threats: Outside of the national park, habitat for *C. l. lepidus* is generally unsuitable for livestock grazing, oil and gas exploration, or other development. Mining may have localized effects. Overcollecting, e.g., at Sitting Bull Falls, may reduce populations in areas well known to snake collectors, especially given the articles that have appeared in the popular herpetocultural literature (e.g., Swinford 1989; 1990).

Recommendations: *Crotalus l. lepidus* should maintain its current listing as threatened. Any evidence of overcollecting of *C. l. lepidus* should be closely monitored.

Literature Cited:

- Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque, NM. xix + 431 p.
- Secretaría De Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. Diario Oficial De La Federación, Mexico CDLXXXVII(10):2-60.
- Swinford, G.W. 1989. Captive reproduction of the banded rock rattlesnake *Crotalus lepidus klauberi*. Pp. 99-110 in M.J. Uricheck (ed.). 13th International Herpetological Symposium on Captive Propagation and Husbandry. Phoenix, Arizona.
- Swinford, G.W. 1990. Collecting the banded rock rattlesnake (*Crotalus lepidus klauberi*) in the mountains of southern New Mexico. Purpose: Captive breeding. Vivarium 3(1):8-10.
- Swinford, G.W. 1992. Status of the mottled rock rattlesnake, *Crotalus lepidus lepidus* in southeastern New Mexico. Unpubl. Rept. New Mexico Dept. Game and Fish. Santa Fe, NM. 17 p.

BIRDS

ENDANGERED

Brown pelican, *Pelecanus occidentalis*

Distribution: This coastal species breeds from California and the mid-Atlantic states southward to South America (A.O.U. 1998). Brown Pelicans are occasional visitors inland to New Mexico; they occur at all seasons but are most frequent during the summer-fall period. Through 2005, there have been some 57 reports involving nearly 70 individual birds, these from 18 of New Mexico's 33 counties, with most from large lakes or along major rivers, including the San Juan, Rio Grande, Canadian, Gila, and Pecos drainages. Most brown pelicans that occur in New Mexico are the Pacific subspecies *P. O. californicus*, although the eastern *P. o. carolinensis* is also likely to occur.

Current Status: The species is federally-listed as endangered; it was listed by New Mexico as threatened in 1983, and reclassified as endangered in 1990 as the extent of its occurrence in New Mexico became better understood. Another success story of the federal Endangered Species Act, the brown pelicans occurring from Alabama and Florida northward along the Atlantic coast had recovered to the extent that delisting was achieved in 1985 (U.S.F.W.S. 1985). However, populations from Louisiana, Texas, and California southward have yet to achieve similar recovery. In New Mexico, brown pelicans were recorded annually during the five-year period 2001-2005, averaging 3 individuals per year and with reports from 10 counties.

Threats: An important factor in the decline of the species was pesticide contamination of its prey base (fish), leading to impaired reproduction as well as direct mortality (U.S.F.W.S. 1985; Johnsgard 1993). Other threats include loss and/or disturbance of breeding areas and illegal killing.

Recommendation: No change in status is recommended. Strict enforcement of laws against harming all pelicans is essential in protecting those individuals that occur in New Mexico.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American Birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Johnsgard, P. A. 1993. Cormorants, darters, and pelicans of the world. Smithsonian Press, Washington, D.C. 445 p.
- U.S. Fish and Wildlife Service. 1985. Removal of the brown pelican in the southeastern United States from the list of endangered and threatened wildlife; final rule. Federal Register 50:4938-4945.

Aplomado falcon, *Falco femoralis*

Distribution: This grassland raptor occurs from the southwestern United States south to southern South America (A.O.U. 1998; Keddy-Hector 2000). The historic range in New Mexico included desert grasslands across the southern one-third of the state, and north in the central region to Socorro County (Hector 1987; Keddy-Hector 2000; Meyer and Williams 2005). The species requires extensive, unbroken desert grasslands characterized by relatively tall, dense grass cover and low woody plant densities (Montoya et al. 1997, Young et al 2002).

Current Status: The northern subspecies, *F. f. septentrionalis*, is federally-listed as endangered (U.S.F.W.S. 1986) with a nonessential experimental population designation for all of New Mexico and Arizona (U.S.F.W.S. 2006); the species was listed by New Mexico as endangered in 1990. Following a documented nesting in southern New Mexico in 1952 (Ligon 1961), the species was very rarely reported in the state from the 1960s through the 1980s (Meyer and Williams 2005). By the early 1990s, however, an increased presence of aplomados in New Mexico became apparent, and this raised hopes that natural recolonization of historic range was underway (Williams 1997); this increase coincided with the 1992 discovery of thriving populations in nearby Chihuahua, Mexico (Montoya et al. 1997). Overall, the decade 1990-1999 produced 24 credible reports involving 26-31 falcons in southern New Mexico, with three-six observations occurring per year by the latter part of the decade (Meyer and Williams 2005). That trend has continued into the 2000s, with multiple reports from throughout the historic New Mexico range, including observations of pairs, one of which occupied a territory for at least two years and fledged young, the first

successful nesting by native aplomado falcons in New Mexico and the United States in half a century (Meyer and Williams 2005). Extensive surveys and studies in adjacent Chihuahua, Mexico better clarified the extent of the distribution there, and indicated falcons in northern Chihuahua and southern New Mexico should be considered a single interacting population (Young et al. 2004).

Threats: Alteration or degradation of this falcon's grassland habitat was likely the primary cause of the species' decline in the United States, this occurring through reduction of grass cover and subsequent increase in woody vegetation (brush encroachment) following excessive grazing (U.S.F.W.S. 1986, 1990, Hector 1987).

Recommendation: No change in status is recommended. All agencies and organizations should continue to work closely to protect individuals and populations and to provide adequate suitable habitat to encourage continued natural recolonization. This challenge will be particularly important given the U.S. Fish and Wildlife Service's designation of the entire state of New Mexico a nonessential experimental population area for the aplomado falcon, and the resulting removal of requirements for aplomado habitat conservation measures that had resulted from previous Biological Opinions. Monitoring should be conducted to quantify both: 1) natural recolonization by native stock from Chihuahua, which would be assisted by effective protection of occupied and potential habitat; and 2) releases of captive birds of tropical southern Mexico origin into New Mexico, and any related changes to habitat condition and prey abundance that may occur with the experimental population designation associated with such releases. A conservation strategy not currently under consideration, but having merit, involves revising the outdated 1990 recovery plan to reflect new information, which could lead to revised strategies and recovery goals based upon current circumstances.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Hector, D. P. 1987. The decline of the aplomado falcon in the United States. *Am. Birds* 41:381-389.
- Keddy-Hector, D. P. 2000. Aplomado falcon. *In* The birds of North America, No. 549. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.
- Ligon, J. S. 1961. New Mexico birds. Univ. New Mexico Press, Albuquerque, NM. 360 p.
- Meyer, R. A. and S. O. Williams III. 2005. Recent nesting and current status of aplomado falcon (*Falco femoralis*) in New Mexico. *N. Am. Birds* 59:352-356.
- Montoya, A. B., P. J. Zwank, and M. Cardenas. 1997. Breeding biology of aplomado falcons in desert grasslands of Chihuahua, Mexico. *J. Field Ornithol.* 68:135-143.
- U.S. Fish and Wildlife Service. 1986. Final rule: determination of the northern aplomado falcon to be an endangered species. *Federal Register* 51:6686-6690.
- U.S. Fish and Wildlife Service. 1990. Northern aplomado falcon recovery plan. U.S. Fish and Wildlife Service, Albuquerque, NM. 58 p.
- U.S. Fish and Wildlife Service. 2006. Final rule: establishment of a nonessential experimental population of northern aplomado falcons in New Mexico and Arizona. *Federal Register* 71:42298-42315.
- Williams, S. O. III. Recent occurrences of aplomado falcons in New Mexico; is natural recolonization of historic range underway? *New Mexico Ornithological Society Bull.* 25:39.
- Young, K. E., B. C. Thompson, D. M. Browning, Q. H. Hodgson, J. L. Lanser, A. Lafon Terrazas, W. R. Gould, and R. Valdez. 2002. Characterizing and predicting suitable aplomado falcon habitat for conservation planning in the northern Chihuahuan Desert. New Mexico Cooperative Fish and Wildlife Research Unit, Las Cruces, NM. 210 p.
- Young, K. E., B. C. Thompson, A. Lafon Terrazas, A. B. Montoya, and R. Valdez. 2004. Aplomado falcon distribution and abundance in the northern Chihuahuan Desert of Mexico. *J. Raptor Research* 38:107-117.

White-tailed ptarmigan, *Lagopus leucurus*

Distribution: This alpine tundra-inhabiting grouse occurs from Alaska and the Yukon south through the Rocky Mountains; it reaches its southernmost limits in the Sangre de Cristo Mountains of New Mexico (Braun et al. 1993, A.O.U. 1998). In New Mexico, the species occurred historically on all the ridges and peaks of the Sangres above timberline, from the vicinities of Santa Fe Baldy and Pecos Baldy northward to the Colorado line (Bailey 1928, Ligon 1961).

Current Status: The species was listed as endangered by New Mexico in 1975. By the early 1900s, the species had become extremely rare throughout its New Mexico range (Bailey 1928), and by the mid-1900s it was extirpated from the southern peaks and restricted to only a few peaks in the northernmost reaches of its former habitat (Ligon 1961). A 1981 transplant of Colorado birds into the southern portion of the range was successful and there have been records in and near the transplant area in most years 1990-2006, including observations of nests and young. In addition, reports have increased from the northern peaks (Latir, Wheeler) in recent years, providing evidence of persistence of native stock in far northern New Mexico.

Threats: Initial declines were attributed to habitat degradation from grazing, particularly by domestic sheep, combined with unrestricted killing (Bailey 1928, Ligon 1961, Lee 1967, Hubbard 1970). Use of New Mexico's limited alpine tundra habitat by livestock as well as by growing numbers of elk and bighorn sheep, plus increased human use including wilderness hiking, ski area development, construction of snow catchment fences, and microwave relay stations, are among the threats to the state's remnant ptarmigan population (Braun et al. 1993).

Recommendation: No change in status is recommended. NMDGF should work with land managers to protect alpine and timberline habitats for this species. NMDGF should conduct a coordinated survey of all suitable habitat in the Sangre de Cristo Mountains, to document current distribution and abundance.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Bailey, F. M. 1928. Birds of New Mexico. New Mexico Dept. of Game and Fish, Santa Fe, NM 807 p.
- Braun, C. E., K. Martin, and L. A. Robb. 1993. White-tailed ptarmigan. *In* The birds of North America, No. 68. Academy of Natural Sciences, Philadelphia, PA and American ornithologists' Union, Washington, D.C. 24 p.
- Hubbard, J. P. 1970. Check-list of the birds of New Mexico. New Mexico Ornithological Society Publ. No. 3. 108 p.
- Lee, L. 1987. White-tailed ptarmigan. *In* New Mexico wildlife management. New Mexico Dept of Game and Fish, Santa Fe, NM 250 p.
- Ligon, J. S. 1961. New Mexico birds. Univ. New Mexico Press, Albuquerque, NM 360 p.

Whooping crane, *Grus americana*

Distribution: Formerly widespread in North America, by 1941 the species had declined to about 16 individuals in a single wild flock that migrated between Canada and coastal Texas (Lewis 1995). Natural occurrence of the species in New Mexico is unproved; unverified sightings from the Hatch and Portales areas in the 1850s and 1930s, respectively (Allen 1952), may have been this species. More recent was an intriguing but unconfirmed report of two whoopers seen at Grulla N.W.R., Roosevelt County, for one day in December 2004 (Williams 2005). Beginning in 1975, an experimental population was produced in Idaho, using sandhill cranes (*G. canadensis*) as foster parents for young whoopers, and that flock wintered in the middle Rio Grande Valley in New Mexico.

Current Status: The whooping crane, an enduring symbol of national and international efforts to recover endangered species, is federally-listed as endangered. It was first listed as threatened by New Mexico in 1975, and reclassified as endangered in 1990. Rangewide, the recovery efforts appear to be achieving some success. According to the U.S. Fish and Wildlife Service and Patuxent Wildlife Research Center, by January 2006 the world population of whoopers was up to 476 individuals, including 218 in the wild flock that migrates between Canada and Texas, 64 in an experimental flock that migrates between Wisconsin and Florida, 59 in an experimental, non-migrating flock in Florida, and 135 in several captive breeding facilities. In the west, however, because of the lack of pairing and reproduction plus high mortality rates, all efforts to establish a viable Rocky Mountain flock were terminated, with the remaining birds being reclassified as "experimental, nonessential" and all critical habitat designations within the state being removed (U.S.F.W.S. 1997). Two whoopers wintered in New Mexico in 2000-01, but only one survived to winter here in 2001-02. That 18-year old individual migrated north from New Mexico in spring 2002, but was never seen again and presumably died, bringing the experiment to an end.

Threats: Overall decline of the species is attributed to habitat loss and alteration; once reduced in numbers, killing and disturbance by humans, disease, and collision with manmade objects became important (Lewis 1995).

Recommendation: With the demise of the last survivor of the discontinued Rocky Mountain experimental flock, and the continued absence of proof of natural occurrence of the species in the state, NMDGF should consider whether the species should be removed from New Mexico's list of threatened and endangered species.

Literature Cited:

- Allen, R. P. 1952. The whooping crane. National Audubon Society Research Report No. 3. New York, NY. 246 p.
- Lewis, J. C. 1995. Whooping crane. *In* The birds of North America, No. 153. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 28 p.
- U.S. Fish and Wildlife Service. 1997. Designation of the whooping cranes of the Rocky Mountains as experimental nonessential and to remove whooping crane critical habitat designations from four locations. Federal Register 62:38932-38939.
- Williams, S. O. III. 2005. New Mexico, winter season 2004-05. *N. Am. Birds* 59:302-304.

Piping plover, *Charadrius melodus*

Distribution: This small shorebird of the northern Great Plains, Great Lakes region, and eastern coastal areas (Haig 1992) is a very rare migrant in New Mexico, where reported at wetlands in Colfax, Guadalupe, Socorro, Chaves, and Eddy counties.

Current Status: The species is federally-listed as endangered in the Great Lakes region and as threatened away from there (U.S.F.W.S. 1985); it was listed by New Mexico as threatened in 1988 and reclassified as endangered in 1990. It is listed as threatened by the state of Colorado. Although Piping Plovers nest in southeastern Colorado (Kingery 1998), not far north of New Mexico, the species has been reported from New Mexico on only 7 occasions, most recently in April 2001 (Williams 2001). Breeding populations outside of New Mexico, which produce the birds that have been observed in New Mexico, have dynamic populations in recent years. The Northern Great Plains piping plover population, which extends south to the Arkansas River of southeastern Colorado, is closest to New Mexico and has greater fluctuations in population counts. While there were clear increases in the Atlantic Coast and smaller Great Lake populations, numbers of piping plovers observed in U.S. Northern Great Plains during the 1991, 1996, and 2001 international piping plover breeding censuses were more variable, at 2032, 1599, and 1981 adults, respectively (Ferland and Haig 2002). Observed numbers of piping plovers appear to vary substantially depending upon availability of mudflat and sandbar habitats, water levels, violent storm systems, etc. Despite a period of at least 40 years of no known piping plover breeding in Colorado beginning in 1949, surveys by the U.S. Army Corps of Engineers on southeast Colorado reservoirs recorded as many as 24 breeding pairs in 2003.

Threats: The loss or alteration of nesting and wintering habitats, through development, vehicular traffic, human disturbance, and the negative effects of impoundments and/or irregular water releases in riverine areas, are the major threats (U.S.F.W.S. 1985, Ryan et al. 1993).

Recommendation: Recommend downlisting piping plover from endangered to threatened. Downlisting the species under the WCA would make the state status consistent with the federal listing status. Because the piping plover does not breed within New Mexico, its occurrence within the state is dependent upon status and conditions of breeding populations elsewhere. Protection of mudflat and sandbar habitats at New Mexico wetlands will benefit this and other migrant shorebird species.

Literature Cited:

- Ferland, C.L. and S.M. Haig. 2002. 2001 International piping plover census. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, Oregon. 293 p.
- Haig, S. M. 1992. Piping plover. *In* The birds of North America, No. 2. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 18 p.
- Kingery, H. E., ed. 1998. Colorado breeding bird atlas. Colorado Bird Atlas Partnership, Denver, CO. 636 p.

- Ryan, M. R., B. G. Root, and P. M. Mayer. 1993. Status of piping plovers in the Great Plains of North America: a demographic simulation model. *Conservation Biology* 7:581-585.
- U.S. Fish and Wildlife Service. 1985. Determination of endangered and threatened status for the piping plover; final rule. *Federal Register* 50:50726-50734.
- Williams, S. O. III. 2001. New Mexico, spring season 2001. *N. Am. Birds* 55:336-338.

Least tern, *Sterna antillarum*

Distribution: The least tern breeds from California, the Dakotas, and Maine south to southern Mexico and the Caribbean, with interior populations breeding primarily in the Mississippi River Basin (Sidle et al. 1988, A.O.U. 1998). In New Mexico, this summer resident nests at Bitter Lake National Wildlife Refuge, Chaves County, and for many years that was the only known nesting locale in the state (Hubbard 1978). During 2002 and 2003, however, least terns were found summering farther south in the Pecos Valley at Brantley Lake, Eddy County, and nesting was documented there in 2004, the first New Mexico breeding away from Bitter Lake. The terns attempted to nest again at Brantley Lake in 2005, but failed due to high water and to human disturbance. The species is an occasional visitor to other wetlands in at least 16 additional New Mexico counties.

Current Status: The interior-breeding population is federally-listed as endangered, and this includes the birds occurring in New Mexico; it was listed as endangered by New Mexico in 1976. The state's breeding population has been quite small throughout much of the past 50 years, rarely exceeding 8 breeding pairs at Bitter Lake National Wildlife Refuge, and reproductive success typically has been poor. During the 10-year period 1990-1999, the breeding population averaged only about 5-6 pairs each year, with continued poor productivity. In the six-year period 2000-2005, however, the population at Bitter Lake increased steadily, to 14 pairs by 2005, and remarkably high productivity was achieved, averaging 1.24 young fledged per pair during that period. At Brantley Lake, up to 7 pairs summered in 2004, and at least 6 chicks fledged; up to 9 pairs were there early in 2005, but numbers declined to 3-4 pairs during the season, and no successful nesting was documented.

Threats: Loss or alteration of riverine habitats through inundation, channelization, and altered flow regimes plus predation, human disturbance of nesting beaches and flats, and chemical contamination of the prey base have limited the interior populations (U.S.F.W.S. 1990, Thompson et al. 1997). The Bitter Lake National Wildlife Refuge population may be jeopardized by oil and gas development, lowered water tables, and contamination. The struggling Brantley Lake population is threatened by ill-timed water level fluctuations and by human disturbance to limited sand flat habitat.

Recommendation: No change in status is recommended. NMDGF should continue to cooperate with other agencies to monitor the known nesting populations, and to continue to identify, protect, and manage habitat to benefit this species.

Literature Cited:

- American Ornithologist's Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Hubbard, J. P. 1978. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society Publ. No. 6. 110 p.
- Sidle, J. G., J. J. Dinan, M. P. Dryer, J. P. Rumancik Jr., and J. W. Smith. 1988. Distribution of the least tern in interior North America. *Am. Birds* 42:195-201.
- Thompson, B. C., J. A. Jackson, J. Burger, L. A. Hill, E. M. Kirsch, and J. L. Atwood. 1997. Least Tern. *In* The birds of North America, No. 290. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 32 p.
- U.S. Fish and Wildlife Service. 1990. Recovery plan for the interior population of the least tern, *Sterna antillarum*. U.S. Fish and Wildlife Service, Twin Cities, MN 90 p.

Common ground-dove, *Columbina passerina*

Distribution: The species occurs from the southernmost United States, including southern New Mexico, south into Latin America (A.O.U. 1998). Within New Mexico, it occurs primarily across the southern tier of counties. This is

a species of low elevations; it prefers brushy, well-watered valleys, frequenting riparian woodlands and shrublands, especially mesquite thickets along streams and canyon bottoms.

Current Status: This species formerly was resident in southern New Mexico (Ligon 1961) but by the 1980s was only a rare visitor there; it was listed by New Mexico as endangered in 1983. During the 10-year period 1990-1999, New Mexico reports averaged less than 5 birds per year, with no documentation of nesting. Documented occurrences increased during 2000-2005, averaging up to 12 birds per year, including reports from eight counties but with most from the southwestern counties of Hidalgo, Grant, Luna, and Doña Ana. It was recently found summering annually at several Hidalgo County locales, and with breeding suspected but not confirmed.

Threats: Loss or degradation of native shrublands in lowland riparian areas, through clearing, burning, excessive grazing, or water table reduction, plus the absence of water in such habitats, are the chief concerns.

Recommendation: No change in listing status is recommended. Protection and enhancement of shrubby riparian habitats, and provision of surface water in such areas, should be encouraged.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
Ligon, J. S. 1961. New Mexico birds. Univ. New Mexico Press, Albuquerque, NM. 360 p.

Buff-collared nightjar, *Caprimulgus ridgwayi*

Distribution: This nocturnal species occurs primarily from western and southern Mexico south into Nicaragua; it reaches its northernmost distribution limits in southeastern Arizona and southwestern New Mexico (A.O.U. 1998), where it summers in low-elevation desert canyons characterized by thickets of mesquite, acacia, hackberry, and other brush, with scattered junipers on adjacent slopes. Most New Mexico reports are from Guadalupe Canyon, Hidalgo County, with single reports from Doña Ana and Grant counties.

Current Status: This species was listed by New Mexico as endangered in 1975. It was first discovered in the United States in Guadalupe Canyon, Hidalgo County (Johnson and Hardy 1959), but it has not been reported from there since 1985; Department surveys for listed species there 1987-2004 failed to detect this species. There has been but one report of the species in the state since 1985, an unconfirmed occurrence of one heard at Redrock, Grant County, 30 May 1999 (Williams 1999). The species is rare but regular in occurrence in southern Arizona (Bowers and Dunning 1997, Corman and Wise-Gervais 2005).

Threats: Loss of native habitat in brushy desert canyons, through vegetation clearing, burning, overgrazing, or water table reduction threatens this species at the northern fringe of its range. Human disturbance, including by bird watchers, could likewise jeopardize small populations by disrupting breeding activity.

Recommendation: No change in listing status is recommended. NMDGF should continue to search for this species in the state, and to work with public and private land managers to protect and enhance Guadalupe Canyon and similar habitats for native species such as this nightjar.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington D.C. 829 p.
Bowers, R. K. Jr. and J. B. Dunning Jr. 1997. Buff-collared nightjar. *In* The birds of North America, No. 267. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 16 p.
Corman, T. E. and C. Wise-Gervais, eds. 2005. Arizona breeding bird atlas. Univ. New Mexico Press, Albuquerque, NM 636 p.
Johnson, R. F. and J. W. Hardy. 1959. The Ridgway whip-poor-will and its associated avifauna in southwestern New Mexico. *Condor* 61:206-209.
Williams, S. O. III. 1999. New Mexico, spring season 1999. *N. Am. Birds* 53:312-314.

Elegant trogon, *Trogon elegans*

Distribution: This primarily Mexican species reaches the northern limit of its range in southeastern Arizona and southwestern New Mexico (A.O.U. 1998), where it is a rare summer resident of riparian habitats in montane canyons (Hall and Karubian 1996). In New Mexico, it is found annually in Hidalgo County in the Peloncillo Mountains. Nonbreeding vagrants rarely occur elsewhere in southwestern New Mexico, other mountain ranges of southern Hidalgo County (most recently in 2004) and in Catron, Grant, Sierra, and Otero counties.

Current Status: The species was listed as endangered by New Mexico in 1975; it is listed by U.S. Fish and Wildlife Service as a species of special concern (U.S.F.W.S. 2002). It became one of the first non-game birds in the United States to receive special protection when it was protected from all forms of collecting by Arizona in about 1940. Elegant Trogons breed in New Mexico in only one canyon in the Peloncillo Mountains, where Department surveys and reports of cooperators have documented one to two pairs annually since 1991.

Threats: Loss of limited breeding habitat (including large trees with suitable nesting cavities) and foraging habitat (including fruiting shrubs) from fire, wood-cutting, excessive livestock grazing, water table reduction, and road construction or other development, plus disturbance of nesting birds by humans (including photographers and bird watchers using recorded vocalizations to attract birds) are the principal threats.

Recommendation: No change in status is recommended. Preservation and enhancement of mid-elevation montane riparian habitats in the Peloncillo Mountains and similar ranges is necessary, including maintaining water tables in canyons sufficient to support sycamores. Protection of breeding territories and nesting birds from human disturbance is another priority. Annual monitoring by NMDGF of the known breeding population, and continued surveys for additional populations, should continue.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Hall, L. S. and J. O. Karubian. 1996. Breeding behavior of elegant trogons in southeastern Arizona. *Auk* 113:143-150.
- U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. U.S. Fish and Wildlife Service, Arlington, VA. 99 p.

Northern beardless-tyrannulet, *Camptostoma imberbe*

Distribution: This neotropical flycatcher occurs from Costa Rica north through Mexico; it reaches its northernmost limits in southern Texas and in southeastern Arizona and southwestern New Mexico, where in New Mexico it summers regularly only in Guadalupe Canyon, Hidalgo County (A.O.U. 1998). This is a low-elevation riparian species that prefers dense thickets of mesquite, acacia, hackberry, and similar vegetation, typically along stream courses (Phillips et al. 1964, Oberholser 1974).

Current Status: The species was listed as endangered by New Mexico in 1975. It is listed by Texas as threatened, by the U.S. Fish and Wildlife Service as a species of conservation concern, and by New Mexico Partners in Flight as a priority species. This small flycatcher was detected on Department surveys of New Mexico's Guadalupe Canyon each year during the period 1987-2004, with nesting documented in both 2002 and 2003. The species may have benefited from the exclusion of livestock and improved habitat conditions there since the late 1980s, with an annual average of 3.2 territories during 1987-1996. However, numbers dropped following human-caused fire there in the mid-1990s and the onset of drought there in the late 1990s, and have yet to recover, with an annual average of only 1.4 territories during 1997-2004. To date, the species is but an extremely rare vagrant elsewhere in southwestern New Mexico.

Threats: The very small and localized New Mexico population is vulnerable to loss of its required habitat from burning, clearing, reduced water table, and excessive livestock grazing.

Recommendation: No change in listing status is recommended. The preservation and enhancement of native riparian and associated habitats in Guadalupe Canyon and elsewhere in southwestern New Mexico are essential for maintaining this species in the state.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Oberholser, H. C. 1974. The bird life of Texas. Univ. Texas Press, Austin, TX 1069 p.
- Phillips, A. R., J. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. Arizona Press, Tucson, AZ. 212 p.

(Southwestern) willow flycatcher, *Empidonax traillii extimus*

Distribution: The species breeds from southern Canada to the southern United States, and winters from southern Mexico to Panama (A.O.U. 1998). The southwestern subspecies *extimus* (Phillips 1948) breeds primarily in New Mexico, Arizona, and southern California, where it is restricted to remnants of dense streamside vegetation and where breeding populations have suffered declines (Phillips et al. 1964, Unitt 1987, Hubbard 1987, Rosenberg et al. 1991, U.S.F.W.S. 1995). Within New Mexico, significant populations occur along the Rio Grande and Gila drainages, with much smaller populations at isolated locales in the San Juan, upper Canadian, Zuni, San Francisco, and Mimbres drainages.

Current Status: The southwestern subspecies was state-listed by New Mexico as threatened in 1988, and subsequently was also state-listed by Arizona and California. In 1995, the subspecies was federally listed as endangered (U.S.F.W.S. 1995), and New Mexico reclassified the taxon as endangered in 1996. Cooperative surveys conducted statewide 1993-2005 found about 300 summering territories in about 38 locales, primarily from the Rio Grande Valley westward. The majority of sites (n = 26) were small, with only 1-5 territories each, while eight sites had 6-20 territories; only four sites have had more than 20 territories, but two of those have each exceeded 100 territories. The largest site, that in the Cliff-Gila Valley (which once accounted for some 70% of the state's population), declined during 2000-2005, losing nearly 30% of its population. During the same period, however, the site in the Rio Grande Valley above Elephant Butte Reservoir increased more than five-fold, numbering 110 territories in 2005. Also during the 2000-2005 period, the population on federally-managed lands in the vicinity of the Lower Gila Box has likewise shown significant increases.

Threats: A number of threats have been identified as contributing to the endangered status of the southwestern willow flycatcher. These are often interrelated, and include: habitat alteration, fragmentation, and/or loss; fire; water manipulation (diversion, impoundment, pumping, flood control); excessive livestock grazing; brood parasitism by cowbirds; occurrence of remaining birds as small and isolated populations; low productivity; predation; negative impacts from recreation; and negative impacts from research activities. Hastily-designed schemes to eradicate exotic plants such as saltcedar, especially in the middle Rio Grande Valley, likewise jeopardize this flycatcher, which currently nests commonly in such habitat.

Recommendation: No change in listing status is recommended. The Department has been an active member of the Southwestern Willow Flycatcher Recovery Team, which was formed in 1998 and submitted a draft recovery plan to the U.S. Fish and Wildlife Service in 2000. That plan was finalized in 2002 (U.S.F.W.S. 2002). The plan identifies goals and actions to achieve recovery and delisting of the taxon. Meanwhile, all concerned parties must continue to work together to identify, protect, and enhance this flycatcher's riparian habitats.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Hubbard, J. P. 1987. The status of the willow flycatcher in New Mexico. Report to New Mexico Dept. of Game and Fish, Santa Fe, NM. 29 p.
- Phillips, A. R. 1948. Geographic variation in *Empidonax traillii*. Auk 65:507-514.

- Phillips, A. R., J. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. Arizona Press, Tucson, AZ. 212 p.
- Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the Lower Colorado River Valley. Univ. Arizona Press, Tucson, AZ. 416 p.
- Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137-162.
- U.S. Fish and Wildlife Service. 1995. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694-10715.
- U.S. Fish and Wildlife Service. 2002. Final southwestern willow flycatcher recovery plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

Thick-billed kingbird, *Tyrannus crassirostris*

Distribution: This neotropical flycatcher of western Mexico and Guatemala reaches its northern limits in southeastern Arizona and southwestern New Mexico, and in the Big Bend region of western Texas (A.O.U. 1998). In New Mexico, it summers regularly only in Guadalupe Canyon, Hidalgo County. It was first discovered in Guadalupe Canyon in 1958 (Levy 1959), and nesting was documented in New Mexico in 1959 (Zimmerman 1960). In New Mexico, the species requires native broadleaf riparian habitats characterized by mature cottonwoods and sycamores; to date, all New Mexico nests have been in tall sycamores.

Current Status: The species was listed by New Mexico as threatened in 1975, and was reclassified as endangered in 1990. The species is listed by Texas as threatened. Department surveys along a two-mile transect in Guadalupe Canyon documented an annual average of 2.4 territories during the period 1987-2001. However, only one territory was found in both 2002 and 2003, and none was found in 2004. In 2005, only a single bird was reported. Vagrants were occasionally found elsewhere in summer in Hidalgo County through 2001, but there have been no reports away from Guadalupe Canyon since 2001.

Threats: Loss of mature broadleaf riparian woodlands, especially large cottonwoods and sycamores, from fire (prescribed or otherwise), cutting, reduced water table, and grazing that suppresses regeneration, is the principal threat to the small and localized New Mexico population.

Recommendation: No change in status is recommended. NMDGF should continue to monitor the small breeding population, and to encourage public and private land managers to protect and enhance native broadleaf riparian habitats in Guadalupe Canyon and elsewhere in southwestern New Mexico. In particular, fires in riparian areas that kill large trees should be discouraged, as should activities that result in lowered water tables.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Levy, S. H. 1959. Thick-billed Kingbird in the United States. Auk 76:92.
- Zimmerman, D. A. 1960. Thick-billed Kingbird nesting in New Mexico Auk 77:92-94.

THREATENED

Neotropic cormorant, *Phalacrocorax brasilianus*

Distribution: This widespread waterbird of Central and South America reaches its northernmost breeding limits in New Mexico (A.O.U. 1998), where it nests only in the middle Rio Grande Valley. Nonbreeders wander north to Bernalillo, west to the Gila Valley and Hidalgo County, east to the Tularosa Basin and middle and lower Pecos Valley, and northeast to Colfax and Union counties. Nesting cormorants require stands of trees or shrubs, in or near water, that are free from human disturbance.

Current Status: The species was listed by New Mexico as threatened in 1975. Within New Mexico, the species occurs in varying but typically small numbers primarily in the Elephant Butte Lake and Caballo Lake areas, where it is outnumbered by (and often confused with) the larger Double-crested Cormorant (*P. auritus*). First documented

nesting there was in 1972 (Hundertmark 1974), but no more than 50 nests have been found in any season, and in some years, no nests are found. Beginning in 1994, numbers increased north to Bosque del Apache N.W.R. area, and a few pairs nested there during the mid-1990s. However, there has been no documentation of nesting anywhere in New Mexico since 1998, and numbers of individuals reported in most key areas since 2000 have been considerably below historic levels.

Threats: Loss or degradation of limited breeding sites, disturbance of breeding colonies, fluctuations in food supply, contamination, and persecution are among the main threats to this fish-eating species (Telfair and Morrison 1995).

Recommendation: No change in status is recommended. A monitoring program is needed for this and other nesting colonial waterbirds, to determine population trends and to assess the effects of natural and man-caused habitat alterations.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Hundertmark, C. A. 1974. First record of olivaceous cormorant nesting in New Mexico. *Wilson Bull.* 86:65.
- Telfair, R. C. II and M. L. Morrison. 1995. Noetropic cormorant. *In* The birds of North America, No. 137. Academy of natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 24 p.

Bald eagle, *Haliaeetus leucocephalus*

Distribution: The species is widespread in North America, occurring from Alaska and Newfoundland south to northern Mexico and the Gulf Coast. It migrates and winters in suitable habitat throughout New Mexico (Hubbard 1978). Beginning in the late 1980s, bald eagles were found nesting at four sites in two counties: three sites in Colfax and one in Sierra (Williams 2000). In 2005, a pair attempted to nest at a new site in Catron County. In New Mexico, nests are placed in large cottonwoods or ponderosa pines, typically in the vicinity of water but also often in close proximity to concentrations of small mammals such as prairie dogs (Williams 2000).

Current Status: An ongoing conservation success story, bald eagles throughout the lower 48 states (where breeding pairs increased from 417 in 1963 to 5,750 in 1998) were federally reclassified in 1995 from endangered to threatened (U.S.F.W.S. 1995), and were recently proposed for federal delisting (U.S.F.W.S. 1999); the Department supported the proposal to federally delist the species (Maracchini 1999). The species was listed as threatened by New Mexico in 1975. Mid-winter surveys conducted annually by the Department showed that the number of bald eagles wintering in New Mexico steadily increased from the late 1970s, from an annual average of 220 birds then to 450 by the mid-1990s. The small nesting population was reduced to three active territories when the Sierra County territory was abandoned in 1999. A state recovery plan for the bald eagle is in progress.

Threats: The principal threats to bald eagles in New Mexico are human disturbance (especially to nesting pairs but also to wintering birds), loss or degradation of breeding and wintering habitat (including declines in prey and in nest- and roost-site availability), environmental contamination, electrocution, and illegal killing (including both shooting and poisoning).

Recommendation: No change in status is recommended. NMDGF should continue to monitor the known breeding population, encourage (through protection) new breeding pairs, and work with land managers to maintain and enhance the riparian/wetland areas and prey base where these eagles occur.

Literature Cited:

- Hubbard, J. P. 1978. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society Publ. No. 6. 110 p.
- Maracchini, J. A. 1999. September 30, 1999 letter to U.S.F.W.S. regarding proposal to delist the bald eagle in the lower 48 states. 2 p.
- U.S. Fish and Wildlife Service. 1995. Final rule to reclassify the bald eagle from endangered to threatened in all of the lower 48 states. Federal Register 60:3600X-36010.

- U.S. Fish and Wildlife Service. 1999. Proposed rule to remove the bald eagle in the lower 48 states from the list of endangered and threatened wildlife. Federal Register 64:36454-36464.
- Williams, S. O. III. 2000. History and current status of bald eagles nesting in New Mexico. New Mexico Ornithological Society Bull. 28:43-44.

Common black-hawk, *Buteogallus anthracinus*

Distribution: This neotropical raptor reaches its northern limits in the southwestern United States, where in New Mexico it is an uncommon but regular summer resident that historically was largely restricted to the San Francisco, Gila, and Mimbres drainages. It is rare but increasing east to the middle Rio Grande Valley, the Hondo Valley, and the middle and lower Pecos Valley, and in 2003 nested for the first time north to the Canadian River. Breeding birds require mature, well-developed riparian forest stands (e.g., cottonwood bosques) that are located near permanent streams where the principal prey of fish, amphibians, and reptiles is available (Schnell 1994).

Current Status: The species, which declined in abundance as its riparian habitat was reduced, was listed by New Mexico as threatened in 1975. It is also state-listed by Texas and Arizona. In 1994-1995, R. W. Skaggs (1996) intensively surveyed the San Francisco, Gila, and Mimbres basins, and estimated a population of up to 80 pairs. Recent reports from the Gila Valley suggest that population remains healthy. With recent gains in eastern New Mexico, the statewide population may now number about 100 pairs.

Threats: Loss of southwestern riparian habitat, particularly cottonwood bosques and flowing streams, is the principal threat to this riparian-obligate species (Hubbard 1965, Oberholser 1974, Schnell 1994). Other threats include disturbance to nesting birds and illegal shooting.

Recommendation: No change in status is recommended. NMDGF should expand survey work for this riparian species, to include the development of a monitoring system to measure status and trends, and should continue to encourage the preservation and enhancement of riparian habitats.

Literature Cited:

- Hubbard, J. P. 1965. Bad days for the black hawk. Audubon Field Notes 19:474.
- Oberholser, H. C. 1974. The bird life of Texas. Univ. Texas Press, Austin, TX. 1069 p.
- Schnell, J. H. 1994. Common black-hawk. In The birds of North America, No. 122. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.
- Skaggs, R. W. 1996. The common black-hawk in southwestern New Mexico, 1994-95 inventories. Report to New Mexico Dept. of Game and Fish, Santa Fe, NM. 14 p.

Peregrine falcon, *Falco peregrinus*

Distribution: The species occurs almost worldwide (Brown and Amadon 1968). In New Mexico, the American subspecies *F. p. anatum* breeds locally in mountains and river canyons and migrates essentially statewide (Skaggs et al. 1988); the tundra subspecies *F. p. tundrius* is a rare migrant through the state.

Current Status: The *anatum* subspecies was federally delisted in 1999; based on available data, the Department argued that downlisting from endangered to threatened was warranted but that delisting was not (Maracchini 1998). The Department was encouraged by the gradually increasing occupancy of breeding sites observed after 1980, and in recognition of that, the Department downlisted the species from endangered to threatened status in 1996. However, occupancy has changed little since 1997 and has not yet achieved the level of a healthy, self-sustaining population, which generally is recognized as 85% occupancy of known sites (U.S.F.W.S. 1984, Ratcliffe 1993, Johnson and Williams 2005). In New Mexico, occupancy rates averaged 83% by any peregrine during the five-year period 2001-2005, and 80% by territorial pairs (Johnson and Williams 2005). Of even greater concern, however, has been a long-term decline in productivity by the species in New Mexico and elsewhere in the southwestern United States. New Mexico data demonstrate that although productivity recovered from historic lows by the early 1980s, it began trending lower after 1984 and has yet to stabilize. Through 2005, productivity remained 37% below its 1960-1964 average, and 23% below its 1984-1988 average (Johnson and Williams 2005).

Threats: Chemical contamination of the environment remains a threat, as old compounds continue to be used in parts of the species' range and especially as new compounds are developed and applied to the land (Ratcliffe 1993, Williams and Johnson 2005). In New Mexico, disturbance to nesting pairs and illegal taking are also threats (Johnson 1984, Johnson and Williams 2005).

Recommendation: No change in status is recommended. NMDGF should continue to work cooperatively with other agencies to systematically monitor the breeding population for occupancy and productivity, and continue to work with land management agencies to identify and protect suitable breeding habitat; such cooperation is currently stipulated under a Master Interagency Agreement among the NMDGF, USFWS, and USFS. In particular, NMDGF should work closely with USFWS to implement its post-delisting monitoring plan (U.S.F.W.S. 2003). Take for falconry should continue to be prohibited in New Mexico until biological parameters, including occupancy and productivity rates, improve (Maracchini 1999). The outcome and timing of changes in the species' status likely will depend on the emphasis placed on protection of peregrine falcon habitat by land managers.

Literature Cited:

- Brown, L. and D. Amadon. 1968. Eagles, hawks, and falcons of the world. McGraw-Hill Co., New York, NY. 945 p.
- Johnson, T. H. 1994. Peregrine falcon habitat management in National Forests of New Mexico. Report to Southwest Region, U.S. Forest Service, Albuquerque, NM. 22 p.
- Johnson, T. H. and S. O. Williams III. 2005. The peregrine falcon in New Mexico—2005. Report to New Mexico Dept. of Game and Fish, Santa Fe, NM. 18 p.
- Maracchini, J. A. 1998. November 23, 1998 letter to U.S. Fish and Wildlife Service regarding federal delisting of the American peregrine falcon. 3 p.
- Maracchini, J. A. 1999. November 12, 1999 letter to U.S. Fish and Wildlife Service regarding take of wild peregrine falcons. 2 p.
- Ratcliffe, D. 1993. The peregrine falcon, 2nd ed. Academic Press, San Diego, CA. 454 p.
- Skaggs, R. W., D. H. Ellis, W. G. Hunt, and T. H. Johnson. 1988. Peregrine falcon. Pages 127-136. *In* Proceedings Southwest Raptor Management Symposium. National Wildlife Federation, Washington, D.C.
- U.S. Fish and Wildlife Service. 1984. Recovery plan for American peregrine falcon Rocky Mountain/Southwest population. U.S. Fish and Wildlife Service, Denver, CO. 105 p.
- U.S. Fish and Wildlife Service. 2003. Monitoring plan for the American peregrine falcon. U.S. Fish and Wildlife Service, Divisions of Endangered Species and Migratory Birds and State Programs, Pacific Region, Portland, OR. 53 p.

(Gould's) wild turkey, *Meleagris gallopavo mexicana*

Distribution: The species occurs wildly in North America; however, the subspecies *mexicana*, of Mexico's Sierra Madre, occurs naturally in the United States only in the Animas and Peloncillo ranges and the intervening Animas Valley in southern Hidalgo County, New Mexico (Ridgway and Friedmann 1946). It occurs in all major canyons and adjacent foothills areas in the Peloncillo Mountains, from Guadalupe Canyon north primarily to the Skeleton Canyon area but with smaller numbers farther north, and in the Animas Mountains, as well as along the middle Animas Valley. This turkey is found primarily in pine-oak forested canyons and adjacent slopes, and in cottonwood-sycamore riparian situations; important habitat components include water and tall trees for roosting.

Current Status: This unique subspecies was listed as threatened in New Mexico in 1975. Gould's turkeys were studied intensively in New Mexico under NMDGF contracts during 1982-1996; estimates for the Peloncillo Mountains population during that period fluctuated from fewer than 20 up to approximately 75 birds (Schemnitz and Potter 1984, Willging 1987, Figert 1989, York 1991), but with no consistent trend and with some of the higher estimates including young birds; under optimum conditions there, the adult population probably numbers at least 50 individuals. The Animas Mountains population had been estimated at some 30 adults in the 1980s (Schemnitz and Willging 1986). Reports of flocks of up to 30 (including juveniles) in the Peloncillo Mountains and up to 17 in the Animas Mountains in recent years indicate that populations in those two ranges are maintaining themselves. No systematic surveys have been conducted or reported upon in recent years, and claims of "hundreds" of Gould's turkeys in the area remain to be confirmed. Based on historic and recent evidence, it seems likely that turkeys have

always been local and relatively rare in that area. Leopold (1959) discussed the reduction of the range of this turkey in northern Mexico.

Threats: Threats to this taxon in Hidalgo County include habitat loss from removal of vegetation, fire, competition with livestock (both cattle and feral hogs), lack of water sources, hybridization with non-native turkeys, and human killing and disturbance.

Recommendation: No change in status is recommended. NMDGF should conduct systematic surveys for this taxon in its New Mexico range, and develop a monitoring program to identify trends (if any) in the population. Although the population has been and continues to be small, it seems to be well-adapted to the local conditions; hence, augmentation with stock from elsewhere (e.g., Mexico) is not recommended.

Literature Cited:

- Figert, D. E. 1989. Status, reproduction, and habitat use of Gould's turkey in the Peloncillo Mountains of New Mexico. M.S. Thesis, New Mexico State Univ., Las Cruces, NM.
- Leopold, A. S. 1959. Wildlife of Mexico. Univ. California Press, Berkeley, CA. 568 p.
- Ridgway, R. and H. Friedmann. 1946. Birds of North and Middle America, vol. 10. U.S. Natl. Museum Bull. 50:455-457.
- Schemnitz, S. D. and T. D. Potter. 1984. Status and ecology of Gould's turkey (*Meleagris gallopavo mexicana*) in the Peloncillo Mountains, Coronado National Forest, New Mexico. New Mexico Dept. Game and Fish, contract 516-71-27, final report. 104 p.
- Schemnitz, S. D., and R. C. Willging. 1986. Gould's turkey status report. West. Wild Turkey Workshop Proc. 3:38-39.
- Willging, R. C. 1987. Status, distribution, and habitat use of Gould's turkey in the Peloncillo Mountains, New Mexico. M.S. Thesis, New Mexico State Univ., Las Cruces, NM.
- York, D. L. 1991. Habitat use, diet, movements, and home range of Gould's turkey in the Peloncillo Mountains, New Mexico. M.S. Thesis, New Mexico State Univ., Las Cruces, NM.

Whiskered screech-owl, *Megascops trichopsis*

Distribution: This primarily Mexican and Central American species prefers pine-oak woodland (Marshall 1957); it occurs from the southwestern United States south to Nicaragua. In New Mexico, it occurs only in Hidalgo County, where found regularly in several Peloncillo Mountains canyons (e.g., Skeleton, Whitmire, Cottonwood, Clanton) and has been found occasionally in the Animas Mountains (Indian Creek Canyon vicinity). In New Mexico, it is a species of dense pine-oak woodlands and oak woodlands just below the pine-oak zone, especially favoring oak riparian situations in mountain canyons and dense woodlands on adjacent north facing slopes.

Current Status: The species was listed as threatened in New Mexico in 1990, as the status of the small resident population in the Peloncillo Mountains became better understood. First detected in the state in 1974 (Ligon and Brenowitz 1976), it was found to be resident in small numbers in early 1990 (Williams and Hubbard 1990). Subsequent Department surveys through the 1990s documented the extent of the Peloncillo Mountains population; including 15 occupied territories in four canyons in that range in 2000 (Williams 2000). Individuals have been reported from three sites in the Animas Mountains, most recently in May-June 2005. Owls abandoned one Peloncillo Mountains canyon following a prescribed fire in 1997, as none were located there in 1998 or 1999, but it was reoccupied in 2000.

Threats: Loss of pine-oak and oak woodlands in the Peloncillo and Animas mountains, especially in canyon bottom situations, through vegetation removal or fire (natural or prescribed) is the principal concern. Cavity trees (snags, etc.) are especially vulnerable to fire and woodcutting. Human disturbance, particularly excessive playback of its vocalizations by bird watchers, could negatively impact these small populations.

Recommendation: No change in status is recommended. NMDGF should continue to survey for and monitor the limited New Mexico population, and to encourage public and private land managers to protect pine-oak and oak woodlands in Hidalgo County, especially in canyon riparian situations.

Literature Cited:

- Ligon, J. D. and G. L. Brenowitz. 1976. First record of the whiskered owl in New Mexico. *Condor* 78:112.
- Marshall, J. T. Jr. 1957. Birds of pine-oak woodland in southern Arizona and adjacent Mexico. *Pacific Coast Avifauna* 32:1-125.
- Williams, S. O. III. 2000. New Mexico, spring season 2000. *North Am. Birds* 54:312-315.
- Williams, S. O. III and J. P. Hubbard. 1990. New Mexico, winter season 1989-90. *Am. Birds* 44:305-308.

Boreal owl, *Aegolius funereus*

Distribution: This northern species occurs in boreal forests of the Old and New Worlds; in North America, it reaches its southernmost limits in the mountains of northern New Mexico, where it was first detected in 1987 (Stahlecker and Rawinski 1990). In New Mexico, Department-assisted surveys found the species to be resident in undisturbed spruce-fir and similar forests in the San Juan, Sangre de Cristo, and Jemez mountains (Stahlecker and Duncan 1996).

Current Status: The species was listed as threatened in New Mexico in 1990. Intensive surveys in the state found the species occurred in very small numbers at 10 specific sites in eight general locales, these on public lands in the Carson and Santa Fe National Forests (Stahlecker and Duncan 1996).

Threats: New Mexico's small and highly fragmented boreal owl populations are vulnerable and would be negatively impacted by losses to their specialized and limited subalpine habitats. In particular, timber harvest in such areas would eliminate nesting cavities, reduce prey populations, and remove forest structure necessary for nesting, foraging, and roosting; the slowness of forest succession in high elevation stands implies disturbed habitats would remain unsuitable for one-two centuries (Hayward and Hayward 1993, Hayward and Verner 1994, Hayward 1997).

Recommendation: No change in status is recommended. Conservation of the boreal owl in New Mexico depends on protection of its specialized habitat—high elevation stands of mature and older spruce-fir forests in the San Juan, Sangre de Cristo, and Jemez mountains. Protective measures should include the identification and setting aside of areas of occupancy. Forest management should focus on maintaining the distribution and abundance of such stands, whether occupied by boreal owls or not, with emphasis on retaining these habitats in their natural states. Even-aged timber management on a broad scale should be eliminated in these areas, while management based on simple snag retention in clearcut areas should be recognized as of no value.

Literature Cited:

- Hayward, G. D. 1997. Forest management and conservation of boreal owls in North America. *J. Raptor Res.* 31:114-124.
- Hayward, G. D. and P. H. Hayward. 1993. Boreal owl. *In* The birds of North America, No. 63. Academy Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.
- Hayward, G. D. and J. Verner, eds. 1994. Flammulated, Boreal, and Great Grey Owls in the United States: a technical conservation assessment. U.S.D.A. Forest Service, Gen. Tech. Report RM-253, Fort Collins, CO.
- Stahlecker, D. W. and R. B. Duncan. 1996. The boreal owl at the southern terminus of the Rocky Mountains: undocumented longtime resident or recent arrival. *Condor* 98:153-161.
- Stahlecker, D. W. and J. J. Rawinski. 1990. First records of the boreal owl in New Mexico. *Condor* 92:517-519.

Broad-billed hummingbird, *Cyananthus latirostris*

Distribution: This widespread Mexican species reaches its northern limit in the borderlands region of the southwestern United States (A.O.U. 1998), where it is a species of low to middle elevation riparian woodlands. In New Mexico, the species is a regular summer resident in Guadalupe Canyon, where most of these hummingbirds nest in hackberry thickets and similar vegetation (Baltosser 1986, 1989). In 1998, breeding was confirmed in Skeleton Canyon in the central Peloncillo Mountains, the first away from Guadalupe Canyon (Williams 1998), and the species has occurred essentially annually there and farther north in Post Office Canyon since 1998. In addition,

there have been reports from several additional New Mexico counties, including confirmed records for Grant, Doña Ana, Eddy, Valencia, and Bernalillo counties, but with no indication of breeding in those areas.

Current Status: The species was listed as threatened in New Mexico in 1975. The small population in Guadalupe Canyon and immediately adjacent side canyons is currently estimated at about 12-20 individuals and appears to have been relatively stable in recent years. Farther north in the Peloncillo Mountains, NMDGF surveys and cooperator reports indicate another 10-15 individuals may summer regularly in three additional canyons there.

Threats: The principal threat is loss of riparian woodlands in Guadalupe Canyon and similar canyons in the Peloncillo Mountains, from clearing (brush removal, tree cutting), burning, or other impacts, including lowered water tables and excessive grazing.

Recommendation: No change in status is recommended. The protection and enhancement of riparian woodlands and adjacent xeric habitats in Guadalupe Canyon and similar canyons in southwestern New Mexico should be encouraged. NMDGF should continue to monitor the status of the breeding populations in Guadalupe Canyon and other canyons in the Peloncillo Mountains, and to search for additional populations.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Baltosser, W. H. 1986. Nesting success and productivity of hummingbirds in southwestern New Mexico and southeastern Arizona. *Wilson Bull.* 98:353-367.
- Baltosser, W. H. 1989. Nectar availability and habitat selection by hummingbirds in Guadalupe Canyon. *Wilson Bull.* 101:559-578.
- Williams, S. O. III. 1998. New Mexico, summer season 1998. *Field Notes* 52:487-490.

White-eared hummingbird, *Hylocharis leucotis*

Distribution: This species of Mexican and Central American highlands reaches its northernmost limits in the mountains of southeastern Arizona and southwestern New Mexico (A.O.U. 1998). This hummingbird prefers relatively moist montane forests and forested canyons, and is found most commonly in the pine and pine-oak zones (Howell and Webb 1995). White-eared hummingbirds were first found summering in New Mexico in the Animas Mountains in the mid-1970s (Hubbard 1978), and have continued yield reports, most recently in 2001 and 2003. There are additional reports from elsewhere in southwestern New Mexico in the Peloncillo Mountains (most recently in 1992) and north to the Pinos Altos Mountains in 1993 and 1994 and Mogollon Mountains in 2000 and 2005. Vagrants have strayed farther north and east, to the Manzanita Mountains in 1994 and 1995, to two sites in the Sangre de Cristo Mountains in 1993, and to the Sacramento Mountains in 2005.

Current Status: The species was listed as threatened in New Mexico in 1978. Only small numbers were detected in likely breeding habitats in Hidalgo, Grant, and Catron counties 2000-2005

Threats: As a species restricted to moist mountain canyons and adjacent forested slopes, this hummingbird is vulnerable to loss of such habitat from actions or events including fire, mining, lumbering, road-building, and excessive grazing; acid rain from regional smelters likewise may impact these high mountain forests.

Recommendation: No change in status is recommended. To clarify this species' breeding status in the state, NMDGF should encourage intensive surveys for it in areas of reported occurrence.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Howell, S. N. G. and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford Univ. Press, Oxford, U.K. 849 p.
- Hubbard, J. P. 1978. Revised check-list of the birds of New Mexico. *New Mexico Ornithological Society Publ.* No. 6. 110 p.

Violet-crowned hummingbird, *Amazilla violiceps*

Distribution: This hummingbird of the Mexican highlands reaches its northernmost distribution in southeastern Arizona and southwestern New Mexico. In New Mexico, it summers regularly only in broadleaf riparian woodlands of sycamore, cottonwood, hackberry, and oak in Guadalupe Canyon, Hidalgo County, where it nests exclusively in sycamores (Zimmerman and Levy 1960, Baltosser 1986, 1989, Williams 2002). It has rarely been found north in summer in the Peloncillo Mountains to Clanton and Skeleton canyons, and to Double Adobe Creek in the north Animas Mountains. Singles documented at Anthony November 2001-February 2002 and Las Cruces February 2002 were the first known to winter in New Mexico. Single vagrants have strayed north to Socorro County in 1981, Santa Fe County in 1999, and Los Alamos County in 2005, and east to Luna County in 2002.

Current Status: The species was listed as threatened in New Mexico in 1975. New Mexico's population is small, since the mid-1980s rarely numbering more than about 12 individuals, these distributed among two to five, rarely seven, locations within the New Mexico portion of Guadalupe Canyon and showing no detectable trend (Williams 2002). Occurrences since the late 1990s of individuals in two additional Peloncillo Mountains canyons plus in one canyon in the Animas Mountains may signal pioneering of new range, but to date no breeding or even consistent summering has been documented away from Guadalupe Canyon.

Threats: This hummingbird is threatened by loss of low elevation broadleaf riparian and adjacent xeric habitats in Guadalupe Canyon and similar canyons in southwestern New Mexico, such losses occurring from fire, clearing, excessive grazing pressure, and lowered water tables. Fire poses a significant threat if scarce large-tree riparian habitats are burned or food sources such as agaves are destroyed by fire. Grazing in canyon bottoms may remove necessary dense understory vegetation and impede regeneration of riparian trees.

Recommendation: No change in status is recommended. NMDGF should continue to monitor the small breeding population and its habitat, and encourage public and private land managers to preserve low-elevation broadleaf riparian woodlands in Guadalupe Canyon and elsewhere in southwestern New Mexico.

Literature Cited:

- Baltosser, W. H. 1986. Nesting success and productivity of hummingbirds in southwestern New Mexico and southeastern Arizona. *Wilson Bull.* 98:353-367.
- Baltosser, W. H. 1989. Nectar availability and habitat selection by hummingbirds in Guadalupe Canyon. *Wilson Bull.* 101:559-578.
- Williams, S. O. III. 2002. Status of the violet-crowned hummingbird in New Mexico. *New Mexico Ornithological Society Bull.* 30:91-95.
- Zimmerman, D. A. and S. H. Levy. 1960. Violet-crowned hummingbird nesting in Arizona and New Mexico. *Auk* 77:470-471.

Lucifer hummingbird, *Calothorax lucifer*

Distribution: This primarily Mexican highland species reaches the United States only in southeastern Arizona, southwestern New Mexico, and Trans-Pecos Texas (Scott 1994). A migratory species, it prefers rugged canyons and slopes in dry mountain ranges, especially rocky hillsides, talus slopes, and dry washes vegetated with desert scrub, such as shrubby trees (juniper, pinyon, oak), cactus, yucca, ocotillo, and agave. New Mexico's Peloncillo Mountains appear to be one of its more important areas of occurrence, where it occurs regularly in several mid-elevation canyons, most regularly in Post Office, Skeleton, Cottonwood, and Clanton canyons; occasionally in Guadalupe Canyon. Away from the Peloncillo Mountains, single vagrants have strayed north and east to Grant, Sierra, Luna, and Eddy counties.

Current Status: This hummingbird was listed as threatened in New Mexico in 1985. The Peloncillo Mountains population is small; during the 1990s, it was estimated at about 20 breeding females, and surveys and reports through 2005 continued to support that estimate. Nesting was confirmed in the central Peloncillos in 1995 and 1996, but those sites burned and remained unoccupied for six years.

Threats: Loss of native dry canyon/hillside habitats, including loss or reduction of native food plants from burning or excessive grazing pressure, is the principal threat to the small New Mexico breeding population.

Recommendation: No change in status is recommended. NMDGF should continue to survey for and monitor this species, and to work with land managers in protecting its preferred dry canyon/hillside habitat. Effects of fire (prescribed or otherwise) on nectar resources, particularly on plants such as agaves, requires serious study.

Literature Cited:

Scott, P. E. 1994. Lucifer hummingbird. *In* The birds of North America, No. 134. Academy of natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.

Costa's hummingbird, *Calypte costae*

Distribution: The distribution of this arid-land species is centered on the Sonoran Desert region of the southwestern United States and northwestern Mexico; within New Mexico, it occurs primarily in the southwest, where it is a warm season migrant and occasional breeder, (Baltosser 1989, Baltosser and Scott 1996). All documented or suspected breeding has been in Hidalgo, Grant, and Doña Ana counties; the species is most regular in Guadalupe Canyon, where breeding has been documented, less regular along the lower Gila River, and occasional east to the San Andres and Organ mountains. Migrants have been recorded at several additional Hidalgo, Grant, and Doña Ana locales plus at single sites in Sandoval, McKinley, and Sierra counties.

Current Status: The species was listed by New Mexico as threatened in 1983. In recent years, the species has been irregular in occurrence in the state. In 1993, up to 7 individuals occupied Guadalupe Canyon from late-March to mid-June, and breeding was suspected (Williams 1993). The species staged an impressive invasion in 1995, with reports from 4 locales in 3 counties (Williams 1995) including 2 males east to the San Andres Mountains (Weisenberger and Howe 1996). In 1997, displaying males were at 2 sites near Redrock; in 1998, one was near Virden; in 1999, singles were at Silver City and in the Peloncillo Mountains. One-five birds were reported annually in southwestern New Mexico 2000-2005, but there was no evidence of breeding. The first to be found wintering in New Mexico was documented at Placitas January-February 2002 (Williams 2002).

Threats: Loss of native xeric hillside vegetation and adjacent riparian habitats (from fire, excessive grazing, or clearing) in the Peloncillo Mountains, the lower Gila Valley, and elsewhere in southwestern New Mexico threatens the survival of the species in the state.

Recommendation: No change in status is recommended. NMDGF should continue to work with public and private land managers to identify, preserve, and restore riparian habitats and associated xeric hillside vegetation in southwestern New Mexico, including Guadalupe Canyon and other canyons in the Peloncillo Mountains, and in the lower Gila Valley, particularly in the Middle Box and Lower Box areas.

Literature Cited:

Baltosser, W. H. 1989. Costa's hummingbird: its distribution and status. *Western Birds* 20:41-62.

Baltosser, W. H. and P. E. Scott. 1996. Costa's hummingbird. *In* The birds of North America, No. 251. Academy Natural Sciences, Philadelphia, PA and American Ornithologists' union, Washington, D.C. 32 p.

Weisenberger, M. E. and W. H. Howe. 1996. Costa's hummingbird on the San Andres National Wildlife Refuge. *New Mexico Ornithological Society bull.* 24:32.

Williams, S. O. III. 1993. New Mexico, spring season 1993. *Am. Birds* 47:440-443.

Williams, S. O. III. 1995. New Mexico, spring season 1995. *Field notes* 49:288-290.

Williams, S. O. III. 2002. New Mexico, winter season, 2001-02. *N. Am. Birds* 56:207-209.

Gila woodpecker, *Melanerpes uropygialis*

Distribution: This species of the southwestern United States and western Mexico just enters southwestern New Mexico, where it is a permanent resident in the lower Gila Valley and in southern Hidalgo County. Within the state,

Gila woodpeckers require well-developed broadleaf riparian woodlands characterized by extensive groves of mature cottonwoods and/or sycamores.

Current Status: The species was listed as threatened by New Mexico in 1975. NMDGF surveys 1987-2004 annually found five-eight pairs in Guadalupe Canyon, and reports from additional southern Hidalgo County locales (including nesting in the Animas Valley) have been encouraging. Recent (1996-2005) observations on the east side of the Animas Mountains, represent the first for the species from east of the Continental Divide. Based on available information, however, numbers have declined in the Gila Valley since the 1970s, and remain depressed into the 2000s. The species is listed as endangered by California, where loss of native riparian habitats in the Lower Colorado River Valley has reduced populations (Rosenberg et al. 1991).

Threats: Habitat destruction, especially the cutting or other destructive clearing (burning, inundation) of cottonwood and sycamore stands, is the principal threat to the species in the state. Included in this threat is progressive fragmentation of remaining habitat patches, as mature but isolated cottonwood groves smaller than 20 ha (50 ac) are devoid of Gila woodpeckers (Rosenberg et al. 1991).

Recommendation: No change in status is recommended. NMDGF should continue to monitor known populations, to survey for additional populations, and to encourage land managers, including public and private water managers, to preserve and restore extensive riparian woodlands, particularly mature groves of cottonwoods and sycamores. Prescribed fires that may kill large trees should be avoided in riparian areas.

Literature Cited:

- Edwards, H. H. and G. D. Schnell. 2000. Gila woodpecker. *In* The birds of North America, No. 532. Academy of natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 829 p.
- Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the Lower Colorado River Valley. Univ. Arizona Press, Tucson, AZ. 416 p.

Bell's vireo, *Vireo bellii*

Distribution: This small, insectivorous neotropical migrant breeds in the central and southwestern United States and northern Mexico (Brown 1993). Within New Mexico, it occurs in the southernmost portion of the state, where small numbers summer primarily in the Gila Valley, Guadalupe Canyon, and the lower Rio Grande and Pecos valleys and associated drainages (Hubbard 1978). The species prefers dense, typically low, shrubby vegetation (e.g., hackberry, mesquite, saltcedar) in riparian areas (Brown 1993; Parody and Parker 2002).

Current Status: The species has suffered significant declines in portions of the southwestern United States (Brown 1993), most notably in the Lower Colorado River Valley (Rosenberg et al. 1991) and in central and coastal California (Franzreb 1987), where the California subspecies is federally listed as endangered (U.S.F.W.S. 1986). Declines have likewise been noted in Arizona (Phillips et al. 1964) and New Mexico (Hubbard 1978); the species was listed by New Mexico as threatened in 1975. New Mexico surveys and reports through 2005 indicate overall numbers remain very low and reproductive failure, often caused by cowbird parasitism, is unusually high. The state's largest documented population is in the Lower Gila Box, Grant and Hidalgo counties, where up to 44 territories were located in 1998. A significant population in the vicinity of Rattlesnake Springs, Eddy County, numbers about 20 pairs annually; cowbird parasitism there typically exceeds 60% of vireo nests. The number of territories detected on a transect in Guadalupe Canyon declined from an annual average 4.8 in 1987-1992 to 3.8 in 1993-1998 and to 1.8 in 1999-2004.

Threats: Loss or fragmentation of dense shrubby/woody riparian habitats—from urbanization, agricultural conversion, excessive grazing, burning, brush removal, firewood cutting, flood control, and reservoir construction—plus high rates of brood parasitism by cowbirds, leading to reduced productivity, are the principal threats (Franzreb 1987; Brown 1993).

Recommendation: No change in status is recommended. NMDGF should continue survey and monitoring efforts to detect population distribution and trends, and to encourage land managers to preserve and restore riparian and adjacent shrubby habitats along lowland streams. Restoration projects elsewhere that have employed local

information have proved successful in increasing Bell's vireo populations (Kus 1998). Cowbird control may be useful in very localized areas, but it must be recognized that cowbird parasitism is only a symptom of larger habitat problems (Goldwasser et al 1980; Franzreb 1989).

Literature Cited:

- Brown, B. T. 1993. Bell's vireo. *In* The birds of north America, No. 35. Academy of natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.
- Franzreb, K. E. 1987. Endangered status and strategies for conservation of the least Bell's vireo (*Vireo bellii pusillus*) in California. *Western Birds* 18:43-49.
- Franzreb, K. E. 1989. Ecology and conservation of the endangered least Bell's vireo (U.S. Fish and Wildlife Service Biol. Rept. 89:1-17.
- Goldwasser, S., D. Gaines, and S. R. Wilber. 1980. The least Bell's vireo in California: a defacto endangered race. *Am. Birds* 34:742-745.
- Hubbard, J. P. 1978. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society Publ. No. 6. 110 p.
- Kus, B. E. 1998. Use of restored riparian habitat by the endangered least Bell's vireo (*Vireo bellii pusillus*). *Restoration Ecology* 6:75-82.
- Parody, J. M. and T. H. Parker. 2002. Biogeographic variation in nest placement: a case study with conservation implications. *Diversity and Distribution* 8:11-20.
- Phillips, A. R., J. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. Arizona press, Tucson, AZ. 212 p.
- Rosenberg, K. W., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the Lower Colorado River Valley. Univ. Arizona Press, Tucson, AZ. 416 p.
- U.S. Fish and Wildlife Service. 1986. Determination of endangered status for the least Bell's vireo: final rule. *Federal Register* 51:16474-16482.

Gray vireo, *Vireo vicinior*

Distribution: This little-studied but widespread neotropical migrant breeds in the Four Corners states, southern California, and western Texas; it winters in northwestern Mexico (A.O.U. 1998). In New Mexico, it is most often found in arid juniper woodlands on foothills and mesas, these sometimes associated with oaks or pinyons and often in habitat with a well-developed grass component. Within the state, the species has been found summering/breeding in most counties west of the Great Plains.

Current Status: The species was listed by New Mexico as endangered in 1983. In the state, breeding populations have disappeared from some historic habitats but persist at others. In addition, recent surveys have found the species in new areas and in unexpected numbers. Since the mid-1990s, Department surveys and surveys by other agencies and organizations (Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, Hawks Aloft, New Mexico Natural Heritage Program, Kirtland Air Force Base) have documented territories at a number of significant sites: at least 47 territories in the northwest in San Juan and Rio Arriba counties; 25 territories in the Caja del Rio area, Santa Fe County; 60 territories in the Manzanito Mountains, Bernalillo County; 45 territories at four Socorro County sites; 16 territories in the San Andres Mountains, Doña Ana County; and 57 territories at two Guadalupe Mountains sites in Eddy County. Based on degrees of threat (including restricted range and small overall population) and observed declining population trends rangewide, this species is listed by Partners in Flight as a priority species in North America and by U.S. Fish and Wildlife Service as a national species of conservation concern (U.S.F.W.S. 2002). NMDGF is currently at work compiling a summary of this species' distribution, abundance, habitat associations, and breeding success throughout New Mexico.

Threats: Threats include loss or degradation of quality juniper-grassland habitat, including through burning, clearing, excessive grazing pressure, or oil and gas development, and an increase in nest-parasitism by cowbirds.

Recommendation: No change in status is recommended. Identifying and maintaining quality juniper savannah and other occupied habitats should be a priority. In particular, land managers should consider the needs of this species when contemplating actions such as clearing or burning juniper stands. A state recovery plan should be developed to include a compilation of gray vireo habitat needs and recommended habitat management practices. Additional survey work might yield enough birds for delisting to be considered. However, continued juniper clearing projects

for fuel reduction, grazing enhancement, and bighorn sheep habitat improvement that impact gray vireo habitats may prevent the status of this species from being considered secure in New Mexico.

Literature Cited:

- American Ornithologist's Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. U.S. Fish and Wildlife Service, Division of Migratory Birds, Arlington, VA. 99 p.

Abert's towhee, *Pipilo aberti*

Distribution: This is primarily a species of the lowlands of central and southwest Arizona and adjacent areas, where it is a permanent resident along desert rivers and streams (Twite and Finch 1994). It is found in New Mexico only in the Gila Valley and at San Simon Cienega, Grant and Hidalgo counties, where it inhabits riparian thickets and similar native habitats.

Current Status: The species was listed by New Mexico in 1983. In the Gila Valley, incidental observations in recent years suggest that numbers are reduced from 25 years ago. For example, at Redrock, where 50 were counted in 1969 and 55 in 1981, only 14 were found in 1994 (Williams 1994) and even fewer were found there through 2005. A small population persists upstream, in the Cliff-Gila Valley, where 11 nests were documented in 2000 but only 5 pairs were reported in 2003. Smaller numbers (up to 12) inhabit San Simon Cienega (Williams 1993).

Threats: The species is threatened by loss or degradation of native riparian habitats within its restricted New Mexico range, with excessive grazing within the riparian zone a particular concern. Rea (1983) observed that extensive loss of cottonwood-willow and brushy mesquite habitat along the Gila River in Arizona reduced this species' density. Alternatively, after removal of livestock from the San Pedro Riparian National Conservation Area in Arizona, Abert's towhee densities in cottonwood-willow habitat more than doubled over five years (Krueper et al. 2003).

Recommendation: No change in status is recommended. NMDGF should expand surveys for this species in the Gila Valley and associated drainages, and continue to work with land and water managers to protect and restore native riparian habitats there and at San Simon Cienega.

Literature Cited:

- Krueper, D., J. Bart, and T. D. Rich. 2003. Response of vegetation and breeding birds to the removal of cattle on the San Pedro River, Arizona, U.S.A. *Conservation Biology* 17:607-615.
- Rea, A. 1983. Once a river: bird life and habitat changes on the middle Gila. Univ. Arizona Press, Tucson, AZ 285 p.
- Twit, R. C. and D. M. Finch. 1994. Abert's towhee. *In* The birds of North America, No. 111. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.
- Williams, S. O. III. 1993. New Mexico, spring season 1993. *Am. Birds* 47:440-443.
- Williams, S. O. III. 1994. New Mexico, spring season 1994. *Field Notes* 48:327-329.

(Arizona) grasshopper sparrow, *Ammodramus savannarum ammolegus*

Distribution: This unique local subspecies of the widespread grasshopper sparrow is restricted to grasslands in southeastern Arizona, extreme southwestern New Mexico, and immediately adjacent areas of northern Sonora and Chihuahua. The known range in New Mexico is limited to two populations in southern Hidalgo County, one in the Animas Valley and one in the Playas Valley (Williams 1991, 2006). This sparrow requires extensive, well-developed desert grasslands characterized by grama and other bunchgrasses and generally lacking woody vegetation; abundant thatch and dry grasses are needed for cover.

Current Status: The subspecies was listed as threatened by New Mexico in 1990. NMDGF breeding bird surveys were initiated in June 1987 in the Animas Valley specifically for this sparrow. In June 1992, the Animas Valley

transect was expanded and a new transect was established in the Playas Valley; there are now 13 years of consistently-gathered data for these two transects. In 1992, 109 sparrows were detected on the Animas transect and 41 were detected on the Playas transect. Since 1992, numbers recorded on each transect have shown year-to-year variation (Williams 1997); these fluctuations may reflect precipitation, local fire events, grazing practices, or other factors. However, both transects have shown persistent, statistically significant long-term declines during the 14-year period 1992-2005. By 2004, the Animas transect had declined 88% (to 21 sparrows) while the Playas transect declined 100% (to 0 sparrows), suggesting that population was nearing extirpation. In 2005, both transects yielded slight increases from 2004—the Animas route up from 21 to 26 birds and the Playas route up from 0 to 2 birds, but these small increases did not alter the long-term declining trends (Williams 2006).

Threats: The main threat to this taxon's continued survival in southern Hidalgo County is loss, degradation, and fragmentation of its native grassland habitat, primarily from excessive livestock grazing leading to reduced grass cover and increased brush encroachment. Ill-timed fires (especially those occurring during late spring-early summer) may severely depress recruitment.

Recommendation: Given the steep and persistent declines in both populations, and the near extirpation of one of them, uplisting from threatened to endangered is recommended. NMDGF should encourage grazing management practices and burning programs that perpetuate suitable grasslands for this unique subspecies. In particular, consideration should be given to grass banking or other means of reducing stocking rates in times of drought. NMDGF should continue to monitor the two populations each June, and continue to survey for possible additional populations in that vicinity.

Literature Cited:

- Williams, S. O. III. 1991. Discovery and status of the Arizona grasshopper sparrow in New Mexico. *New Mexico Ornithological Society Bull.* 19:32.
- Williams, S. O. III. 1997. Trends in Arizona grasshopper sparrow breeding populations in New Mexico: value of long-term studies. *New Mexico Ornithological Society Bull.* 25:35.
- Williams, S. O. III. 2006. Trends in Arizona grasshopper sparrow populations on the Diamond A (Gray) Ranch, Hidalgo County, New Mexico. Rept. to New Mexico Dept. of Game and Fish, Santa Fe, NM. 2 p.

Baird's sparrow, *Ammodramus bairdii*

Distribution: This grassland sparrow breeds in the northern Great Plains from the Canadian prairie provinces south to Montana, the Dakotas, and western Minnesota; it winters in southeastern Arizona and southwestern Texas south into north-central Mexico (A.O.U. 1998, Green et al. 2002). It is primarily a migrant in New Mexico, occurring mainly in the eastern plains and southern lowlands; it winters locally in southern grasslands, particularly in Otero, Luna, and Hidalgo counties.

Current Status: The status of this migratory species is of international concern, including in Canada (Gossen et al. 1993), and in the United States, where it is listed by Partners in Flight as a priority species in North America and by the U.S. Fish and Wildlife Service as a species of conservation concern (U.S.F.W.S. 2002); it was listed by New Mexico as threatened in 1975. The species formerly was relatively numerous and widespread in New Mexico (Hubbard 1978) but in recent years is very rarely reported. Surveys by NMDGF cooperators in 2000-2005 identified Otero Mesa grasslands as especially important to migrant Baird's sparrows.

Threats: The decline throughout the species' range is attributed to loss of native grassland habitat owing to unsustainable range management practices, conversion to cropland, invasion by exotic plants, and shrub encroachment (Phillips et al. 1964; Oberholser 1974; Gossen et al. 1993, Green et al. 2002). In New Mexico, loss, degradation, and fragmentation of grasslands, from excessive grazing and oil and gas development, are of particular concern.

Recommendation: No change in status is recommended. NMDGF should work with public and private land managers to identify, describe, and protect migration and winter habitat, and to develop a monitoring program for migrant and wintering populations.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Gossen, J. P., S. Brechtel, D. DeSmet, D. Hijertaas, and C. Werschler. 1993. Canadian Baird's sparrow recovery plan. Recovery of nationally endangered wildlife, Rept. No. 3. Canadian Wildlife Federation, Ottawa. 28 p.
- Green, M. T., P. E. Lowther, S. L. Jones, S. K. Davis, and B. C. Dale. 2002. Baird's sparrow. *In* The birds of North America, No. 638. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.
- Hubbard, J. P. 1978. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society Publ. No. 6. 110 p.
- Oberholser, H. C. 1974. The bird life of Texas. Univ. Texas Press, Austin, TX. 1069 p.
- Phillips, A. R., J. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. Arizona Press, Tucson, AZ. 212 p.
- U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. U.S. fish and Wildlife Service, Division of Migratory Birds, Arlington, VA.

Yellow-eyed junco, *Junco phaeonotus*

Distribution: This sparrow of the higher mountains of Mexico and Guatemala reaches its northern limits in the sky island mountain ranges of southeastern Arizona and southwestern New Mexico (A.O.U. 1998; Sullivan 1999). Historically known to be resident in New Mexico only in the Animas Mountains, Hidalgo County, where it was largely confined, at least in the nesting season, to the limited coniferous forest there. A second population was discovered in the Big Burro Mountains, Grant County, in 2003 (Williams 2004) and nesting was documented there in 2004 and 2005 (DeLong 2004, 2005a). The species undertakes altitudinal migration in Arizona (Moore 1972; Horvath and Sullivan 1988) and presumably in New Mexico, which may explain the occasional winter sightings in the Peloncillo and Big Hatchet mountains.

Current Status: The species was listed by New Mexico as threatened in 1983. It was reported as "common" in the Animas Mountains in early years (Bailey 1928), but precise data are lacking. Surveys of suitable habitat there in 1992, 1995, 1996, and 1997 found fewer than 30 adults each year. However, informal surveys found only 2 birds there in 2000, none in 2001, 5 singing males in 2002, and none in 2003. In 2005, Department surveys of available habitat in the Animas Mountains documented only 9 territories, with successful reproduction in at least 2 territories (DeLong 2005b). In the newly-discovered population in the Big Burro Mountains, 4-6 territories were detected in 2004 (DeLong 2004) and 7 territories were documented in 2005 (DeLong 2005a), and nesting was confirmed there each year.

Threats: The very small and restricted New Mexico populations are vulnerable to loss or modification of their limited coniferous forest habitat, this occurring from burning, cutting, grazing, or other factors. Grazing pressure has been shown to be especially detrimental to this ground nesting species in Arizona, where cattle grazing was responsible for a dramatic 75% reduction in nest success (Walsberg 2005). In addition, recruitment may suffer in years when dry conditions suppress breeding.

Recommendation: No change in status is recommended. A monitoring program is recommended for this species in the Animas and Big Burro mountains. Private and public land managers are encouraged to protect this junco's limited New Mexico habitat.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Bailey, F. M. 1928. Birds of New Mexico. New Mexico Dept. of Game and Fish, Santa Fe, NM 807 p.
- DeLong, J. P. 2004. Yellow-eyed junco surveys in the Big Burro Mountains in southwestern New Mexico [2004]. Rept. to New Mexico Dept. of Game and Fish, Santa Fe, NM. 13 p.
- DeLong, J. P. 2005a. Yellow-eyed junco surveys in the Big Burro Mountains of southwestern New Mexico [2005]. Rept. to New Mexico Dept. of Game and Fish, Santa Fe, NM 13 p.

- DeLong, J. P. 2005b. Yellow-eyed junco surveys in the Animas Mountains in southwestern New Mexico [2005]. Rept. to New Mexico Dept. of Game and Fish, Santa Fe, NM. 11 p.
- Horvath, E. G. and K. A. Sullivan. 1988. Facultative migration yellow-eyed juncos. *Condor* 90:482-484.
- Moore, N. J. 1972. Ethology of the Mexican junco (*Junco phaeonotus palliatus*). Ph.D. diss., Univ. Arizona, Tucson, AZ.
- Sullivan, K. A. 1988. Ontogeny of time budgets in yellow-eyed juncos: adaptation to ecological constraints. *Ecology* 69:118-124.
- Sullivan, K. A. 1999. Yellow-eyed junco. *In* The birds of North America, No. 464. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 24 p.
- Walsberg, G. E. 2005. Cattle grazing in a National Forest greatly reduces nesting success in a ground-nesting sparrow. *Condor* 107:714-716.

Varied bunting, *Passerina versicolor*

Distribution: This is primarily a Mexican species that enters the United States only along the Mexican border in Arizona, New Mexico, and Texas (A.O.U., Groschupf and Thompson 1998). In New Mexico, this neotropical migrant summers regularly in small numbers in Hidalgo, Doña Ana, and Eddy counties, where it prefers dense, shrubby vegetation associated with relatively arid canyons.

Current Status: The species was listed as threatened in New Mexico in 1975. Surveys and reports by NMDGF personnel and cooperators during the period 1987-2005 indicate this species persists as a summer resident in local areas of Hidalgo, Doña Ana, and Eddy counties; additionally there were reports of vagrants in Grant, Luna, Socorro, Sierra, and Otero counties during the same period. The populations remain small however, with the two-five occupied territories found annually in Guadalupe Canyon, Hidalgo County since 1990 representing the state's largest "concentration." However, results of surveys in the vicinity of Carlsbad Caverns National Park in 2003 detected these buntings in five canyons there (Williams 2004), suggesting larger numbers in Eddy County than previously known.

Threats: Loss of habitat, in particular the loss of dense shrubby riparian habitat required by this species, is a principal threat in New Mexico; such loss could occur through burning, clearing, excessive grazing, and reduced water tables. Cowbird parasitism, documented in Guadalupe Canyon in 1993 (Williams 1994), may also threaten New Mexico's small breeding populations.

Recommendation: No change in status is recommended. NMDGF should continue to monitor known populations, survey for and document new populations, and to encourage land managers to preserve and restore dense shrubby (e.g., mesquite) habitat in areas of this bird's occurrence.

Literature Cited:

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, D.C. 829 p.
- Groschupf, K. D. and C. W. Thompson. 1998. Varied bunting. *In* The birds of North America, No. 351. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 20 p.
- Williams, S. O. III. 1994. New Mexico, fall season 1994. *Am. Birds* 48:137-139.
- Williams, S. O. III. 2004. New Mexico, spring season 2003 & summer season 2003. *North Am. Birds* 57:383-385; 525-527.

MAMMALS

ENDANGERED

Arizona shrew, *Sorex arizonae*

Distribution: Arizona shrew is known from the Huachuca, Santa Rita, and Chiricahua Mountains of southeastern Arizona (Diersing and Hoffmeister, 1977; Hoffmeister, 1986), and portions of Chihuahua, Mexico (Caire et al., 1978). In New Mexico, it is known only from the Animas Mountains (Conway and Schmitt, 1978; Cook, 1986). In the Animas Mountains, Arizona shrew occupies mesic woodlands dominated by Douglas fir (*Pseudotsuga menziesii*), quaking aspen (*Populus tremuloides*), and netleaf oak (*Quercus reticulata*), often near springs. In Arizona, it is associated with silver-leaf oak (*Q. hypoleucoides*), Arizona white oak (*Q. arizonica*), Arizona madrone (*Arbutus arizonica*), Chihuahua pine (*Pinus leiophylla* var. *chihuahuana*), and Arizona sycamore (*Platanus wrightii*) (Simons and Van Pelt, 1999). The known elevation range is from approximately 5170 to 8500 ft. Mature forest with ground cover, including live understory vegetation and woody debris, are important habitat features for this species (Simons and Van Pelt, 1999; Simons and Hoffmeister, 2003).

This is a terrestrial shrew that does not hibernate and forages for invertebrates in and under forest litter during alternating periods of activity during the day and night. The reproductive biology of this species is largely unknown; breeding occurs at least from late July through October (Simons and Hoffmeister, 2003).

Current Status: The New Mexico State Game Commission approved the listing of Arizona shrew as endangered in 1978 (Jones and Schmitt, 1997). Although limited, information on New Mexico populations suggests that the Arizona shrew is a very rare and extremely localized species. Surveys in 2001 documented the presence of Arizona shrew at two new locations in the Animas Mountains (L. H. Simons, pers. comm.). The species appears to be reasonably abundant at several sites in southern Arizona (Simons and Van Pelt, 1999).

Threats: The apparent rarity, extremely limited distribution, and small population size in New Mexico make this species highly vulnerable to any adverse habitat alterations. Destruction of mature riparian forest communities and associated understory vegetation and woody debris are the primary threats to the Arizona shrew in New Mexico.

Recommendation: No change in the listing status of Arizona shrew is recommended. Periodic surveys of distribution and population status in the Animas Mountains should be continued, and other possibly suitable habitats in the Peloncillo Mountains should be surveyed for presence. Assessment of the relationships between New Mexico and other populations (Ortega et al., in press) should be continued.

Literature Cited:

- Caire, W. J., E. Vaughan, and V. E. Diersing. 1978. First record of *Sorex arizonae* (Insectivora: Soricidae) from Mexico. *Southwestern Naturalist* 23:532-533.
- Cook, J. A. 1986. The mammals of the Animas Mountains and adjacent areas, Hidalgo County, New Mexico. *Occasional Papers, Museum of Southwestern Biology* 4:1-45.
- Conway, M. C. and C. G. Schmitt. 1978. Record of the Arizona shrew *Sorex arizonae* from New Mexico. *Journal of Mammalogy* 59:631.
- Diersing, V. and D. F. Hoffmeister. 1977. Revision of the shrews *Sorex merriami* and a description of a new species of the subgenus *Sorex*. *Journal of Mammalogy* 58:321-333.
- Hoffmeister, D. F. 1986. *Mammals of Arizona*. The University of Arizona Press and Arizona Game and Fish Department. 602 pp.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. *Life Among the Muses: Papers in Honor of James S. Findley*. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Ortega, J., S. Young, L. H. Simons, and E. Maldonado. In press. Characterization of six microsatellite DNA loci for *Sorex arizonae*. *Molecular Ecology Notes*.
- Simons, L. H. and D. F. Hoffmeister. 2003. *Sorex arizonae*. *Mammalian Species* 732:1-3.
- Simons, L. H. and W. E. Van Pelt. 1999. Occurrence of *Sorex arizonae* and other shrews (Insectivora) in southern Arizona. *Southwestern Naturalist* 44:334-342.

Mexican long-nosed bat, *Leptonycteris nivalis*

Distribution: Mexican long-nosed bats are known to occur at higher elevations (1550 to 9300 ft) in at least 15 states in Mexico (Arita and Humphrey, 1988). In the United States, the species is only found in southwest Texas (Borell and Bryant, 1942; Easterla, 1972; Mollhagen, 1973) and southwestern New Mexico (Arita and Humphrey, 1988; Hensley and Wilkins, 1988; Hoyt et al., 1994). Two bats collected in 1963 and 1967 in Hidalgo County, New Mexico and identified as Southern long-nosed bats (*L. curasoae*) were later identified as *L. nivalis* (Arita and Humphrey, 1988), and the presence of this species in southern Hidalgo County was re-confirmed in 1992 (Hoyt et al., 1994) and during 2003-2005 (Bogan et al., 2006). Primary areas of occurrence in New Mexico are the Animas, Peloncillo, and Big Hatchet mountains and the areas between these ranges (Bogan et al., 2006).

Mexican long-nosed bats inhabiting southwest New Mexico represent summer migrants from Mexico (Hoyt et al., 1994), and they are present only from mid-July to mid-September (Bogan et al., 2006). In New Mexico, Mexican long-nosed bats inhabit upper desert scrub and pine-oak woodlands in or near mountainous areas. Characteristic vegetation in these areas includes agave (*Agave* spp.), juniper (*Juniperus* spp.), oak (*Quercus* spp.), and Mexican piñon (*Pinus cembroides*). Roosting habitats of this species in New Mexico are not fully known, although all known day roosts are in caves and rock fissures, and an abandoned building near the Animas Mountains is used as a night roost between feeding forays (Bogan et al., 2006). They roost in caves, mines, hollow trees, and man-made structures in other portions of their range (Hall and Dalquest, 1963; Novick, 1963; Hensley and Wilkins, 1988).

Information on the reproductive biology of this species is very limited. Easterla (1973) speculated that young are born in Mexico before their arrival to Big Bend National Park. Mexican long-nosed bats are active at night, when they leave day roost sites to search for night-blooming food plants, principally on agaves and various cacti (Hall and Dalquest, 1963; Easterla, 1972; 1973; Gardner, 1977; Hensley and Wilkins, 1988). These bats primarily feed upon nectar and pollen, but may also eat some soft fruits and insects associated with flowering plants. Individuals forage long distances, often across valleys separating mountain ranges, between their day roosts and areas where food plants are available.

Current Status: The Mexican long-nosed bat is listed as endangered by the U. S. Fish and Wildlife Service, and a species recovery plan has been prepared (USFWS, 1994, 1995). The New Mexico State Game Commission approved listing the species as endangered in 1990; it was also listed during 1975-1978, apparently based on the nomenclature in use at the time for long-nosed bats (Jones and Schmitt, 1997). Population sizes, migratory habits and distribution in New Mexico are not fully understood. Hoyt et al. (1994) conservatively estimated that they netted 150 to 200 individuals of *Leptonycteris* in the proportion of two *L. curasoae* for every one *L. nivalis* in the Animas Mountains. A recent study by Bogan et al. (2006) identified day roost sites in the Animas, Peloncillo, and Big Hatchet mountains; numbers of long-nosed bats (both species) at these roosts ranged from 4 to a few thousand individuals and varied during the summer.

Threats: The species was federally listed as a result of identified population declines and the lack of formal protection for the species' habitat, particularly food plants such as agave. Disturbance of roost sites, including maternal colonies, has also been identified as a potential threat for this species.

Recommendation: No change in the current listing status of Mexican long-nosed bat is recommended. Identification and protection of roost sites and maintenance of viable populations of food plants (particularly agave) are necessary to conserve this species in New Mexico. The recently completed study of long-nosed bat species in southern Hidalgo County (Bogan et al., 2006) will provide a more thorough understanding of this bat's population status, movements, and habitat use in New Mexico.

Literature Cited

- Arita, H. T. and S. R. Humphrey. 1988. Revisión taxonómica de los murciélagos magueyeros del género *Leptonycteris* (Chiroptera: Phyllostomidae). Acta Zoologica Mexicana (n.s.), 29:1-60.
- Bogan, M.A., P.M. Cryan, C.D. Weise, and A. England. 2006. Roosts and movements of bats of the genus *Leptonycteris* in southwestern New Mexico. Presentation at the 39th Joint Annual Meeting of the Arizona and New Mexico Chapters of The Wildlife Society, Flagstaff, AZ, 2-4 February 2006 (abstract).

- Borell, A. E. and M. D. Bryant. 1942. Mammals of the Big Bend area of Texas. Univ. California Publ. Zool. 48:1-62.
- Easterla, D. A. 1972. Status of *Leptonycteris nivalis* (Phyllostomatidae) in Big Bend National Park, Texas. Southwestern Naturalist 17:287-292.
- Easterla, D. A. 1973. Ecology of the 18 species of Chiroptera at Big Bend National Park, Texas. Northwest Missouri State University Studies. 43:1-16
- Gardner, A. L. 1977. Food habits. Pp. 293-350, in Biology of bats of the New World family Phyllostomatidae, part II. R. J. Baker, J. K. Jones, Jr., and D. C. Carter, eds. Special Publications of the Museum, Texas Tech University, Lubbock, 13:1-364.
- Hall, E. R. and W. W. Dalquest. 1963. The mammals of Veracruz. University of Kansas Publications, Museum of Natural History. 14:165-362.
- Hensley, A. P. and K. T. Wilkins. 1988. *Leptonycteris nivalis*. Mammalian Species 307:1-4.
- Hoyt, R. A., J. S. Altenbach, and D. J. Hafner. 1994. Observations on long-nosed bats (*Leptonycteris*) in New Mexico. Southwestern Naturalist 39:175-179.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Mollhagen, T. 1973. Distributional and taxonomic notes on some west Texas bats. Southwestern Naturalist 17:427-430.
- Novick, A. 1963. Orientation in Neotropical bats. II. Phyllostomidae and Desmodontidae. Journal of Mammalogy 44:44-63.
- U. S. Fish and Wildlife Service (USFWS). 1994. Mexican long-nosed bat (*Leptonycteris nivalis*) recovery plan. U. S. Fish and Wildlife Service, Albuquerque, NM. 91 pp.
- U. S. Fish and Wildlife Service (USFWS). 1995. Endangered and threatened wildlife and plants. Federal Register 32 38453; September 30, 1988.

(Peñasco) least chipmunk, *Neotamias* (formerly *Tamias*) *minimus atristriatus*

Distribution: The least chipmunk (*Neotamias minimus*) occurs from central Yukon to western Quebec, south to California and New Mexico, and northeast to Wisconsin (Hall, 1981). In New Mexico, least chipmunks inhabit the northern mountain ranges (Chuska, San Juan, Jemez, Sangre de Cristo, and Sandia). In addition, disjunct and isolated populations assigned to the subspecies *N. minimus atristriatus* (Peñasco least chipmunk) occur in portions of the Sacramento Mountains in southcentral New Mexico, including James Canyon, Peñasco Canyon, and Sierra Blanca Peak (Findley et al., 1975; Sullivan and Petersen, 1988).

Historically, Peñasco least chipmunks in the Sacramento Mountains occupied two distinctly different habitats. Habitat in James and Peñasco canyons was characterized by mesic meadows and herbaceous riparian communities adjacent to agricultural fields, ponderosa pine (*Pinus ponderosa*) forest, and juniper (*Juniperus monosperma*) woodlands. In contrast, habitat at Sierra Blanca is more typical for least chipmunks from other localities, and includes high elevation talus slopes and glacial cirques surrounded by Englemann spruce (*Picea engelmannii*), quaking aspen (*Populus tremuloides*), corkbark fir (*Abies lasiocarpa*), and Douglas fir (*Pseudotsuga menziesii*) (Conley, 1970; Sullivan, 1985; Sullivan and Petersen, 1988).

Foods of the Peñasco least chipmunk include a variety of nuts, seeds, and fruits such as those from sunflowers (*Helianthus* spp.), gooseberry (*Ribes* sp.), wild strawberry (*Fragaria ovalis*), piñon (*Pinus edulis*), and Gambel's oak (*Quercus gambelii*), as well as a variety of flowers, leaves, and insects (Bailey, 1932). Young are born mid-summer, and juveniles have been observed in early September (Bailey, 1932).

Current Status: The Peñasco least chipmunk was proposed as a federal candidate species, but was not added to the U. S. Fish and Wildlife Service's candidate list. The subspecies was approved for listing as threatened by the New Mexico State Game Commission in 1983 (Jones and Schmitt, 1997). This chipmunk has not been confirmed in James Canyon or Peñasco Canyon since 1969 (Conley, 1970) despite intensive capture efforts in 1981-1982 (Yates, 1982). Given habitat changes in these areas, it is likely that the James Canyon and Peñasco Canyon populations have been extirpated. The remaining known populations of Peñasco least chipmunk are restricted to high elevation talus slopes and the Sierra Blanca area. A survey conducted on Sierra Blanca in 1981-1982 estimated a population

of only 15-20 individuals. A reported specimen of least chipmunk captured in Sixteen Springs Canyon in 1996 was subsequently identified as a gray-footed chipmunk (*Neotamias canipes*), a very similar species. Surveys by Hope and Frey (2000) found Peñasco least chipmunks in high elevation talus slopes in the northern Sacramento Mountains and verified its presence on Buck Peak as reported by Ortiz et al. (1998).

Threats: Historic Peñasco least chipmunk habitat in James and Peñasco canyons has been significantly altered by grazing and agricultural activities. These areas appear to no longer support populations of Peñasco least chipmunk. Known populations are restricted to small patches of high elevation talus habitat, and the species is sensitive to any natural or human-induced changes to these habitats. Additionally, the species is possibly threatened by competition from the closely related gray-footed chipmunk, which appears to have replaced Peñasco least chipmunk in several areas of former occurrence (J. K. Frey, personal communication, 2004). It is unknown if this replacement is due to direct competition, habitat changes that have favored one species over the other, or a combination of both.

Recommendations: No change in the current listing status of Peñasco least chipmunk is recommended. Protection of known habitats in the Sacramento Mountains (including the Sierra Blanca Peak vicinity) and additional survey work to better define current distribution, population size, and habitat requirements are recommended. This subspecies was formerly placed in the genera *Tamias* and *Eutamias*; change of the scientific name to *Neotamias minimus atristriatus* in this list is recommended to conform with Frey (2004).

Literature Cited:

- Bailey, V. 1932. Mammals of New Mexico. North American Fauna 53:1-412.
- Conley, W. H. 1970. Geographic variation in the least chipmunk, *Eutamias minimus* in New Mexico and eastern Arizona. Journal of Mammalogy 51:695-702.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Frey, J. K. 2004. Taxonomy and distribution of the mammals of New Mexico: an annotated checklist. Occasional Papers, Museum of Texas Tech University 240:1-32.
- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, NY, 2nd ed., 1:xv + 1-600 + 90.
- Hope, A. G. and J. K. Frey. 2000. Survey for the Peñasco least chipmunk (*Tamias minimus atristriatus*) in the Lincoln National Forest with notes on rodent community assemblages. Final report to Lincoln National Forest, Alamogordo, NM.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Ortiz, B., D. Ortiz, and B. Perez. 1998. 1998 survey of the Peñasco least chipmunk (*Tamias minimus atristriatus*) in the northern Sacramento Mountains, New Mexico. Unpublished report on file at Lincoln National Forest, Alamogordo, NM.
- Sullivan, R. M. 1985. Phyletic, biogeographic, and ecologic relationships among montane populations of least chipmunks *Eutamias minimus* in the Southwest. Systematic Zoology 34:419-448.
- Sullivan, R. M. and K. E. Petersen. 1988. Systematics of southwestern populations of least chipmunks *Tamias minimus* reexamined: a synthetic approach. Occasional Papers, Museum of Southwestern Biology 5:1-27.
- Yates, T. L. 1982. Status of the Peñasco chipmunk. Preliminary report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 519-71-01. 3 pp.

(Arizona) montane vole, *Microtus montanus arizonensis*

Distribution: The montane vole (*Microtus montanus*) occurs from British Columbia south to east-central California, Arizona, and New Mexico (Hall, 1981; Sera and Early, 2003). The Arizona subspecies, *Microtus montanus arizonensis*, is restricted to the White Mountains of eastern Arizona (Hoffmeister, 1986) and adjacent portions of the Gila National Forest in New Mexico and is the southernmost and most geographically isolated of montane vole subspecies (Hubbard et al., 1983; Frey et al., 1995; Frey, 2005). In New Mexico, Arizona montane voles are known only from Catron County where they have been documented at Centerfire Bog, Jenkins Creek, Flanagan Spring, Romero Creek, SA Creek, and the upper San Francisco River (Hubbard et al., 1983; Frey et al., 1995; Frey, 2005).

Arizona montane vole habitat in New Mexico consists of mesic sedge and grass meadows bordering small creeks and marshes at elevations around 6800 ft. Sedge and grass cover used by this vole is typically 9 or more inches in height (Frey, 2005). The sympatric Mexican vole (*M. mexicanus*) also occurs in these areas, but generally prefers drier habitats. Arizona montane voles construct distinct runways and build houses among grasses and matted sedges. Their diet consists primarily of grasses and sedges.

Current Status: The New Mexico State Game Commission approved listing the Arizona montane vole as endangered in 1979 (Jones and Schmitt, 1997). Current information suggests that the New Mexico populations are small and isolated; however vole populations are known to fluctuate dramatically in response to habitat changes (Findley et al., 1975). Surveys conducted along Jenkins Creek by the Department in 1998 and 2000 reconfirmed the presence of this species in this locality. Surveys in 2004 found Arizona montane vole still persists at the Jenkins Creek locality and documented four new localities on the Gila National Forest, all within the San Francisco River drainage system (Frey, 2005).

Threats: The combination of small, isolated populations and limited habitat increase the vulnerability of the Arizona montane vole to any adverse habitat alterations due to natural climatic changes and human activities such as livestock grazing, water diversion, and wetland conversion. Although much of the known habitat occurs on the Gila National Forest, other historic sites that may persist are on private land.

Recommendations: No change in the current listing status of Arizona montane vole is recommended at this time. Efforts should be made to protect sensitive mesic meadow habitat on both public and private lands in the drainages of known occurrence and other high-elevation riparian areas in west-central New Mexico. Maintenance of cattle exclosures and addition of new exclosures to protect areas of occurrence would benefit this vole. Cooperative projects between NMDGF and the U.S. Forest Service to enhance stream and riparian habitat and restore cienegas on the Gila National Forest would benefit this subspecies. Funding and implementation for such projects is needed to improve the habitat and population status for this species.

Literature Cited:

- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Frey, J. K. 2005. Status assessment of the Arizona montane vole (*Microtus montanus arizonensis*) in New Mexico. Final report to New Mexico Dept. Game and Fish, Santa Fe, NM, contract 04-516.75. 39 pp. + appendices.
- Frey, J. K., J. H. Fraga, and F. C. Bermudez. 1995. A new locality of the montane vole (*Microtus montanus arizonensis*) in New Mexico. Southwestern Naturalist 40:421-422.
- Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, NY, 2nd ed., 2: vi + 601-1181 + 90.
- Hoffmeister, D. F. 1986. Mammals of Arizona. University of Arizona Press and Arizona Game and Fish Department. 602 pp.
- Hubbard, J. P., C. S. Thaeler, Jr., and C. G. Schmitt. 1983. Notes on voles (*Microtus*, Family Cricetidae) in New Mexico. Nemouria, Occas. Papers, Delaware Museum Natural History 28:1-8.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Sera, W. E. and C. N. Early. 2003. *Microtus montanus*. Mammalian Species 716:1-10.

Gray wolf, *Canis lupus*

Distribution: The historic distribution of the gray wolf included much of North America extending from northern tundra regions southward to Durango, Mexico (Hall, 1981). In the north-central portion of the United States, gray wolves occur in Michigan, Wisconsin, and Minnesota, while in the Northern Rocky Mountain region, gray wolves are presently found in Wyoming, Idaho, and parts of southern Montana. Presently, there are approximately 1,000 wild, free-ranging gray wolves in the Northern Rockies. Understanding the distribution of Mexican wolves requires a review of the taxonomy of gray wolves in the Southwest. Work on the taxonomy of gray wolves by Young and Goldman (1944) and Hall (1981) revealed 24 subspecies of gray wolves in North America, five of which occurred in

the Southwest and Mexico: *C. l. baileyi*, *C. l. mogollonensis*, *C. l. monstrabilis*, *C. l. nubilis*, and *C. l. youngi*. Taxonomic revisions of Mexican wolves by Bogan and Mehlhop (1983) lumped *C. l. mogollonensis* and *C. l. monstrabilis* into *C. l. baileyi*. More recently, Nowak (1995) proposed reducing the original 24 subspecies of North American gray wolves into five, of which *C. l. baileyi* is one. Taxonomic classifications by Young and Goldman (1944), Hall (1981), Bogan and Mehlhop (1983), and Nowak (1995) were based on comparisons of morphological characteristics, relying heavily on skull measurements. They concluded that *C. l. baileyi* is a morphologically distinct subspecies of the gray wolf. More recently, molecular genetic (DNA) analyses have identified distinct genetic attributes in Mexican wolves (Garcia-Moreno et al., 1996; Hedrick, 1995; Wayne, et al., 1992).

The U. S. Fish and Wildlife Service concluded that a realistic delineation of the original range of the Mexican wolf should include the restricted range of *C. l. baileyi* as described by Young and Goldman (1944), Hall (1981), and Nowak (1995); much of the expanded range resulted from consolidation of subspecies by Bogan and Mehlhop (1983); expansion of *C. l. baileyi* into ranges of exterminated subspecies of wolves described by Nowak (1995). This estimated range is consistent with the dispersal capability of gray wolves (Fritts, 1983). The range of the Mexican wolf for purposes of reintroduction includes portions of central and north Mexico, west Texas, south New Mexico, and central and southwest Arizona (Parsons, 1996). Information on territory size of Mexican wolves does not exist; however, territories of wolves in other regions of North America range from 25 to over 5,000 square miles (Mech, 1970; Fuller et al, 1992).

The natural history of the Mexican wolf is based largely on anecdotal observations of northern wolf populations. Mexican wolves were virtually eliminated before in-depth studies of their biology could be undertaken. Most Mexican wolves were taken in pine-oak woodlands, pinyon-juniper woodlands, and grasslands interspersed between these areas, generally above 4500 ft. (Brown, 1983). The combination of prey availability, cover, and water found in montane woodlands appear to have been preferred by Mexican wolves. Diets of Mexican wolves were poorly documented; however, they probably preyed on larger mammals such as mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), elk (*Cervus elaphus*), collared peccaries (*Tayassu tajacu*), beavers (*Castor canadensis*), cottontails (*Sylvilagus* spp.), and jackrabbits (*Lepus* spp.) (Bailey, 1932; Leopold, 1959; Parsons, 1996). For Mexican wolves released in Arizona since 1998, approximately 80% of wild prey has been identified as elk with lesser numbers of mule deer and white-tailed deer also confirmed as wolf kills (USFWS, unpublished data). Wolves generally capture their prey by chasing, often in groups pursuing prey for long distances. Family groups (packs) form the basic social unit of wolves that typically consist of a breeding pair and yearling offspring (Mech, 1970).

Control activities aimed at elimination of wolves undoubtedly affected the structure of these social animals (Parsons, 1996). Precise data on pack sizes and social structure were not documented before these animals were extirpated. Most information gathered on wild Mexican wolves comes from trappers, who generally targeted lone animals. Most information on the productivity of wild Mexican wolves has been obtained by persons engaged in digging in wolf dens to kill the young (Brown, 1983). A sample of eight dens from Mexico had litter sizes of 4 to 8 pups (McBride, 1980). A sample of 86 litters of captive Mexican wolves ranged from one to nine, with a mean of 4.6 (Siminski, 1996). Captive females come into estrous between mid-February and mid-March, gestation periods average 63 days, and parturition occurs in April and May (Parsons, 1996).

Current Status: The gray wolf within the southwestern United States and Mexico is federally-listed as endangered by the U. S. Fish and Wildlife Service. The New Mexico State Game Commission approved a state listing of wolves as endangered in 1975 (Jones and Schmitt, 1997). In 1978, McBride (1980) estimated that fewer than 50 wolves existed in the Mexican States of Chihuahua and Durango. The current status of wolves in Mexico is unknown, but current numbers are believed to be considerably lower than McBride's estimates. Recent surveys in Mexico have failed to detect any wolves in the wild (Carrera, 1994), and it appears very unlikely that there are any wild wolves remaining in Mexico. Intensive investigation of reports of wolves along the U. S./Mexico border areas of New Mexico and Arizona failed to provide any clear evidence of Mexican wolves in any of these areas (Wolock, 1994; Whitaker et al., 1995). There is a federal recovery plan for the Mexican wolf (USFWS, 1982). The goal of the recovery plan is to re-establish at least 100 wolves in 5,000 mi² of the subspecies historic range (USFWS, 1982). Background information concerning the reintroduction of Mexican wolves has been thoroughly reviewed and made available to the public (USFWS, 1996).

In March 1997, the Secretary of the Department of the Interior authorized the reintroduction of Mexican wolves to the Southwest. This decision included selection of the preferred alternative as described in the Final Environmental

Impact Statement (USFWS, 1996). Beginning in March 1998, captive-reared Mexican wolves were released into the Blue Range Wolf Recovery Area in the Apache National Forest in eastern Arizona. Initial releases occurred at 6 different locations within Arizona. The Final Rule for the experimental population of Mexican wolves allowed for the translocation of wolves throughout the recovery zone, and for wolves from the initial releases to naturally disperse onto public lands in Arizona and adjacent New Mexico on the Gila National Forest.

Mexican gray wolves have been present continuously in New Mexico since about 2000. Wolves dispersed to New Mexico naturally after being released in Arizona, and other wolves were translocated to remote sites in the Gila Wilderness. The 2005 end of year count yielded approximately 35-49 free-ranging Mexican wolves associated with known groups within the recovery area. Of these wolves, 3 groups, as well as a few single animals, were in New Mexico. Two of these groups were confirmed as successful breeding pairs in 2005.

Threats: The principal cause of the decline and apparent extirpation of the wolf in New Mexico was a highly-efficient predator control program, the goal of which was to eradicate the species. Causes of death for reintroduced wolves released since 1998 have been primarily shooting and collisions with vehicles, but have also included mountain lions, rattlesnake bites, and diseases.

Recommendations: No change in the listing status of the Mexican wolf is recommended. NMDGF should continue to actively participate in the on-going recovery activities of the U. S. Fish and Wildlife Service and other cooperators in order to monitor the status of the reintroduced Mexican wolves and their habitats, and to work with local interests to ensure that successful Mexican wolf reintroduction is consistent with ongoing land uses.

Literature Cited:

- Bailey, V. 1932. Mammals of New Mexico. North American Fauna, 53:1-412.
- Bogan, M. A. and P. Mehlhop. 1983. Systematic relationships of gray wolves (*Canis lupus*) in southwestern North America. Occasional Papers, Museum of Southwestern Biology, 1:1-21.
- Brewster, W. G. and S. H. Fritts. 1995. Taxonomy and genetics of the gray wolf in western North America: a review. Pages 353-374 in L. N. Carbyn, S. H. Fritts and D. R. Seip, eds. Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Edmonton, Alberta, Occasional Publication No. 35, 642 pp.
- Brown, D. E. 1983. The wolf in the Southwest: The making of an endangered species. University of Arizona Press, Tucson, AZ. 195 pp.
- Carrera, J. 1994. Mexican wolf recovery program. Annual report. PROFAUNA, A. C. Saltillo, Coahuila, Mexico. 10 pp.
- Fritts, S. H. 1983. Record dispersal of a wolf from Minnesota. J. Mammal. 64(1): 166-167.
- Fuller, T. K., W. E. Berg, G. L. Radde, M. S. Lenarz, and G. B. Joselyn. 1992. A history and current estimate of wolf distribution and numbers in Minnesota. Wildl. Soc. Bull. 20:42-55.
- G. Lopez Islas and C. B. Vasquez Gonzales. 1991. Linaje de lobos Mexicanos ASan Juan de Aragon@: Historia, evidencias de su autenticidad y posibilidad de certificacion. Unpublished Report. Parque Zoológico de San Juan de Aragón, Mexico City.
- Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, NY, 2nd ed., 2: vi + 601-1181 + 90.
- Hedrick, P. 1995. Genetic evaluation of the three captive Mexican wolf lineages and consequent recommendations. Unpublished report of the Mexican Wolf Recovery Team Genetics committee to U. S. Fish and Wildlife Service, Albuquerque, NM. 23 pp.
- Hoffmeister, D. F. 1986. Mammals of Arizona. University of Arizona Press, Tucson, xx + 602 pp.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.
- Leopold, A. S. 1959. Wildlife of Mexico: The game birds and mammals. University of California Press, Berkeley, CA.
- Lindsay, E. H. And N. T. Tessman. 1974. Cenozoic vertebrate localities and faunas in Arizona. Journal of the Arizona Academy of Science 9:3-24.
- McBride, R. T. 1980. The Mexican wolf (*Canis lupus baileyi*): A historical review and observations on its status and distribution. Endangered Species Report 8, U. S. Fish and Wildlife Service, Albuquerque, NM. 38 pp.

- Mech, L. D. 1970. The wolf: the ecology and behavior of an endangered species. Natural History Press. Doubleday Publ. Co., New York, NY. 380 pp.
- Nowak, R. M. 1995. Another look at wolf taxonomy. Pages 375-397 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, eds. Ecology and conservation of wolves in a changing world. Canadian circumpolar Institute, Edmonton, Alberta, Occasional Publication No. 35. 642 pp.
- Parson, D. R. 1996. Case study: The Mexican wolf. Pages 101-123 in E. A. Herrera and L. F. Huenneke, eds. New Mexico's natural heritage: Biological diversity in the land of enchantment. New Mexico Journal of Science, vol. 36.
- Siminski, D. P. 1996. International studbook for the Mexican gray wolf (*Canis lupus baileyi*). Arizona-Sonora Desert Museum, Tucson, AZ.
- U. S. Fish and Wildlife Service. 1982. Mexican wolf recovery plan. U. S. Fish and Wildlife Service, Albuquerque, NM.
- U. S. Fish and Wildlife Service. 1996. The reintroduction of the Mexican wolf within its historic range in the United States. Draft Environmental Impact Statement. U. S. Fish and Wildlife Service. Albuquerque, NM.
- Wayne, R. K., N. Lehman, M. W. Allard, and R. L. Honeycutt. 1992. Mitochondrial DNA and variability of the gray wolf: Genetic consequences of population decline and habitat fragmentation. Conservation Biology 6:559-569.
- Young, S. P. and E. A. Goldman. 1944. The wolves of North America. American Wildlife Institute, Wash., DC.

(Desert) bighorn sheep, *Ovis canadensis mexicana*

Distribution: Bighorn sheep historically ranged from southwest Canada to northwest Mexico, with the desert subspecies *O. c. mexicana* occurring in New Mexico, Arizona, Texas, Sonora, Chihuahua, and Coahuila (Hall, 1981). Historically, desert bighorn sheep probably occurred in many of the arid mountain ranges in south and central New Mexico (NMDGF, 2003). There is evidence of their occurrence as far northwest as the Zuni Mountains and the Malpais area south of Grants; as far north and east as the Capitan and Jicarilla Mountains; as far south and east as the Sacramento and Guadalupe Mountains. However, it is believed that their core distribution included the Magdalena, Mogollon, San Andres, Organ, West Potrillo, Burro, Big Hatchet, Little Hatchet, San Luis, Peloncillo, and Alamo Hueco Mountain ranges as well as the San Francisco River drainage (Bailey, 1932; Buechner, 1960; Sands, 1967).

Currently, free-ranging desert bighorn sheep are found in the following mountain ranges in New Mexico: Peloncillo, Hatchet (Big and Little Hatchet Mountains), San Andres, Fra Cristobal, and Ladron. In addition, a captive population of approximately 90 sheep currently lives within NMDGF's Red Rock breeding facility in Hidalgo County.

Desert bighorn sheep inhabit arid, open habitats. Their habitat is characterized by steep, rocky, and broken terrain that confers high visibility. Although primarily grazers feeding upon grasses and forbs, desert bighorn sheep diets in New Mexico include large amounts of shrubs and browse (Sandoval, 1979; Watts, 1979; Bavin, 1980; Elenowitz, 1983). Sandoval (1979) found 45 species of plants in the diet of the desert bighorn in New Mexico, with mountain mahogany (*Cercocarpus montanus*), globemallow (*Sphaeralcea* spp.), bladderpod (*Lesquerella purpurea*), and grasses as the main items. Bighorn sheep obtain minerals from natural salt-licks (Shackleton, 1985); however, little is known about mineral requirements of desert bighorn sheep. Watts (1979) noted them crossing 4 km (22 miles) of open lands between the Big Hatchet Mountains and the Cairn Hills to utilize mineral licks. Summer activities of desert bighorn are often concentrated within two miles of water sources (Leslie and Douglas, 1979; Cunningham and Ohmart, 1986). In the San Andres Mountains, bighorn sheep were usually found within one mile of surface water.

Males generally remain separate from female and juvenile sheep except during the breeding season. In the San Andres Mountains, the rut occurs mainly from July into December; however, some breeding does occur in other seasons (Sandoval, 1980). Lambs are generally born between February and April, but they also occur as early as December and as late as September. Disease, predation, competition, human conflicts, and accidents are the primary causes of mortality for desert bighorn sheep in New Mexico (McCarty and Bailey, 1994; NMDGF, 2003).

Current Status: The New Mexico State Game Commission approved a listing of the *O. c. mexicana* subspecies as endangered in 1980, excluding the Peloncillo Mountains and Red Rock Wildlife Area populations in 1988 (Jones and Schmitt, 1997). This subspecies also has special protection in Mexico (Secretaría de Desarrollo Social, 1994). Desert bighorn sheep populations in New Mexico have declined precipitously, and they now occur in a handful of the mountain ranges that they historically inhabited. While it is difficult to accurately determine when the populations of desert bighorn sheep in New Mexico were locally extirpated, it is generally believed to have occurred as follows: prior to 1800 in the Zuni and Magdalena Mountains; between 1850-1900 in the San Francisco River and Turkey Creek drainages and Burro Mountains; early 1900s in the Alamo Hueco, Animas, Peloncillo, and West Potrillo Mountains; 1940s to 1950s in the Guadalupe and Sacramento Mountains and El Malpais area (NMDGF, 2003).

Currently, there are only six desert bighorn sheep populations in New Mexico (including the captive population at Red Rock), all of which were established or re-established through transplant efforts. The total free ranging population of desert bighorn sheep in New Mexico is currently estimated at approximately 305-370 individuals, with an additional 60 sheep at the Red Rock captive facility (NMDGF, unpublished data). Based on aerial and ground surveys, individual desert bighorn sheep population estimates are: Peloncillos (N=60-70); Hatchets (N =60-75); San Andres (N=105-110); Fra Cristobal (N=55-80); and Ladrone (N=25-35).

A population and habitat viability analysis (PVHA) was conducted for New Mexico desert bighorn sheep in July 1999. The PVHA results suggested that without regular and substantial supplementation, all existing populations of desert bighorn in New Mexico were at significant risk of extinction within 65 years (Fisher et al., 1999). High mortality rates appeared to be the proximate factor placing these populations at risk (Fisher et al., 1999). The persistence of a male-biased sex ratio among lambs born at the Red Rock facility also impacts New Mexico's augmentation and reintroduction programs.

A plan to guide recovery of desert bighorn sheep in New Mexico was completed in 2003 (NMDGF, 2003). This plan identifies the criteria for downlisting from endangered to threatened as ≥ 250 free-ranging desert bighorn distributed among at least 2 distinct populations or metapopulations, each containing ≥ 100 individuals.

Threats: The principal factors currently threatening desert bighorn sheep populations in New Mexico include mountain lion predation and habitat modification from extensive livestock grazing and fire suppression. (NMDGF, 2003). From 1993-2003, approximately 85% of all known-cause mortalities of radiocollared desert bighorn sheep have been due to mountain lion predation. Domestic sheep represent a serious threat to desert bighorn sheep because of the potential for the transmission of fatal diseases, especially pneumonia which can decimate bighorn populations (McCarty and Bailey, 1994). Low genetic diversity exists in the Red Rock herd, and hence the wild herds, although the impact of this on herd health is not well understood (Caughley 1994). In small wild populations, impacts of demographic stochasticity may be greater than genetics in regulating population declines (Lande 1988).

Recommendation: No change in the current listing status of the desert bighorn sheep is recommended. NMDGF should continue to monitor herds and study limiting factors within both extant populations and unoccupied historic ranges. Recovery strategies should consider results and recommendations of the PVHA. Population numbers of desert bighorn sheep in New Mexico in November 2005 were sufficiently high to meet the criteria in NMDGF (2003) for downlisting of the subspecies to threatened. Because these population levels have persisted for less than a year, the recommendation is to forego consideration of downlisting until 2008 when a positive trend can be more accurately assessed.

Literature Cited:

- Bailey, V. 1932. Mammals of New Mexico. North American Fauna, 53:1-412.
- Bavin, B. 1980. Post-release study of desert bighorn sheep in the Big Hatchet Mountains. Desert Bighorn Council. Trans. 24:12-14.
- Buechner, H. K. 1960. The bighorn sheep in the United States: its past, present and future. Wildl. Monogr. 4. 174 pp.
- Caughley, G. 1994. Directions in conservation biology. J. Animal Ecol. 63:215-244.
- Cunningham, S. C., and R. D. Ohmart. 1986. Aspects of the ecology of desert bighorn sheep in Carrizo Canyon, California. Desert Bighorn Council Transactions 30:14-19.
- Elenowitz, A. S. 1983. Habitat use and population dynamics of transplanted desert bighorn sheep in the Peloncillo Mountains, New Mexico. M. S. Thesis. New Mexico State University, Las Cruces, NM. 158 pp.

- Fisher, A., E. Rominger, P. Miller, and O. Byers. 1999. Population and habitat viability assessment workshop for the desert bighorn sheep of New Mexico (*Ovis canadensis*): Final report. IUCN/SSC Conservation Breeding Specialist Group: Apple Valley, MN.
- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, 2nd ed., NY, 1:xv +1-600 + 90 and 2: vi + 601-1181 + 90.
- Jones, C., and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Lande, R. 1988. Genetics and demography in biological conservation. Science. 241:1455-1459.
- Leslie, D. M. Jr. and C. L. Douglas. 1979. Desert bighorn of the River Mountains, Nevada. Wildlife Monographs 66:1-55.
- McCarty, C. W. and J. A. Bailey. 1994. Habitat requirements of desert bighorn sheep. Colorado Division of Wildlife Special Report 69. 27 pp.
- New Mexico Department of Game and Fish. 2003. Plan for the recovery of desert bighorn sheep in New Mexico: 2003-2013. 58 pp.
- Sandoval, A. V. 1979. Preferred habitat of desert bighorn sheep in the San Andres Mountains, New Mexico. M. S. Thesis. Colorado State University, Fort Collins, CO. 314 pp.
- Sandoval, A. V. 1980. Preferred habitat of desert bighorn sheep in the San Andres Mountains, New Mexico. M. S. Thesis. Colorado State University, Fort Collins, CO. 314 pp.
- Sands, J. L. 1967. Bighorn sheep. Pages 69-82 in New Mexico Wildlife Management. New Mexico Dept. Game and Fish, Santa Fe, NM.
- Secretaría de Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determinia las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y sujetas a protección especial, y que establece especificaciones para su protección. Diaro Oficial De La Federación, México CDLXXXVIII(10):2060.
- Shackleton, D. M. 1985. *Ovis canadensis*. Mammalian Species 230:1-9.
- Watts, T. J. 1979. Detrimental movement patterns in a remnant population of bighorn sheep (*Ovis canadensis mexicana*). M. S. Thesis. New Mexico State University, Las Cruces, NM.

THREATENED

Least shrew, *Cryptotis parva*

Distribution: The least shrew occurs from Colorado to southern South Dakota, eastward to Connecticut, and southward to the Gulf Coast through Mexico to Panama (Hall, 1981; Fitzgerald et al., 1994). New Mexico represents the westernmost extent of the species' distribution. The least shrew was first discovered in the state at Tukumcari in 1981 (Hoditschek et al., 1985). This species is known from three general localities in eastern New Mexico: 1) the Tukumcari area, including Tukumcari Lake (Quay County), 2) Salt Lake on Grulla National Wildlife Refuge near Portales (Roosevelt County), and 3) Bitter Lake National Wildlife Refuge and vicinity in the Pecos River Valley, including Bottomless Lakes State Park and BLM Overflow Wetlands (Chaves County) (Hoditschek et al., 1985; Owen and Hamilton, 1986; Frey 2005). Efforts to trap shrews in other suitable habitats in eastern New Mexico (areas near Santa Rosa, Carlsbad, and Conchas Lake) failed to find this species (Shuster, 1987).

As presently understood, the least shrew in New Mexico may consist of two subspecies, *C. p. parva* on the eastern plains and *C. p. berlandieri* in the Pecos River Valley (Hafner and Shuster, 1996). The populations in the Pecos River Valley are likely relicts of a more widespread distribution that have become isolated since the Pleistocene by climatic changes, whereas those from the vicinities of Tukumcari and Portales may be the result of more recent expansion of populations in western Texas.

The least shrew occupies a variety of habitats within the western portion of its range. The species inhabits riparian woodlands in southeastern Colorado (Choate and Reed, 1988) and short grass prairie and mesic meadows in northeastern Colorado (Fitzgerald et al., 1994). Mesic areas with dense grass cover appear to represent primary habitat for this species in New Mexico. They occupy mesic meadows with willows (*Salix gooddingii*) and cattails (*Typha angustifolia*) along the edge of Tukumcari Lake (Cully, 1983; Hoditschek et al., 1985). At Grulla National Wildlife Refuge, they were found in communities of alkali sacaton (*Sporobolus airoides*), grama (*Bouteloua* sp.),

and various forbs (Owen and Hamilton, 1986). Frey (2005) found this species associated with saltgrass (*Distichlis stricta*) meadows and cattail/bulrush (*Scirpus* spp.) marshes, but also in mesic areas dominated by non-native grasses.

Food habits of the least shrew are similar to other shrew species, and include insects, arthropods, and earthworms (Fitzgerald et al., 1994). Gestation takes 21 to 23 days, young are born blind and hairless, and weaning occurs about 21-23 days after birth (Fitzgerald et al., 1994).

Current Status: The least shrew was approved for listing as threatened by the New Mexico State Game Commission in 1985 (Jones and Schmitt, 1997). Known distribution in New Mexico is limited to three general areas of occurrence in the eastern third of the state. Recent surveys by Frey (2005) found that the species persists at all historic sites in New Mexico and occurs elsewhere in the Tucumcari area and the Pecos River Valley near Bitter Lake National Wildlife Refuge and Bottomless Lakes State Park. Thus, least shrew appears to be more common and widespread in these areas than previously known (Frey, 2005). It eventually may be found in other areas of eastern New Mexico with similar habitat.

Threats: Because of its reliance on mesic grasslands and wetlands, this species is vulnerable to habitat loss and degradation resulting from climatic variation (i.e., drought) and human activities (e.g., water diversion, agriculture, and excessive grazing).

Recommendation: No change in the current listing status of the least shrew is recommended. Additional surveys in the vicinity of known localities and in other parts of eastern New Mexico with suitable habitat should be conducted to better ascertain the species distribution and population status in the state. Conservation projects that maintain suitable mesic habitat and continuity between these habitats in eastern New Mexico would benefit this species. Additional genetic studies of the relationship between the Pecos River Valley and eastern plains populations in New Mexico would provide valuable information for management purposes. Successful implementation of measures to protect and enhance habitat for this species could lead to future delisting under the WCA.

Literature Cited:

- Choate, J. R. and M. P. Reed. 1988. Least shrew, *Cryptotis parva*, in southwestern Kansas and southeastern Colorado. *Southwestern Naturalist* 33:361-362.
- Cully, J. F. 1983. Tucumcari Lake wildlife inventory. Final report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 516-71-31. 68 pp.
- Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994. *Mammals of Colorado*. Denver Museum of Natural History and University Press of Colorado, Niwot, CO. 467 pp.
- Frey, J.K. 2005. Status and habitat of the least shrew (*Cryptotis parva*) in New Mexico. Final report to New Mexico Dept. Game and Fish, Santa Fe, NM, contract 05-516.0000.0080. 40 pp + appendices.
- Hafner, D. J. and C. J. Shuster. 1996. Historical biogeography of western peripheral isolates of the least shrew, *Cryptotis parva*. *Journal of Mammalogy* 77:536-545.
- Hall, E. R. 1981. *The Mammals of North America*. John Wiley & Sons, New York, NY, 2nd ed., 1:xv +1-600 + 90.
- Hoditschek, B., J. F. Cully, Jr., T. L. Best, and C. Painter. 1985. Least shrew (*Cryptotis parva*) in New Mexico. *Southwestern Naturalist* 30:600-601.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. *Life Among the Muses: Papers in Honor of James S. Findley*. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Owen, R. D. and M. J. Hamilton. 1986. Second record of *Cryptotis parva* (Soricidae: Insectivora) in New Mexico, with review of its status on the Llano Estacado. *Southwestern Naturalist* 31:403-405.
- Shuster, C. J. 1987. Distribution, relative population densities, and habitat of *Cryptotis parva* in New Mexico. Final report, New Mexico Dept. Game and Fish, Santa Fe, NM contract 516.6-75-19. 20 pp.

Southern long-nosed bat, *Leptonycteris curasoae*

Distribution: The southern long-nosed bat occurs from South America north through Mexico to southern Arizona and southwestern New Mexico; populations in the United States represent the northern extent of the species' range

(Findley et al., 1975; Hall, 1981; Hoffmeister, 1986; Wilson and Reeder, 2005). In New Mexico, this bat is known from the Animas, Peloncillo, and Big Hatchet mountains and adjacent valleys in southern Hidalgo County (Findley et al., 1975; Baltosser, 1980; Hoyt et al., 1994; Bogan et al., 2006). Similar to the Mexican long-nosed bat (*L. nivalis*), the southern long-nosed bat is a migratory species that is found in the United States only during summer months (Hayward and Cockrum, 1971; Findley et al., 1975; Wilson, 1985). Bogan et al. (2006) reported occurrence in New Mexico from mid-July to mid-September. Habitats utilized by the southern long-nosed bat include forested canyons and adjacent desert grassland and shrub lands (Findley et al., 1975; Hoffmeister, 1986). The diet consists of nectar, pollen, and soft fruits of agaves (*Agave* spp.) and various cacti, with insects being taken incidentally. In Arizona, migrant females are pregnant when they arrive from Mexico and subsequently give birth and rear their young in maternal colonies (Hoffmeister, 1986). Caves and rock fissures are the only known day roost sites in New Mexico (Bogan et al., 2006), but the species is also known to roost in trees, mines, culverts, and buildings elsewhere in its range. An abandoned building near the Animas Mountains is a known night roost for long-nosed bats between feeding forays (Bogan et al., 2006).

Current Status: The southern long-nosed bat is listed as endangered by the U. S. Fish and Wildlife Service and a federal recovery plan has been prepared (USFWS, 1995). The New Mexico State Game Commission approved the addition of this species to the threatened list in 1975 (Jones and Schmitt, 1997). Until recently, few studies have been conducted on this bat in New Mexico, and its ecology and population size and trends are not fully understood. Hoyt et al. (1994) conservatively estimated that they netted 150 to 200 individuals of *Leptonycteris* in the proportion of two *L. curasoae* for every one *L. nivalis* in the Animas Mountains. A recent study by Bogan et al. (2006) identified day roost sites in the Animas, Peloncillo, and Big Hatchet mountains; numbers of long-nosed bats (both species) at these roosts ranged from 4 to a few thousand individuals and varied during the summer.

Wilson and Reeder (2005) considered U.S. and Mexican populations of the subspecies *L. c. yerbabuena* to be specifically distinct from *L. curasoae* of South America, but this taxonomic arrangement has not been universally accepted. United States populations were formerly placed in the species *L. sanborni*.

Threats: Current threats are thought to include a lack of formal protection for the species' habitat, disturbance of both day and night roost sites and maternity colonies, and degradation of food resources (agave and cacti).

Recommendation: No change in the current listing status of the southern long-nosed bat is recommended. Identification and protection of roost sites and maintenance of viable populations of food plants (particularly agave) are necessary to conserve this species in New Mexico. The recently completed study of long-nosed bat species in southern Hidalgo County (Bogan et al., 2006) will provide a more thorough understanding of this bat's population status, movements, and habitat use in New Mexico.

Literature Cited:

- Baltosser, W. H. 1980. A biological inventory of endangered species occurring in Guadalupe Canyon, Hidalgo County, New Mexico. Final report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 519-68-06, 73 pp.
- Bogan, M.A., P.M. Cryan, C.D. Weise, and A. England. 2006. Roosts and movements of bats of the genus *Leptonycteris* in southwestern New Mexico. Presentation at the 39th Joint Annual Meeting of the Arizona and New Mexico Chapters of The Wildlife Society, Flagstaff, AZ, 2-4 February 2006 (abstract).
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, NY, 2nd ed., 1:xv +1-600 + 90.
- Hayward, B. J. and E. L. Cockrum. 1971. The natural history of the western long-nosed bat *Leptonycteris sanborni*. Western New Mexico University, Research Sciences 1:75-123.
- Hoffmeister, D. F. 1986. Mammals of Arizona. The University of Arizona Press and Arizona Game and Fish Department. 602 pp.
- Hoyt, R. A., J. S. Altenbach, and D. J. Hafner. 1994. Observations on long-nosed bats (*Leptonycteris*) in New Mexico. Southwestern Naturalist 39:175-179.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.

- Wilson, D. E. 1985. Status report, *Leptonycteris sanborni* Hoffmeister, Sanborn's long-nosed bat. U. S. Fish and Wildlife Service, Office of Endangered Species, Albuquerque, NM, unpublished report ii+36 pp.
- Wilson, D. E. and D. M. Reeder. 2005. Mammal Species of the World: A Taxonomic and Geographic Reference. Johns Hopkins University Press, Baltimore, MD. xxxvi + 2142 pp.
- U. S. Fish and Wildlife Service (USFWS). 1995. Lesser long-nosed bat recovery plan. USFWS, Albuquerque, NM. 45 pp.

Spotted bat, *Euderma maculatum*

Distribution: The spotted bat is widely distributed across western North America, occurring locally from central California and southern British Columbia, and southward through the Big Bend region of Texas to central Mexico (Hall, 1981; Fenton et al., 1983, 1987). Nowhere within this range is the species considered to be abundant. In New Mexico, spotted bats are known from numerous localities including Albuquerque (Bernalillo Co.), the Jemez Mountains (Sandoval Co.), the Mogollon Mountains (Catron Co.), the San Mateo Mountains (Socorro Co.), the Sacramento Mountains (Otero Co.), Mesilla Park (Doña Ana Co.), Lake Roberts (Grant Co.), Ghost Ranch (Rio Arriba Co.), and Aztec (San Juan Co.). Perry et al. (1995) reported spotted bats from the Sacramento Mountains, indicating a more extensive range in New Mexico than previously suspected.

This species has been recorded in a wide variety of habitats, including riparian communities, pinyon-juniper woodlands, and ponderosa pine and spruce-fir forests (Findley et al., 1975), and in burned areas of ponderosa pine forest (Ellison et al., 2005). In New Mexico, the spotted bat occurs in forested areas between 3900 and 10600 ft elevation. Spotted bats may summer in forested areas and migrate through lower elevations during other seasons (Hoffmeister, 1986). Most New Mexico records of spotted bats are from warmer months (April - September), but Sherwin and Gannon (2005) documented winter roosting in Albuquerque buildings. Ruffner et al. (1979) captured several specimens in Utah in January and February. Moths represent the principal food source of the spotted bat (Ross, 1967; Easterla, 1973). Young may be born in early summer based on captures of lactating females in late June to mid-July (Findley et al., 1975). Spotted bats utilize cliff faces and rock crevices for roosting, and such rocky areas are an essential habitat component for this species (Easterla, 1973).

Current Status: Spotted bats were approved for listing as threatened by the New Mexico State Game Commission in 1988 (Jones and Schmitt, 1997). Surveys in New Mexico and other states documented population declines throughout the species' historic range in 1983. Recent spotted bat surveys in New Mexico have relied upon both listening for audible echolocation sounds as well as the use of Anabat detectors. The current status of the spotted bat in New Mexico is not fully understood.

Threats: Threats and limiting factors are largely unknown, but the species is likely adversely affected by pesticides, disturbance of foraging habitats, and disturbance to roosting sites. This bat is relatively rare throughout its range, thus its scarcity in New Mexico may be a function of its biology rather than due to any impacts.

Recommendations: No change in the current listing status of the spotted bat is recommended. NMDGF should continue to encourage land management agencies to protect known foraging and roosting habitats. Surveys, particularly those based on standardized acoustic methods and direct observations, are needed to better identify the species' distribution, population trends, and threats in New Mexico.

Literature Cited:

- Easterla, D. A. 1973. Ecology of the 18 species of Chiroptera at Big Bend National Park, Texas. Northwest Missouri State University Studies 43:1-165.
- Ellison, L. E., A. L. Everette, and M. A. Bogan. 2005. Examining patterns of bat activity in Bandelier National Monument, New Mexico, by using walking point transects. Southwestern Naturalist 50:197-208.
- Fenton, M. D., D. C. Tennant, and J. Wyszecski. 1983. A survey of the distribution of *Euderma maculatum* (Chiroptera: Vespertilionidae) throughout its known range in the United States and Canada by monitoring its audible echolocation calls. U. S. Fish and Wildlife Service, contract 14-16-0002-82-210, final report: 1-44.
- Fenton, M. D., D. C. Tennant, and J. Wyszecski. 1987. Using echolocation calls to measure the distribution of bats: the case of *Euderma maculatum*. Journal of Mammalogy 69:142-144.

- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, NY. 2nd ed., 1:xv +1-600 + 90.
- Hoffmeister, D. F. 1986. Mammals of Arizona. The University of Arizona Press and Arizona Game and Fish Department. 602 pp.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Perry, T. W., P. M. Cryan, S. R. Davenport, and M. E. Bogan. 1995. New locality for *Euderma maculatum* (Chiroptera: Vespertilionidae) in New Mexico. Southwestern Naturalist 42:99-101.
- Ross, A. 1967. Notes on food habits of bats. Journal of Mammalogy 42:66-71.
- Ruffner, G. A., R. M. Poche, M. Meierkord, and J. A. Neal. 1979. Winter bat activity over a desert wash in southwestern Utah. Southwestern Naturalist 24:447-453.
- Sherwin, R. E. and W. L. Gannon. 2005. Documentation of an urban winter roost of the spotted bat (*Euderma maculatum*). Southwestern Naturalist 50:402-407.

Western yellow bat, *Lasiurus xanthinus*

Distribution : The western yellow bat occurs from southern California eastward through Arizona and southwestern New Mexico and south into Baja California and western and central Mexico (Wilson and Reeder, 2005). It was recently reported from Big Bend National Park, Texas (Higginbotham et al., 1999). In New Mexico, the species is known only from Guadalupe Canyon and the Animas Mountains in southern Hidalgo County (Mumford and Zimmerman, 1963; Findley et al., 1975; Baltosser, 1980; Cook, 1981).

This species is associated with riparian woodlands, and is most frequently captured over water (Findley et al., 1975; Baltosser, 1980; Cook, 1981). In Guadalupe Canyon, western yellow bat habitat includes riparian woodlands with cottonwoods (*Populus fremontii*), Arizona sycamores (*Plantanus wrightii*), and Arizona white oaks (*Quercus arizonica*). Similar to the closely related southern yellow bat, western yellow bats probably roost in trees and other large vegetation; elsewhere in its range, it has been reported to use the dead fronds of palms and yucca as roost sites. The species has been recorded in New Mexico only in summer months (May-September), and likely migrates southward for the winter. The diet includes arthropods, particularly flying insects. Pregnant females have been taken in May and June and lactating females in August (Mumford and Zimmerman, 1963; Cook, 1981), suggesting that young are born in mid-summer. Pregnant specimens of this species examined from New Mexico contained two embryos (Barbour and Davis, 1969).

Current Status: This species was approved for listing as threatened by the New Mexico State Game Commission in 1975 (Jones and Schmitt, 1997). The New Mexico populations are peripheral and believed to be of low density. Formerly considered to be a subspecies of the southern yellow bat (*Lasiurus ega*), genetic studies resulted in the designation of *L. xanthinus* as a distinct species (Baker, et al., 1988; Morales and Bickham, 1995)

Threats: Loss or alteration of forested riparian habitats in southwest New Mexico is the major threat to this peripheral species.

Recommendation: No change in the current listing status of western yellow bat is recommended. Protection and enhancement of riparian woodlands in southwestern New Mexico should be encouraged and would benefit this species. Population surveys and ecological studies of the species in New Mexico should be encouraged. The recent discovery of the species in Chihuahuan Desert habitat in Texas suggests additional surveys in this habitat in New Mexico may be warranted.

Literature Cited:

- Baltosser, W. H. 1980. A biological inventory of endangered species occurring in Guadalupe Canyon, Hidalgo County, New Mexico. Final report, New Mexico Dept. Game and Fish, Santa Fe, NM, contract 519-68-06, 73 pp.

- Baker, R. J., J. C. Patton, H. H. Genoways, and J. W. Bickham. 1988. Genic studies of *Lasiurus* (Chiroptera: Vespertilionidae). Occasional Papers, Museum of Texas Tech University 17:1-15.
- Barbour, R. W. and W. H. Davis. 1969. Bats of America. University of Kentucky, Lexington, KY. 286 pp.
- Cook, J. A. 1981. The bat fauna of the Animas Mountains in the summer of 1981. Final report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 519-69-04, 25 pp.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Higginbotham, J. L., L. K. Ammerman, and M. T. Dixon. 1999. First record of *Lasiurus xanthinus* (Chiroptera: Vespertilionidae) in Texas. Southwestern Naturalist 44:343-347.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Morales, J. C. and J. W. Bickham. 1995. Molecular systematics of the genus *Lasiurus* (Chiroptera: Vespertilionidae) based on restriction-site maps of the mitochondrial ribosomal genes. Journal of Mammalogy 76:730-749.
- Mumford, R. E. and D. A. Zimmerman. 1963. The southern yellow bat in New Mexico. Journal of Mammalogy 44:417-418.
- Wilson, D. E. and D. M. Reeder. 2005. Mammal Species of the World: A Taxonomic and Geographic Reference. Johns Hopkins University Press, Baltimore, MD. xxxvi + 2142 pp.

White-sided jackrabbit, *Lepus callotis*

Distribution: The white-sided jackrabbit (*Lepus callotis*) is a species almost entirely confined to Mexico, which represents the core distribution for this species. The subspecies *L. c. gaillardi* occurs throughout the Mexican Plateau, from Jalisco north to southwestern New Mexico (Findley et al., 1975; Hall, 1981). In New Mexico, it is known only from the Animas Valley and very limited parts of the Playas Valley in southern Hidalgo County; these two valleys constitute the entire range in the United States (Findley et al., 1975; Bednarz, 1977; Bednarz and Cook, 1984).

This elusive hare was reported only a few times after its discovery along the Mexican-U.S. border in 1892 (Mearns, 1896). Two were collected in the Playas Valley in 1931 (Anderson and Gaunt, 1962). Bogan and Jones (1975) obtained a single specimen in 1974. Systematic surveys for this species in New Mexico were initiated in the 1980s, and spotlighting from a vehicle at night was found to be an effective survey method.

White-sided jackrabbits tend to form male-female pairs, which is most evident during the breeding season (at least mid-April to mid-August) but may persist year-round. Pregnant females have been found March through October. Males with mates defend territories from intruder males. This species rests in shelter forms in dense grass and rarely use underground burrows (Best, 1999)

Studies by Bednarz and Cook (1984), Conway (1975), and Conley and Brown (1977) confirmed that the white-sided jackrabbit is a desert grassland specialist. Plants species associated with white-sided jackrabbit habitat in the Animas and Playa Valleys include blue grama (*Bouteloua gracilis*), black grama (*B. eriopoda*), tobosa (*Hilaria mutica*), buffalograss (*Buchloe dactyloides*), wolftail (*Lycurus pheloides*), flatsedge (*Cyperus* spp.), snakeweed (*Gutierrezia sarothrae*), soaptree yucca (*Yucca elata*), and honey mesquite (*Prosopis glandulosa*). Traphagen (2002) found that presence of buffalograss is an important indicator of white-sided jackrabbit presence, whereas shrub cover was negatively correlated with presence. Most observations (97%) of this species have been recorded in pure grasslands, with the remaining 3% recorded in grasslands with very limited forb and shrub components (Bednarz and Cook, 1984).

Current Status: This species was approved for listing as threatened by the New Mexico State Game Commission in 1975 (Jones and Schmitt, 1997). Spotlight censuses conducted in the Animas Valley between May and August 1976 revealed a mean of 15 individuals (range: 5-25) per census, and resulted in a population estimate of 250 to 300 individuals (Bednarz 1977). During eight censuses conducted in 1981, Cook counted a mean of 7.5 individuals per census (Cook, 1981a; 1981b). Cook also noted that numbers of black-tailed jackrabbits (*L. californicus*) increased 22 times and desert cottontail (*Sylvilagus auduboni*) increased approximately four times; while white-sided

jackrabbit sightings decreased by 50% compared to the findings of Bednarz (1977). Bednarz and Cook (1984) postulated that the decrease of white-sided jackrabbit and increase of black-tailed jackrabbit and desert cottontail was associated with a decrease in the density and vigor of grasses and concomitant increase in forb and shrub cover.

During five surveys in the Animas Valley during 1990, only 3.2 individuals were observed per census (Mehlhop, 1995). During 1994 and 1995, seven surveys conducted in the same general areas surveyed by Bednarz and Cook revealed a mean of 1.1 individuals per census and a total of eight individuals (Mehlhop 1995). While different sampling efforts by Mehlhop (1995) and Bednarz and Cook preclude statistical comparison, these data strongly suggest a significant decrease in the population from 1976 to 1995. Whether these surveys accurately reflected the overall New Mexico population of white-sided jackrabbit is unknown.

Data from NMDGF surveys conducted between 1997 and 2002 have not been fully analyzed; however, they have resulted in more individuals per survey than was reported by Mehlhop (1995). No observations of this species have been made in the Playas Valley during recent surveys, and the status of white-sided jackrabbit in this area remains uncertain. While the overall status of the species remains unclear, the Animas Valley population appears to be more secure than the Playas Valley population.

Threats: Loss and degradation of grassland habitats in the Animas Valley through drought, shrub encroachment, and changes in grass species composition represent the primary threats to the white-sided jackrabbit in New Mexico. In Zacatecas, Mexico, overgrazing and shrub encroachment are thought to have encouraged expansion of the range of black-tailed jackrabbit and the exclusion of white-sided jackrabbit (Matson and Baker, 1986); similar patterns of habitat use between these two hares have been observed in Chihuahua, Mexico (Desmond, 2004). Baker (1977) noted that excessive grazing might be one of the factors contributing to the decline of white-sided jackrabbit and apparent replacement by black-tailed jackrabbit. Although such mortality probably does not represent a significant threat to this species, vehicles sometimes kill white-sided jackrabbits (N. Moore-Craig, personal communication, 1992). Indiscriminate shooting of white-sided jackrabbits could threaten this species; however, Bednarz (1977) found no evidence of shooting during his study.

Recommendation: No change in the current listing status for white-sided jackrabbit is recommended. NMDGF should continue to conduct surveys to assess population status and trends using the protocol proposed by Mehlhop (1995). Private landowners are encouraged to employ non-detrimental livestock grazing practices within white-sided jackrabbit habitat and to employ shrub control where appropriate to maintain the grassland habitat needed by this species. The relationship between U.S. and Mexican populations of the species and population status in other portions of its range should be investigated.

Literature Cited:

- Anderson, S. and A. S. Gaunt. 1962. A classification of the white-sided jackrabbits of Mexico. *American Museum Novitates*. 2088:1-16.
- Baker, R.H. 1977. Mammals of the Chihuahuan Desert region - future prospects. Pp. 221-225 in R.H. Wauer and D.H. Riskind (eds.), *Transactions of the Symposium on the Biological Resources of the Chihuahuan Desert Region – United States and Mexico*. Sul Ross State University, Alpine, Texas, 17-18 October 1974. National Park Service, *Transactions and Proceedings Series No. 3*.
- Bednarz, J. 1977. The white-sided jackrabbit: distribution, numbers, and biology in the grasslands of Hidalgo County. Final report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 519-64-25. 33 pp.
- Bednarz, J. C. and J. A. Cook. 1984. Distribution and number of the white-sided jackrabbit (*Lepus callotis gaillardii*) in New Mexico. *Southwestern Naturalist* 29:358-360.
- Best, T.L. 1999. White-sided jackrabbit, *Lepus callotis*. Pp. 701-702 in D.E. Wilson and S. Ruff (eds.), *The Smithsonian Book of North American Mammals*. Smithsonian Institution Press, Washington D.C. xxvi +750 pp.
- Bogan, M. A. and C. Jones. 1975. Observations of *Lepus callotis* in New Mexico. *Proceedings of the Biological Society of Washington* 88:45-50.
- Conway, M. C. 1975. A rare hare. *New Mexico Wildlife* 21(2):45-50.
- Conley, W. and W. C. Brown. 1977. Habitat partitioning between the jackrabbits *Lepus callotis* and *L. californicus*. Final report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 51665-23. 9 pp.

- Cook, J. A. 1981a. Distribution and numbers of white-sided jackrabbits (*Lepus callotis*) in the Animas Valley in summer 1991. Final report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 519-69-04. 13 pp.
- Cook, J. A. 1981b. Distribution and numbers of white-sided jackrabbits (*Lepus callotis*) in the Animas Valley in summer 1991. Addendum to final report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 519-69-04. 8 pp.
- Desmond, M.J. 2004. Habitat associations and co-occurrence of Chihuahuan Desert hares (*Lepus californicus* and *L. callotis*). *American Midland Naturalist* 151:414-419.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. *Mammals of New Mexico*. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Hall, E. R. 1981. *The Mammals of North America*. John Wiley & Sons, New York, 2nd ed., 1:xv +1-600 + 90.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. *Life Among the Muses: Papers in Honor of James S. Findley*. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Matson, J. O., and R. H. Baker. 1986. *Mammals of Zacatecas*. The Museum, Texas Tech University, Special Publications 24:1-88.
- Mearns, E. A. 1896. Preliminary description of a new subgenus and six new species and subspecies of hares, from the Mexican border of the United States. *Proceedings, U. S. National Museum* 17:551-565.
- Mehlhop, P. 1995. Status of the white-sided jackrabbit in New Mexico with recommendations for a monitoring protocol. Final report, Share With Wildlife Program, New Mexico Dept. Game and Fish, Santa Fe, NM, contract 95-516-32. 42 pp.
- Traphagen, M. B. 2002. Buffalograss (*Buchloe dactyloides*): an important grass species for predicting the presence of the white-sided jackrabbit (*Lepus callotis*) in southern New Mexico. Final report, New Mexico Dept. Game and Fish, Santa Fe, NM, contract 02-515-43. 19 pp. + appendices.

(Organ Mountains) Colorado chipmunk, *Neotamias* (formerly *Tamias*) *quadrivittatus australis* (including Oscura Mountains population)

Distribution: The Colorado chipmunk (*Neotamias quadrivittatus*) is widely distributed across five western states, including southern Colorado, eastern Utah, northeastern Arizona, the extreme western portion of the Oklahoma Panhandle, and northern and central New Mexico (Durrant, 1952; Findley et al., 1975; Hall, 1981; Hoffmeister, 1986; Caire et al., 1989; Fitzgerald et al., 1994). In New Mexico, Colorado chipmunks are known to inhabit the Chuska, Zuni, San Mateo, Jemez, Gallinas, Sangre de Cristo, Sandia, and Manzano Mountain ranges. They also occur in piñon-juniper woodlands from Johnson Mesa to the Canadian River Canyon (Findley et al., 1975). Southern populations in New Mexico (Organ and Oscura mountains) are isolated from populations in the northern half of the state, and from each other, and are currently recognized as two distinct subspecies: Organ Mountains chipmunk (*N. q. australis*) and Oscura Mountains chipmunk (*N. q. oscuraensis*).

Chipmunks were discovered in the Organ Mountains in 1903 by O. B. Metcalf (Bailey, 1932), and were initially regarded as a subspecies of gray-collared chipmunk, *Neotamias cinereicollis cinereus* by Howell (1929) and Bailey (1932). Findley et al. (1975) regarded chipmunks from the Organ Mountains to be gray-collared chipmunks (*N. cinereicollis*). A morphological study indicated a close phyletic relationship between the Organ Mountains chipmunks and northern populations of *N. q. quadrivittatus* (Patterson, 1980). As a result of this work, the Organ Mountains chipmunks were described as the subspecies *N. q. australis* (Patterson, 1980). Chipmunks were discovered in the Oscura Mountains in 1977 (Patterson, 1980) and, although considered a form of Colorado chipmunk, were not formally described as a new subspecies for almost 20 years (Sullivan, 1996).

The distribution of the Organ Mountains chipmunk is limited to the Organ Mountains in southern New Mexico (Patterson, 1980). Most habitat for this subspecies is found on the north-facing slopes in the vicinity of Aguirre Springs, and is characterized by ponderosa pine (*Pinus ponderosa*), oaks (*Quercus* spp.), junipers (*Juniperus* spp.), Apache plume (*Fallugia paradoxa*), and sumac (*Rhus* spp.) at elevations between 6000 and 7300 ft (Patterson 1980). The distribution of the Oscura Mountains chipmunk is limited to the Oscura Mountains at the northern end of the Tularosa Basin on White Sands Missile Range in south-central New Mexico (Sullivan, 1996). Habitat for this species is restricted to northwest-facing limestone cliff edges in pinyon-juniper-oak communities, which is characterized by pinyon (*Pinus edulis*), one-seed juniper (*J. monosperma*), mountain mahogany (*Cercocarpus*

montanus), antelope brush (*Pursia tridentata*), four-wing salt bush (*Atriplex canescens*), and oaks (*Quercus* sp.). Open areas are variously covered with side-oats grama (*Bouteloua curtipendula*), black grama (*B. eriopoda*), blue grama (*B. gracilis*), Chihuahuan love-grass (*Eragrostis erosa*), and soap-tree yucca (*Yucca elata*) (Sullivan, 1996).

Colorado chipmunks from more northerly locales generally breed in late spring (Bailey, 1932; Patterson, 1980); however, Oscura Mountains chipmunks appear to breed in early spring (Sullivan, 1996). Lactating females and juvenile animals were observed in mid-September, and females with embryos were collected in early April. The Oscura Mountains chipmunk appears to have a reproductive pattern intermediate to Colorado chipmunks in northern New Mexico and Organ Mountains chipmunks (Patterson, 1980; Sullivan, 1996). The early spring conception pattern of Oscura Mountains chipmunks (Sullivan, 1996) is similar to that reported for Organ Mountains chipmunks (Patterson, 1980) and appears to coincide with periods of reduced water stress and increased food production.

Both subspecies, similar to other chipmunks, are adept tree climbers but spend much of their time in brushy vegetation, limestone ledges, cliffs, and rockpiles. They tend to be most active in early morning and late afternoon.

Current Status: The Organ Mountains chipmunk was approved for listing as threatened by the New Mexico State Game Commission in 1983 (Jones and Schmitt, 1997). In 1987, NMDGF proposed the addition of the Oscura Mountains population of Colorado chipmunks based on a study by Sullivan and Yates (1987) that indicated the Oscura Mountains chipmunks were most closely related to chipmunks in the Organ Mountains. The Oscura Mountains population was included within the listing of the Organ Mountains subspecies in 1988 (Jones and Schmitt, 1997) as an undescribed subspecies under the Organ Mountains chipmunk. The Oscura Mountains population was later described as a new subspecies, *T. q. oscuraensis*, by Sullivan (1996). The Organ Mountains population of chipmunks was estimated at 1,000 to 2,000 by Patterson (1980). No estimates have been attempted for the Oscura Mountains population, but surveys conducted in 2004–2005 suggest a small population (T. Griffin, personal communication, 2005). The most recent surveys of both populations were conducted by Riviuccio et al. (2003) using auditory detection; live-trapping proved to be largely ineffective.

Threats: These small, isolated chipmunk populations are extremely vulnerable to habitat loss or alteration. Excessive scientific collecting and disease (i.e., sylvatic plague) may also pose threats to these populations. The mosaic of piñon-juniper-oak woodland habitats of the Oscura Mountains chipmunk and the broken topography with limestone cliffs and ledges has a patchy distribution and is restricted to the west and northwest cliffs in the Oscura Mountains (Sullivan, 1996). Because of the localized and patchy distribution of this habitat, the most immediate threat to this species is destruction of natural habitat by human activities and fire.

Recommendations: No change in the listing status of the Organ Mountains Colorado chipmunk (considered to include the Oscura Mountains population) is recommended. Coordination with White Sands Missile Range in monitoring of the Oscura Mountains chipmunk should be continued. The use of predictive habitat models and auditory detection methods (following Riviuccio et al., 2003) in monitoring of the two populations is recommended. To clarify the current taxonomy and protected status of these two populations, it is also recommended that provisions under the WCA be initiated in the near future to list the Oscura Mountains chipmunk, *T. q. oscuraensis*, as a threatened subspecies rather than continuing to list it as an undescribed form under the Organ Mountains subspecies of Colorado chipmunk. The Colorado chipmunk was formerly placed in the genera *Tamias* and *Eutamias*; change of the scientific name to *Neotamias quadrivittatus* in this list is recommended to conform with Frey (2004).

Literature Cited:

- Bailey, V. 1932. Mammals of New Mexico. North American Fauna 53:1-412.
- Caire, W., J. D. Tyler, B. P. Glass, and M. A. Mares. 1989. Mammals of Oklahoma. University of Oklahoma Press, Norman, OK. 567 pp.
- Durrant, S. D. 1952. Mammals of Utah: taxonomy and distribution. Univ. Kansas Publ., Mus. Nat. Hist., 6:1-519.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994. Mammals of Colorado. Denver Museum of Natural History and University Press of Colorado, Niwot, CO. 467 pp.
- Frey, J.K. 2004. Taxonomy and distribution of the mammals of New Mexico: an annotated checklist. Occasional Papers, Museum of Texas Tech University 240:1-32.

- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, NY, 2nd ed., 1:xv +1-600 + 90.
- Hoffmeister, D. F. 1986. Mammals of Arizona. The University of Arizona Press and Arizona Game and Fish Department. 602 pp.
- Howell, A. H. 1929. Revision of the American chipmunks (genera *Tamias* and *Eutamias*). North American Fauna 52:1-157.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Patterson, B. D. 1980. A new subspecies of *Eutamias quadrivittatus* (Rodentia: Sciuridae) from the Organ Mountains, New Mexico. Journal of Mammalogy, 61:455-464.
- Rivieccio, M., B.C. Thompson, W.R. Gould, and K.G. Boykin. 2003. Habitat features and predictive habitat modeling for the Colorado chipmunk in southern New Mexico. Western North American Naturalist 63:479-488.
- Sullivan, R. M. 1996. Genetics, ecology, and conservation of montane populations of Colorado chipmunks (*Tamias quadrivittatus*). Journal of Mammalogy 77:951-975.
- Sullivan, R. M. and T. L. Yates. 1987. Results of the protein electrophoretic analysis of the Organ Mountain chipmunk (*Eutamias quadrivittatus australis*) relative to other populations of *E. quadrivittatus* in New Mexico. Progress report, New Mexico Department of Game and Fish, Santa Fe, NM, contract 515.6-75-01. 6 pp.

Southern pocket gopher, *Thomomys umbrinus*

Distribution: The known distribution of the southern pocket gopher is restricted to a few mountain ranges in southeastern Arizona and the Animas Mountains in New Mexico (Findley et al., 1975; Hinesley and Thaeler, 1977; Cook, 1982, 1986; Hoffmeister, 1986). In New Mexico, the species has been found mostly at elevations above 7200 ft in the Animas Mountains as well as at lower elevations along creeks in that area (Hinesley and Thaeler et al., 1977; Cook, 1982, 1986). The Animas Mountains population has been recognized as a distinct subspecies (*T. u. emotus*). A recent survey for this species or other pocket gophers in the Big Hatchet Mountains, east of the Animas Mountains, was unsuccessful in detecting southern pocket gopher (Geluso, 2006)

Pocket gophers are fossorial (i.e., live primarily underground) and eat roots of various plant species that are encountered as they dig their burrow systems. They are generally not social, and the only time that individuals coexist in the same burrow system occurs when females are caring for their young. They are polygamous and breeding may occur more than two times in a year (Hall, 1981). Cook (1982, 1986) found pregnant females between mid-March and early April, with 2-3 embryos in each specimen.

Current Status: The New Mexico State Game Commission approved the listing of the southern pocket gopher as endangered in 1975 (Jones and Schmitt, 1997). The primary reasons for listing the species were endemism and its very restricted distribution in New Mexico. The species is difficult to survey because of its fossorial nature, the relative inaccessibility of its habitat, and its co-occurrence with a closely-related species (Botta's pocket gopher, *Thomomys bottae*) in parts of its range. There are no population estimates for this species in New Mexico.

Threats: Habitat disturbance or alteration, as well as activities such as rodent control, could threaten the New Mexico population. At present, the area of occurrence in New Mexico appears to be secure.

Recommendation: No change in the current listing status of the southern pocket gopher is recommended. Periodic surveys (every 5-10 years) should be conducted in the Animas Mountains to determine distribution and population status. Additional surveys in the Peloncillo and Big Hatchet mountains may be warranted to determine if the species is more widespread than known.

Literature Cited:

- Cook, J. A. 1982. The mammals of the Animas Mountains, Hidalgo County, New Mexico, with notes on the effects of fire on mammals of a sacaton grassland. M.S. thesis, University of New Mexico, Albuquerque, NM.

- Cook, J. A. 1986. The mammals of the Animas Mountains and adjacent areas, Hidalgo County, New Mexico. Occasional Papers, Museum of Southwestern Biology 4:1-45.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Geluso, K. 2006. A mountain range (Big Hatchet Mountains) in southern New Mexico without pocket gophers at high elevations? Final report to Endangered Species Prog., New Mexico Dept. Game and Fish, Santa Fe, contract 05-516.53. 13 pp.
- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, NY, 2nd ed., 1:xv +1-600 + 90.
- Hinesley, L. L. and C. S. Thaler, Jr. 1977. Karyotype and distribution of the southern pocket gopher, *Thomomys umbrinus emotus* Goldman. Journal of Mammalogy 58:235-237.
- Hoffmeister, D. F. 1986. Mammals of Arizona. The University of Arizona Press and Arizona Game and Fish Department. 602 pp.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.

Meadow jumping mouse, *Zapus hudsonius*

Distribution: The meadow jumping mouse (*Zapus hudsonius*) occurs from Alaska, southward through British Columbia to the southwest United States, and southeastward to Georgia (Hafner et al., 1981; Hall, 1981). The subspecies *Z. h. luteus* (New Mexico meadow jumping mouse) is endemic to New Mexico and Arizona (Hafner et al., 1981). Hafner et al. (1981) reported this subspecies at 14 localities in New Mexico in the San Juan, Sangre de Cristo, Jemez, and Sacramento Mountains, and in the Rio Grande Valley between Española and Bosque del Apache National Wildlife Refuge. Morrison (1992) subsequently verified the presence of meadow jumping mouse in most localities reported by Hafner et al. (1981), and located new populations in the Jemez Mountains (8 localities in the upper Guadalupe River drainage), the Rio Grande Valley (2 new localities near Española and Isleta), the Rio Chama (1 new locality), and in the Sacramento Mountains (13 different sites along tributaries of the Rio Peñasco). One historic locality in the Sangre de Cristo Mountains was not reconfirmed in 2006; however, the species was found at two new sites at Sugarite Canyon State Park and on Coyote Creek (J. K. Frey, personal communication, 2006). A closely-related species, the western jumping mouse (*Zapus princeps*), also occurs in the Sangre de Cristo range.

In the Sacramento Mountains, soil moisture, vegetative cover characteristics and composition, and proximity of permanent water were similar to other meadow jumping mouse habitat in New Mexico (Morrison, 1990). Typical plant species associated with meadow jumping mouse habitat include spikerush (*Eleocharis macrostachya*), sedges (*Carex* spp.), rushes (*Juncus* spp.), and numerous species of grasses (e.g., *Agrostis*, *Poa*, *Agropyron*, and *Bromus*), forbs, and willows.

The extremely short activity season of this rodent is generally limited to the months of July through September in montane areas, and possibly longer at lower-elevation sites. Surveys must therefore be conducted during mid to late summer, otherwise the species is not detected during small mammal trapping efforts. The diet is comprised primarily of grass seeds, with fungi, plants, and invertebrates also consumed. Due to the short activity season, only a single litter is produced each year.

Current Status: The meadow jumping mouse was listed as threatened by the New Mexico Department of Game and Fish in 1983 (Jones and Schmitt, 1997). Zwank et al. (1997) captured meadow jumping mice in all habitats that they surveyed at Bosque del Apache National Wildlife Refuge. Other extant populations in the Rio Grande and Rio Chama valleys were surveyed in the late 1980s (Morrison, 1992) and the species was found at four of seven historical localities. These localities appear to represent relicts of a formerly more extensive range in this valley. Meadow jumping mice may use the vegetated margins of irrigation ditches adjacent to agricultural areas in the Rio Grande Valley, which suggests that habitat disturbance may not be a limiting factor under some conditions, provided that soil moisture and herbaceous plant cover and composition are sufficient to replicate natural habitat (Morrison, 1990).

Surveys for this species were conducted in the Jemez and Sacramento Mountains during 2005 (Frey, 2005b) and the results indicated a significant decline in presence and suitable habitat for these montane populations than was reported by Morrison (1992) based on her surveys in the late 1980s. Frey (2005) found that the species and its habitat were found at only 2 of 12 historic sites in the Jemez Mountains and 2 of 11 historic sites in the Sacramento Mountains. Frey (2005b) found that herbaceous vegetation, particularly sedges, with a vertical height of at least 24 inches was a significant predictor of meadow jumping mouse presence at survey sites in the Sacramento and Jemez Mountains. In all cases where meadow jumping mice were found, livestock were currently being excluded (Frey, 2005b). Drought conditions and loss of dense herbaceous vegetation and moist soil conditions along streams due to excessive grazing pressure were identified as the primary reasons for the significant loss of habitat in these two ranges. Subsequently, surveys in 2006 in the Sangre de Cristo Mountains found this species at 2 of 3 historic localities, and persisting at two other previously unknown locations within that range (J. K. Frey, personal communication, 2006). The species was absent at the only known historic site in the San Juan Mountains.

Many of the montane sites where the species persists are very small, only a few acres in size, and are widely separated from other occupied sites. The presence of beaver dams and/or human-made impoundments and the exclusion of livestock from riparian areas were identified as the most important factors for the presence of suitable habitat for this species in montane parts of its range.

Threats: As a result of the species' reliance on mesic and densely-grassed habitats in proximity to water, primary threats to the meadow jumping mouse in New Mexico include habitat degradation due to development, conversion of mesic areas to agricultural crop production, excessive grazing pressure from livestock, removal of beavers and their dams, downcutting of streams, drought, and water diversions. The drastic reduction in herbaceous vegetation along streams in many areas of historic occurrence due to drought and excessive grazing poses the most immediate threat to this species. The highly fragmented nature of its distribution in the state is also a major contributor to the vulnerability of this species and increases the likelihood of very small, isolated populations being extirpated. Even if suitable habitat exists (or is restored) in some locations, the likelihood of recolonization from other populations is extremely limited.

Recommendation: Uplisting of the meadow jumping mouse from threatened to endangered is recommended. This recommendation is based on the results of surveys in the Jemez, Sacramento, and Sangre de Cristo mountain ranges in 2005-2006 and the substantial evidence for significant habitat loss in these mountain ranges since the late 1980s and early 1990s when the last intensive survey effort was done (Frey 2005b; J.K. Frey, personal communication, 2006). In addition to the recommendation for uplisting, immediate efforts to protect and, where appropriate, enhance herbaceous moist-soil habitat for this species in montane areas of its range should be implemented, through construction of new cattle exclosures or improvement of existing exclosures to create a series of refugial habitat areas, particularly in the Sacramento and Jemez mountains. Longer-term habitat improvement efforts that are needed to maintain this species in montane areas include: 1) implementation of grazing management practices that enhance and maintain herbaceous riparian wetlands with required habitat components, including adequate vertical cover as provided by sedges, grasses, and forbs; 2) restoration of suitable habitat in montane riparian areas where the species has been extirpated, such as by willow planting, check-dam construction, and erosion protection features; and 3) re-establishment of beaver in montane streams where channel downcutting and loss of riparian and wet meadow vegetation has occurred. NMDGF should implement a regular monitoring program of all known populations and locations where habitat restoration has been achieved, possibly once per every 2-3 years, and should continue surveys to document other potential extant populations. Additional research on specimens of *Zapus* historically collected in New Mexico is also needed, especially collections from the Sangre de Cristo Mountains, given the extreme similarity between this species and the closely-related western jumping mouse found in northern New Mexico (Frey, 2005a). Additional monitoring of known lower-elevation populations in the Rio Grande and Rio Chama valleys is also warranted as these populations have not been adequately surveyed since prior to the drought period that began in the mid-1990s.

Literature Cited:

Frey, J.K. 2005a. Key to the squirrels, pocket gophers, New World rats and mice, voles, and jumping mice of New Mexico. Final report to Share with Wildlife Program, New Mexico Dept. Game and Fish, Santa Fe, NM, contract 05-516.18. 75 pp.

- Frey, J.K. 2005b. Status assessment of montane populations of the New Mexico jumping mouse (*Zapus hudsonius luteus*) in New Mexico. Final report to New Mexico Dept. Game and Fish, Santa Fe, NM, contract 05-516.57. 74 pp. + appendices.
- Hafner, D. J., K. E. Petersen, and T. L. Yates. 1981. Evolutionary relationships of jumping mice (genus *Zapus*) of the southwestern United States. *Journal of Mammalogy* 62:501-512.
- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, NY, 2nd ed., 2: vi + 601-1181 + 90.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 in T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. *Life Among the Muses: Papers in Honor of James S. Findley*. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Morrison, J. L. 1990. The meadow jumping mouse in New Mexico: habitat preferences and management recommendations. Pp. 136-141, *In Proceedings of the symposium on managing wildlife in the Southwest*. P. R. Krausman and N. S. Smith, eds. Arizona Chapter, The Wildlife Society, Phoenix, AZ.
- Morrison, J. L. 1992. Persistence of the meadow jumping mouse, *Zapus hudsonius luteus*, in New Mexico. *Southwestern Naturalist* 37:308-311.
- Zwank, P. J., S. R. Najera, and M. Cardenas. 1997. Life history and habitat affinities of meadow jumping mice (*Zapus hudsonius*) in the middle Rio Grande Valley of New Mexico. *Southwestern Naturalist* 42:318-322.

American marten, *Martes americana*

Distribution: The American marten, also known as pine marten, is widely distributed across North America, and occurs from Alaska to New Brunswick, southward to California and New Mexico and eastward to New York (Hall, 1981). In New Mexico, the species is known only from the north-central mountains including the San Juan and Sangre de Cristo ranges (Findley et al. 1975). Reports of marten in the Jemez Mountains have not been substantiated. Habitat in New Mexico includes mature, high elevation spruce-fir (*Picea-Abies*) forests (Bailey, 1932; Findley et al., 1975). Mature/old-growth spruce-fir forests with greater than 30% canopy cover and abundant coarse woody debris (i.e., snags, down fall, etc.) have been identified as preferred marten habitat throughout the range of the species (Clark and Stromberg, 1987). Martens may avoid large clearings such as clear cuts or burned areas (Koehler and Hornocker, 1977; Soutiere, 1979).

The summer diet of marten is varied and includes mammals, birds, eggs, fish, insects, and carrion (Buskirk and Ruggiero, 1994). Soft mast and berries are eaten in the fall, and small mammals, including red-backed voles (*Clethrionomys gapperi*), voles (*Microtus* spp.), golden-mantled ground squirrels (*Spermophilus lateralis*), and red squirrels (*Tamiasciurus hudsonicus*) comprise the majority of their winter diet (Buskirk and Ruggiero, 1994). Female marten reach sexual maturity at 15 months and produce a single litter of 3-4 in spring (Clark and Stromberg, 1987). The gestation period of 8-9 months is long due to delayed implantation.

Current Status: The American marten was approved for listing as threatened by the New Mexico State Game Commission in 1975 (Jones and Schmitt, 1997). Martens reach the southern limit of their geographic distribution in New Mexico, where they are considered to be an uncommon resident species. The presence of this species in the Sangre de Cristo Range in Taos County and San Juan Mountains in Rio Arriba County was reconfirmed in the 1990s through the collection of road-killed specimens; the species was also reported from the Taos Ski Valley during 1997-1999 (NMDGF, unpublished data). Recent surveys conducted by a Department contractor found marten in the Sangre de Cristo Range in the vicinity of Taos and Pecos, and in the San Juan Mountains near Chama. In 2003, Department personnel captured and radiocollared several marten in the vicinity of Taos Ski Valley. Preliminary results from monitoring efforts suggest that there is a small resident population in this area, but it remains unclear as to whether this population is isolated from other populations in the Sangre de Cristos. In this study, radiocollared marten used mature spruce-fir forest and talus slopes at elevations between 10000 and 11500 ft in elevation.

Threats: Potential threats to American marten in New Mexico include habitat degradation or fragmentation through timber harvesting in mature/old-growth forests, removal of downed timber as part of fuels reduction projects or as firewood, wildfire, and destruction of talus slopes within the species' range. Marten are also very susceptible to trapping, although there is currently no open season in New Mexico. Illegal take of marten may pose a minor threat in some areas.

Recommendation: No change in the current listing status of the American marten is recommended. Studies to better determine distribution, habitat use, population status, and population isolation in New Mexico are needed to inform forest management practices beneficial to the species.

Literature Cited:

- Bailey, V. 1932. Mammals of New Mexico. *North American Fauna* 53:1-412.
- Buskirk, S. W. and L. F. Ruggiero. 1994. American Marten. *In* The scientific basis for conserving forest carnivores American marten, fisher, lynx, and wolverine in the western United States. L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski, eds. U.S.D.A. Forest Service. General Technical Report RM-254: 7-37.
- Clark, T. W. and M. R. Stromberg. 1987. Mammals in Wyoming. Lawrence, Kansas, University of Kansas Press. 314 pp.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM. xxii + 360 pp.
- Hall, E. R. 1981. The Mammals of North America. John Wiley & Sons, New York, NY, 2nd ed. 2:601-1181+90.
- Jones, C. and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 179-205 *in* T. L. Yates, W. L. Gannon, & D. E. Wilson, eds. Life Among the Muses: Papers in Honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico. 290 pp.
- Koehler, D. M. and M. G. Hornocker. 1977. Fire effects on marten habitat in the Selway-Bitterfoot Wilderness. *Journal of Wildlife Management* 41:500-505.
- Soutierre, E. C. 1979. The effects of timber harvesting on the marten. *Journal of Wildlife Management* 43:850-860.