INVERTEBRATES

CRUSTACEA

ENDANGERED

Socorro isopod, *Thermosphaeroma thermophilum*

Distribution: The Socorro isopod is endemic to a small thermal spring located southwest of Socorro, Socorro County, 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 (zoo).

Current Status: The Socorro isopod is listed as a federal endangered species (Federal Register 1994). 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 Review, Shuster et al. In Review). Population and habitat monitoring has occurred monthly since November 1995 at the native spring and the SIPF. 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 Review).

Threats: Primary threats include vandalism, modification of spring flows, and 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. Since 1988 the Department has been involved with conservation activities detailed in the federal recovery plan (USFWS 1982). This plan identifies goals and actions to achieve recovery and delisting of the taxon that the Department is actively pursuing in collaboration with the U. S. Fish and Wildlife Service, Albuquerque Biological Park, and the private land owner.

Literature Cited

Federal Register. 1994. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12. 42 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, NM.

Lang, B. K., D. A. Kelt, and S. M. Shuster. In Review. 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. In Review. 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). Evolution.

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: Lander Springbrook near Roswell, North Spring (Roswell Country Club - RCC), and Bitter Lake National Wildlife Refuge (BLNWR). Currently, Noel's amphipod is known from three populations on BLNWR: Bitter Creek (Lost River), Sago Spring wetland complex, and a drainage ditch along the western limits of refuge impoundments 6 and 7 (Lang 2002).

Current Status: The Lander Springbrook population was extirpated between 1951-1957, whereas loss of the North Spring population (type locality), occurred during the period 1978-1988 (Cole 1981, 1985, 1988a, 1988b). Extirpation of the species 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; P. Mehlhop, *pers. com*., 1995).

Noel's amphipod is a federal species of concern (Federal Register 1996), and is currently under consideration for a proposed rule to list as endangered with critical habitat under the federal Endangered Species Act (Federal Register 2002). The Department initiated a conservation plan for four state-listed macroinvertebrate species of Chaves County, including *G. desperatus* (NMDGF 2004). Development of this state plan is ongoing.

Acquisition of Federal water rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for this species. 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.

Preliminary results of genetic studies implies the presence of cryptic species at BLNWR (Gervasio et al. 2004). Morphologic and genetic studies are ongoing to assess the 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 amphipod 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 of the *G. pecos* complex 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 pose threats to the long-term viability of *G. desperatus* populations at BLNWR. Regional ground water pumping for agriculture, municipal water supplies, and oil and gas industry operations (exploration, storage, transfer and refining) continue in the Pecos River Valley (BLM 1994, USFWS 1997), and any increases groundwater extraction could lead to further habitat alteration. Oil and gas exploration is ongoing within areas of the Roswell Artesian Basin that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water sources for surface waters at BLNWR. 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). 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 potential degradation of ground and surface water quality posed by domestic sewage contamination (i.e., septic discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR. Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) and septic leachate are 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 20000 Sandhill Fire which severely burned reaches of Bitter Creek formerly inhabited by *G. desperatus* (Lang 2002, 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 potential contaminants.

Recommendation: No change in listing status is recommended. In collaboration with the U. S. Fish and Wildlife Service, the Department should continue to monitor post-fire effects on the aquatic macroinvertebrates and riparian corridor of Bitter Creek. The state conservation plan identifies goals and actions to achieve recovery of the taxon.

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. 2002. Endangered and Threatened Wildlife and Plants; Listing Roswell springsnail, Koster's tryonia, Pecos Assiminea, and Noel's Amphipod as Endangered with Critical Habitat. 50 CFR Part 17 RIN 1018-AI15 67(29):6459-6479.

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. Completion Report (E-20, 5-9) 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.

Noel, M. 1954. Animal ecology of a New Mexico springbrook. Hydrobiologia 6:120-135. 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 sringsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). Second revised draft.

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. Techonomic 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: Historic populations in the Conchas River near Variadero are apparently extirpated (Lang and Mehlhop 1996), and may represent the source of the Conchas Lake population (Taylor 1983). 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). A recent basin-wide mussel inventory of the Canadian River yielded only one fresh valve of an immature paper pondshell from the Ute Creek near Ute Reservoir, Harding County (Lang and Mehlhop 1996). While this record represents an eastward range extension of the paper pondshell within New Mexico, this species was not found in Conchas Lake, nor is it reported as extant in New Mexico. 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 to document current status of the species in New Mexico should be undertaken. 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 system 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 dearth of information available 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 less than 12% of its historic range in New Mexico (Lang 2001). The extant population is confined to a 14 km reach of the middle Black River, Eddy County. In April 2002, live Texas hornshell were reported in the Rio Grande near Laredo, Webb County, Texas (Robert Howells, Malacologist, Texas Parks and Wildlife Department; *pers. com*.).

Research reports focusing on the distribution and abundance, habitat affinities, life history, salinity tolerance, and population genetics of the Texas hornshell in the Black River are summarized in Lang (2001). Smith et al. (2003) described the breeding periodicity and reproductive anatomy of the species.

Threats: Anthropogenic modifications of riverine ecosystems (e.g., habitat loss from the construction of mainstem impoundments, diversion and redistribution of water, water pollution, and 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 account for significant losses 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, the 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). Lang (2001) reported that 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. Opportunities for recolonizing reaches downstream of the Carlsbad Irrigation District dam appear limited by altered physicochemical and hydrologic regimes.

Ground-water depletion and ground and surface water contaminants are considered principal causes of decline in unionid mussels (Metcalf 1982, Taylor 1983, NMGF 1988, Williams et al. 1993, Neves et al. 1997, Strayer 1999). Regional ground-water pumping for agriculture and oil/gas industry operations (exploration, transfer, storage, and refining) are ongoing in the Black River sub-basin and lower Pecos River Valley. 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). Ground- and surface-water contamination can adversely impact aquatic mollusks (Havlik and Marking 1987, Green and Trett 1989, Neves et al. 1997).

The Black River Valley has experienced repeated problems of ground-water depletion and contamination. Water levels of domestic, agricultural/range wells in the area have lowered and even dried-up. Richard (1988a, 19988b) and Richard and Boehm (1989a, 1989b) documented groundwater contamination of domestic and agricultural/range wells (i.e., Washington Ranch, Ballard Wells, etc.) by petroleum-derived hydrocarbons and sulfides in upper Black River Valley. Richard and Bohem (1989b) reported "severe" sulfide contamination of Blue Spring (1988), the most down-gradient discharge point of groundwater in the upper Black River Valley. These authors reported that gas contamination originating up-gradient may have been transported down-gradient (ca. 20 miles) 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 concentration of petroleum industry operations throughout the Black River Valley.

In July 2002, surface waters of the Black River were contaminated by tebuthiuron, a 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, 2003) in the lower Pecos River from Lake Brantley downstream to the Black River confluence near Malaga, New Mexico, have been attributed to toxins produced by the golden alga, *Prymnesium parvum*. The golden

alga toxins are highly toxic to gill-breathing aquatic fauna such as mollusks (mussels, snails), crustaceans, fish, and larval stages of amphibians. Although there are no known instances of surface water contamination by golden alga toxins in the Black River where the Texas hornshell occurs, such a natural phenomenon represents a threat to this species.

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).

Over the long-term, insensitive land-use practices (e.g., excessive clearing of native vegetation, prolonged over-grazing, 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 stability of flow refuges typically 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 should focus 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 resource managers to work in cooperation with private land stewards along the Black River to protect key habitat for the Texas hornshell. Such a conservation process is likely most favorable by developing and implementing a state recovery plan for the species or through a federal incentive program, such as a candidate conservation agreement with assurances (Federal Register 1997).

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).

Cockerell, T. D. A. 1902. Unio popei, Lea, in New Mexico. The Nautilus 16:69-70. 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. 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.

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.

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.

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. Techonomic 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 vicinty 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* (Unionoida) 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), and reported additional populations on BLNWR in Bitter Creek (Lost River), Sago Spring wetland complex downstream of Sinkhole #31, and along the western perimeter of refuge units 3 and 6. The western limits of the species range was from North Spring, Roswell Country Club, where Taylor (1987) reported its extirpation. A population may still persist there (Mehlhop 1992, 1993).

Current Status: Hershler (2001) reassigned *Tryonia kosteri* Taylor, 1987 to the genus, *Durangonella* 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 cochliopinid springsnails from the Desert Southwest Rio Grande region.

Stable populations of *J. kosteri* occur in Bitter Creek (Lost River) and in the lower reaches of Sago Spring wetland complex near sinkhole #31 on BLNWR (Lang 2002). Small populations persist in vestigial habitats associated with springhead discharges along the west drainage ditch of refuge units 3, 6, 7, and in the northwest corner of Hunter Marsh (Dr. M. E. Gordon, *pers. com.*). Lang (2002) reported an extant population of *J. kosteri* from Lake St. Francis on BLNWR.

This species was uplisted from state Threatened to Endangered on the basis of threats posed to impoverished aquatic conditions following the March 2000 Sandhill Fire in the Bitter Creek study area (NMDGF 2000). Aquatic macroinvertebrates and hydrochemical conditions of Bitter Creek were monitored monthly from March 2000 to February 2001, and during each seasonal quarter from March 2001 to February 2002 (Lang 2002). Monitoring has been biannually from August 2002 to present.

Aquistion of Federal water rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for this species. The NMDGF (2004) initiated a conservation plan for a suite of four state-listed Chaves County invertebrates, including *J. kosteri*. Development of this state plan is ongoing. Koster's springsnail is a federal candidate species (Federal Register 1996), and is currently under consideration for a proposed rule to list as endangered with critical habitat under the federal Endangered Species Act (Federal Register 2002).

Threats: While the BLNWR 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 at BLNWR. Regional ground water pumping for agriculture and oil and gas industry operations (exploration, storage, transfer and refining) continue in the Pecos River Valley (BLM 1994, USFWS 1997), and any increases groundwater extraction could lead to further habitat alteration. Oil and gas exploration is ongoing within areas that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water sources for surface waters at BLNWR. 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). There is increased risk of potential degradation of ground and surface water quality posed by domestic sewage

contamination (i.e., septic discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR. Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) and septic leachate are 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). Prolonged drought may affect hydrologic conditions on BLNWR by reducing discharge through refuge surface waters while concomitantly affecting the 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, the Department should continue to monitor post-fire effects on the aquatic macroinvertebrates and riparian corridor of Bitter Creek. The state conservation plan identifies goals and actions to achieve recovery of the taxon.

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. PolicyCoordinating 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 BitterLake 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. 2002. Endangered and Threatened Wildlife and Plants; Listing Roswell springsnail, Koster's tryonia, Pecos Assiminea, and Noel's Amphipod as Endangered with Critical Habitat. 50 CFR Part 17 RIN 1018-AI15 67(29):6459-6479.

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. 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 Fis 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.

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. 2000. Threatened and endangered species of New Mexico: biennial review and recommendations. 116 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 sringsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). Second revised draft.

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. Techonomic 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.

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 which form the headwaters of Alamosa Creek, Socorro County (Taylor 1983, 1987).

Current Status: Hershler (2001) reassigned *Tryonia alamosae* Taylor, 1987 to a new genus, *Psuedotryonia* Hershler, on the basis of molecular genetic study (Hershler et al. 1999) and reproductive anatomy.

Mehlhop (1993) reported on the longitudinal distribution and abundance of the Alamosa springsnail. *Pseudotryonia alamosae* occurs throughout in spring sources and spring-fed tributaries along the north riverbank of Alamosa Creek downstream to approximately 30 meters above the Moniticello Box (Lang 2001, Lang 2003). Current land use practices favor the persistence of the species in Alamosa Creek.

Based on potential impacts from a proposed open pit beryllium mine within 0.3 mile of Alamosa Creek, the NMDGF uplisted *P. alamosae* from state Threatened to Endangered (NMDGF 2000). In August 2000, The New Mexico Environment Department (NMED) found that the proposed beryillium mine did not qualify for minimal impact status, and requested additional information from the applicant to address outstanding issues regarding proposed mine site operations. The NMED halted unauthorized mineral exploration activities at the Alamosa mine site that commenced in March 2002. The Alamosa springsnail is a federal endangered species (Federal Register 1994).

Threats: Primary threats include local/regional groundwater depletion, direct habitat alteration (stream diversion and impoundment), mineral mining, and poor watershed management (Taylor 1983, NMDGF 1988, Lang 2001). Introduction of non-native crayfish can eliminate springsnail populations and degrade habitat conditions (Fernandez and Rosen 1996). The recent invasion of saltcedar along the floodway of Almosa Creek poses a threat to riparian habitat conditions (Lang 2001).

Recommendation: No change in listing status is recommended. The Department is involved with conservation activities detailed in the federal recovery plan (USFWS 1994). This plan identifies goals and actions to achieve recovery and delisting of the taxon that the Department is actively pursuing in collaboration with the U. S. Fish and Wildlife Service and the private land owner. Review of any revised Alamosa mine proposal will be required by statute. Resource agencies should pursue interests expressed by the Monticello Community Ditch Association for wetland restoration and enhancement of the riparian corridor of Alamosa Creek.

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.

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-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. Almosa springsnail (*Tryonia alamosae*) and Socorro sprinsnail (*Pyrgulopsis neomexicana*) draft recovery plan. Albuquerque, NM. 24 pp.

Chupadera springsnail, *Pyrgulopsis chupaderae*

Distribution: The Chupadera springsnail is known from two hillside spring seeps on the Cienega Ranch (renamed "Willow Spring Ranch") 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: Despite intensive ranching (grazing, spring discharge diversion, springrun impoundment) over numerous decades, the Chupadera springsnail has persisted at Willow Spring, at least through 1999 (Taylor 1983, Lang 2002). In 1996, sampling at the unnamed spring yielded no spring snails where a viable population once existed. This wetland habitat was heavily trampled by cattle and completely denuded of riparian vegetation. Accordingly, this species was uplisted from state threatened to endangered under the 1996 Biennial Review. Recent transference of ownership of Willow Spring preempted biannual monitoring initiated in 1998. Frequent requests to visit Willow Spring have been repeatedly denied by the current owner (Lang 2002). *Pyrgulopsis chupaderae* was last observed live in August 1999. The Chupadera springsnail is a federal candidate for listing under the Endangered Species Act (Federal Register 1996). The listing priority was recently increased from 8 to 2 (Ecological Services Office, U. S. Fish and Wildlife Service, Albuquerque; *pers. com.*).

Threats: Imminent threats include local/regional groundwater depletion, diversion or impoundment (i.e., alteration) of spring flow, loss of riparian vegetation, and overgrazing of 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 unknown population status, controlled propagation at the Albuquerque Biological Park may be timely. The Department has attempted to initiate development of a state recovery plan, in cooperation with the private landowner, for this species. However, repeated denial of requests to access known habitat for monitoring purposes are currenlty precluding the ability to update the status, or implement conservation and recovery actions for this species.

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. 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.
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: This endemic species was described from one of three thermal springs located near Socorro, New Mexico (Pilsbry 1916). Taylor (1983) documented a second population at Torreon Springs, Socorro County. *Pyrgulopsis neomexicana* is the most narrowly distributed springsnail in New Mexico (Taylor 1987).

Current Status: Prior to 1971, significant water development and habitat alterations resulted in extirpation of the species at the type locality (Landye 1981, Taylor 1987). The Socorro springsnail is most recently known only from Torreon Springs where the population occupied a small springhead discharge. This restricted habitat (~2.0*l* x 0.5*w* x 0.1*d* m) is wetted by surface discharge and a leaky windmill pump shaft. The riparian corridor adjacent to the short springrun is grazed. This species is federally listed as endangered (Federal Register 1994). Site access to monitor and study *P. neomexicana* has been denied by the private landowner.

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. Population viability is contingent upon maintenance of well-oxygenated, perennial flow within the species preferred thermal range (unknown), and protection of the riparian corridor immediately adjacent to the springrun (Taylor 1983, Mehlhop and Vaughn 1994).

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.

Mehlhop, P. and C. C. Vaughn. 1994. Threats and sustainability of ecosystems for freshwater mollusks. Pp. 68-77, *In* Sustainable Ecological Systems: Implementing an ecological approach to land management. U. S. Forest Service. General Techcial Report RM-247.

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 *Amnicola* from New Mexico and Utah. The Nautilus 29:111-112.

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 *Pyrgulopsis 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).

Current Status: Mehlhop (1992, 1993) documented persistence of the species on BLNWR. In March 1995, a relict population still occurred in North Spring (P. Mehlhop, *pers. com.*). Extant populations on BLNWR include: Bitter Creek (Lost River), Sago Spring, and the western ditch of refuge impoundments 6 and 7. Acquistion of Federal water rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for this species. The NMDGF (2004) initiated a conservation plan for a suite of four state-listed Chaves County invertebrates, including *P. roswellensis*. Development of this state plan is ongoing. The Roswell springsnail is a federal candidate species for listing (Federal Register 1996), and is currently under a proposed rule to list as endangered with critical habitat under the federal Endangered Species Act (Federal Register 2002).

Threats: While the BLNWR 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 Basin pose threats to the long-term viability of *P. roswellensis* at BLNWR. Regional ground water pumping for agriculture and oil and gas industry operations (exploration, storage, transfer and refining) continue in the Pecos River Valley (BLM

1994, USFWS 1997), and any increases groundwater extraction could lead to further habitat alteration. Oil and gas exploration is ongoing within areas that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water sources for surface waters at BLNWR. 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). There is increased risk of potential degradation of ground-and surface-water quality posed by domestic sewage contamination (i.e., septic discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR. Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) and septic leachate are 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 2000 Sandhill Fire, the long-term impact of these effects, whether beneficial or adverse, on the aquatic biota and riparian corridor remain undetermined (Lang 2002). Prolonged drought may affect hydrologic conditions on BLNWR by reducing discharge through refuge surface waters while concomitantly affecting the 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, the Department should continue biannual monitoring of post-fire effects on the aquatic macroinvertebrates and riparian corridor of Bitter Creek. The state conservation plan identifies goals and actions to achieve recovery of the taxon.

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. 2002. Endangered and Threatened Wildlife and Plants; Listing Roswellspringsnail, Koster's tryonia, Pecos Assiminea, and Noel's Amphipod as Endangered with Critical Habitat. 50 CFR Part 17 RIN 1018-AI15 67(29):6459-6479.

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.
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.
Noel, M. 1954. Animal ecology of a New Mexico springbrook. Hydrobiologia 6:120-135.
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 sringsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). Second revised draft.
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. Techonomic 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 Cíenegas, Coahuila, México (Taylor 1983, 1987).

However, the species shows a pattern of localized extinctions throughout its historic range. Taylor (1987) reported extirpation of *Assiminea pecos* from North Spring and at the type locality (Unit 7) on BLNWR.

Current Status: In New Mexico, the species is restricted to isolated populations in the upper reaches of Bitter Creek, the lower reaches of Sago Spring wetland complex near Sinkhole #31, the southwest corners of Units 7 and 15 on BLNWR (Lang 2002). Populations of *A. pecos* in Texas occur on private lands (Diamond Y Spring Preserve, East Sandia Spring) under stewardship of The Nature Conservancy (Lang 2002).

The NMDGF (2004) initiated a recovery plan for 4 state-listed macroinvertebrate species of Chaves County, including *A. pecos*. Development of this state plan is ongoing. Acquisition of Federal water-rights for BLNWR (USDJ 1996, Balleau Groundwater, Inc. 1997) may serve to impart habitat protection for the species. Pecos assiminea is a federal candidate species for listing (Federal Register 1996), and is currently under consideration for a proposed rule to list as endangered with critical habitat under the federal Endangered Species Act (Federal Register 2002).

The Department is collaborating with Dr. Robert Hershler (National Museum of Natural History, Smithsonian Institution) on molecular genetic studies of the *Assiminea pecos* species complex.

Threats: While BLNWR populations of *A. pecos* are stable under current refuge management plans (Research Management Consultants, Inc. 1998), off-refuge land use practices within areas of the Roswell Basin pose threats to the long-term viability of *A. pecos* on BLNWR. Regional ground water pumping for agriculture and oil and gas industry operations (exploration, storage, transfer and refining) continue in the Pecos River Valley (BLM 1994, USFWS 1997), and any increases groundwater extraction could lead to further habitat alteration. Oil and gas exploration is ongoing within areas that Balleau Groundwater, Inc. (1996, 1999) identified as primary ground water sources for surface waters at BLNWR. 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). There is increased risk of potential degradation of ground and surface water quality posed by domestic sewage contamination (i.e., septic discharge) from urban encroachment in aquifer recharge-discharge areas along the western bounds of BLNWR. Illicit dumping of domestic contaminants (e.g., pesticides, herbicides, waste oil, etc.) and septic leachate are 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, the Department should continue to monitor post-fire effects on the aquatic macroinvertebrates and riparian corridor of Bitter Creek. The state conservation plan identifies goals and actions to achieve recovery of the taxon. The Department should continue to support ongoing genetic work of the *Assiminea pecos* complex.

Literature Cited

Bitner, M. J. and T. Graves. 1992. Effect of lot sizes on potential ground-water contaminants from conventiona l 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. 2002. Endangered and Threatened Wildlife and Plants; Listing Roswell springsnail, Koster's tryonia, Pecos Assiminea, and Noel's Amphipod as Endangered with Critical Habitat. 50 CFR Part 17 RIN 1018-AI15 67(29):6459-6479.
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. 2004. Recovery and conservation plan for four invertebrate species: Noel's amphipod (*Gammarus desperatus*), Pecos assiminea (*Assiminea pecos*), Koster's sringsnail (*Juturnia kosteri*), and Roswell springsnail (*Pyrgulopsis roswellensis*). Second revised draft.
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. Techonomic 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: Southern populations of this widely distributed pond snail are disjunct in New Mexico, Texas, and higher elevations of the western states (Bequaert and Miller 1973; Taylor 1983a, 1983b). In New Mexico, the species is known from two small isolated populations at Bitter Lake National Wildlife Refuge (BLNWR), Chaves County, and Valles Caldera National Preserve (Baca Ranch), Jemez Mountains, Sandoval County (Taylor 1983a, 1983b).

Current Status: While this widespread species is stable over much its North American range, some western populations have been subject to decline or local extinction. 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). However, the species was recently documented from live specimens in Hunter Marsh at BLNWR; in grassland pools on the Valle Grande, Valles Caldera National Preserve (Lang 2004); and in high-elevation snowmelt pools near Big Costilla Peak, Vermejo Park, Toas County.

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

Recommendations: No change in listing status is recommended. The Department should continue to conduct statewide surveys of high-elevation vernal pools.

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. 2004. Macroinvertebrates 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. 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 (5900-6400 ft. elevation) of the Animas (Indian Creek Canyon), Big Hatchet, and San Luis (Lang Canyon) mountains 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: In New Mexico, *G. d. dalliana* is more widespread than previously thought. This species occurred sporadically on warmer slopes in the Big Hatchet and San Luis mountains, where it comprised only 0.4% and 2.3%, respectively, of the land-snail community at single-site occurrences (Lang 2000). This species appears to be a denizen of the more mesic and densely wooded habitat of the Animas Mountains, where it occurred at nearly 38% (5 of 16) of all sites surveyed. The shortneck snaggletooth seems particularly fond of the cool, moist, densely wooded corridor along Indian Creek Canyon. This species appears to be closely associated with limestone outcrops and loose soils with deep leaf litter over limestone rubble (Lang 2000).

Threats: Habitat loss from logging, mining activities, or forest fire represent primary threats to localized populations (NMDGF 1988, Lang 2000). Habitat critical to *G. d. dalliana* in the Animas and San Luis Mountains is under stewardship of the Animas Foundation (Gray Ranch). The lone population in the Big Hatchet Mountains occurs on public lands (BLM).

Recommendation: No change in listing status is recommended. The Department should continue land snail surveys to determine the range of this species in southern New Mexico.

Literature Cited

Bequaert, J. C. and W. B. Miller. 1973. The mollusks of the Arid Southwest with an Arizona checklist. Universit 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 speciems. In his species description, Pilsbry (1939) considered it a subspecies of *O. metcalfei*. Based on unique conchological characteristics, Metcalf (1974) elevated *florida* to full species status. 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: Collections made this century indicate that *O. florida* is extinct, as it is known only from dead shells; no live snails have been found despite numerous malacological explorations during the past 14 years (Metcalf and Smartt 1997, Lang 2000). The extinction of *O. florida*, and other primitive oreohelicids in southern and eastern New Mexico, might be attributed to climatic deterioration during the Holocene and/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 desertification, natural catastrophe (rock slide, forest fire), and soil disturbance activities associated with mining and logging (NMDGF 1988, Lang 2000).

Recommendation: Inventory of high-elevation limestone outcrops is recommended on "montane islands" along the international border to explore the possibility of locating an unknown population of this species, which would appears to be highly unlikely within the United States, but possible within México. If an extant population exists 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). In North America, this species occurs 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 (Taylor 1983).

Current Status: The status of *M. lacustre* in New Mexico is unknown.

Threats: The sole New Mexico population occurs on private land managed for recreational uses. 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. The Department should continue surveys of 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-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: The status of this species in New Mexico is unknown. The Road Canyon Creek population occurs on private land.

Threats: Poor watershed management, stream modification (channelization, diversion, dewatering), and water pollution represent primary threats (NMDGF 1988).

Recommendation: No change in listing status is recommended. The Department should continue surveys of 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.

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: The 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 drainages within the Canadian River and Dry Cimarron River basins (Taylor 1983, NMDGF 1988). The largest known population was extirpated from the Pecos River Valley below Carlsbad (Taylor 1983). Subfossil specimens were collected from the Black River, Eddy County (NMDGF files). Canadian River basin populations include: Conchas River, Cabra Springs, and Ute Creek near Gladstone. Additional populations are known from Clayton Lake and Road Canyon Creek (Dry Cimarron basin) (NMDGF 1988).

Current Status: The status of this species in New Mexico is unknown.

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

Recommendation: No change in listing status is recommended. The Department should continue surveys of aquatic habitats 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.

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 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). In the western United States, *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 known 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.

Current Status: The status of this species in New Mexico is unknown.

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

Recommendation: No change in listing status is recommended. The Department 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 (10,485 ft.) glacial cirque (Middle Fork Lake) at the base of Wheeler Peak, Taos County. The Sangre de Cristo peaclam colonizes muddy shallows along the lake perimeter and a narrow 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: Annual population monitoring of *P. sanguinichristi* 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 paratype *P. sanguinchristi* specimens (B. Lang, NMDGF, and Dr. G. L. Mackie, University of Guelph, Canada; *pers. obs.*). No pisidia collected from any other survey sites during this 3 year period were referable to *P. sanguinichristi*.

Based on the absence of *P. sanguinichristi* from the 1995 and 1996 surveys at Middle Fork Lake, 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 status 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 Department 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. sanguinichrisiti* 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, significant 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 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: 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 on the Gila River mainstem (NMDGF files). The Gila springsnail is a federal candidate species for listing (Federal Register 1996). Populations of *P. gilae* 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

thermal spring recreational bathing, and poor watershed management practices (e.g., overgrazing, silvicultural practices) represent primary threats to *P. gilae* populations on federal and private lands (Taylor 1983, 1987; NMDGF 1988; Mehlhop 1993). Fire suppression chemicals have potentially deleterious effects on *P. gilae* populations (McDonald and Hamilton 1995). Introduction of non-native crayfish can adversely impact hydrobiid springsnails and aquatic habitats (Fernandez and Rosen 1996). Long-term persistence of this species is contingent upon protection of the riparian corridor immediately adjacent to springhead and springrun habitats, thereby ensuring the maintenance of perennial, oxygenated flowing water (Taylor 1983, Mehlhop and Vaughn 1994, Mehlhop 1996) within the species' required thermal range.

Recommendation: No change in listing status is recommended. The Department should expand aquatic surveys to include unexplored reaches within the Gila River Basin. 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

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.

Mehlhop, P. 1996. Ecology and conservation needs of hydrobiid snails. The Nature Conservancy, Biodiversity News
Network 9(1):6-7.

Mehlhop, P. and C. C. Vaughn. 1994. Threats to and sustainability of ecosystems for freshwater mollusks. Pp. 68-77, *In* Sustainable Ecological Systems: Implementing an ecological approach to land management. U. S. Forest Service. General Technical Report RM-247.

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: 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). Lang (2002, 2004) reported on the persistence of *P. pecosensis* populations in Blue Spring from the artesian springhead sources downstream through the middle reaches of the springrun.

Acquisition of Blue Spring surface water rights (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 (NMSA 1995).

Threats: Stream channelization, springrun impoundment, and water quality degradation due to agricultural/dairy practices from upstream localities in the watershed were attributed to the demise of the Castle Spring population (Landye 1981, Taylor 1983, Mehlhop 1992).

Taylor (1983) identified ground water depletion as the primary threat to extant populations of *P. pecosensis*. Regional ground water 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).

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 in 1988, the most down-gradient discharge point for ground water in the upper Black River Valley. 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), which raises concerns for surface water quality of the Blue Spring wetland complex and the Black River in the long-term, 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 affect extant populations by reducing flow through the system while concomitantly increasing salinity and potentially concentrating contaminants. Introduction of non-native crayfish can adversely impact springsnails and aquatic habitats (Fernandez and Rosen 1996).

Recommendation: No change in listing status is recommended. The Department should explore options for a "candidate conservation agreement" (Federal Register 1997), or similar agreement (e.g., state recovery plan), that provides a mechanism for species and habitat conservation compatible with past and present land-use practices. Continue annual habitat and population inventory of *P. pecosensis* at monitoring sites in the Blue Spring wetland complex.

Literature Cited

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.

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.

New Mexico Statutes Annotated. 1995. Interstate Stream Commission Water Conservation Program: Pecos River Portion. NMSA Supplement 72-5-28.

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. Techonomic 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 hot springsnail, *Pyrgulopsis thermalis*

Distribution: This endemic springsnail 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). *Pyrgulopsis thermalis* prefers thermal spring flows with temperatures from 33 to 39ºC, but occurs most abundantly within lower limits of this range (Taylor 1987).

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

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, and 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 can adversely impact hydrobiid springsnails and aquatic habitats (Fernandez and Rosen 1996).

Recommendation: No change in listing status is recommended. The Department should expand area of survey 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 the 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/Coyote Creek area, Colfax County (Taylor 1983, NMDGF 1988).

Current Status: The status of this species in New Mexico is unkown.

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

Recommendation: No change in listing status is recommended. The Department should conduct 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 located immediately upstream of the Monticello Box, Socorro County (Lang 2001).

Current Status: *Vertigo ovata* at Blue Spring and Alamosa Creek appears stable under current land use practices, with evidence of successful reproduction and recruitment of immature snails into the adult population (Lang 2001). However, a proposed beryllium mine within the immediate watershed of Alamosa Creek Canyon poses threats to the riparian habitats and native invertebrate populations at this site. The State Game Commission accepted the Department's recommendation to withhold uplisting *V. ovata* from Threatened to Endangered pending further review of a revised permit application that addresses numerous outstanding issues regarding proposed mine site operations (NMDGF 2000). The New Mexico Environment Department halted unauthorized mineral exploration activities at the Alamosa mine site that commenced in March 2002.

Threats: The apparent reduction in habitat suitability and availability for this species in the Desert Southwest 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 et al. *In Review*).

Extant populations 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 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. The Department should continue to review any revised Alamosa mine proposal as required by statute. Resource agencies should pursue interests expressed by the Monticello Community Ditch Association for wetland restoration and enhancement of the riparian corridor of Alamosa Creek.

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.
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.
Metcalf, A. L., R. A. Smartt, and B. K. Lang. *In Review*. A guide to the land snails of New Mexico. Santa Barbara Museum of Natural, Special Publication Series, Santa Barbara, CA.
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.
Taylor, D. T. 1983. Endangered species: status investigation of mollusks of New Mexico. Professional Services Contract Nos. 519-69-01 and 519-69-01A.
Quarles, J. 1983. Groundwater contamination in the United States. University of Pennsylvania Press, Philadelphia.

Hacheta Grande woodlandsnail, *Ashmunella hebardi*

Distribution: The endemic *Ashmunella hebardi* 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 2004). The species may occur at higher elevations on vertical limestone facies immediately west-northwest of Big Hatchet Peak above 7400 ft., however, sampling of this area is physically challenging.

Current Status: Lang (2001, 2004) documented the persistence of *A. hebardi* in Chaney Canyon. Field studies are ongoing to determine the distribution of this species relative to the congener, *Ashmunella mearnsii*, which Metcalf and Smartt (1997) identified as possibly hydridizing with *A. hebardi*. Taxonomic relationships between *A. hebardi* and *A. mearnsi* will be assessed through conchologic and genetic studies (Lang 2004).

Threats: Any form of soil disturbance (e.g., mineral mining) or vegetative cover removal (e.g. logging, fire, or grazing) would likely result in adverse impacts to edaphic conditions and direct habitat loss in areas were this species is known to occur. The prospects of a 2005 prescribed burn (ca. 12,000 acres) to control overgrowth of woody plants in the north-central range of the Big Hatchet Mountains (Thompson Canyon northward to Zeller Peak) could threaten the persistence of *A. hebardi* in Chaney Canyon (Lang 2004). The short- and long-term return effects of fire, whether natural or prescribed, on forest ecosystem dynamics are poorly understood, especially with respect to molluscanfaunal recovery periods (Lang 2001, 2004).

Recommendation: No change in listing status is recommended. The Department is working with the BLM Las Cruces Field Resources Office to consider alternative prescribed fire strategies to prevent burn of forested habitat currently occupied by *A. hebardi* and four other endemic land snail species known to occur in Chaney Canyon.

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 hebardi* 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.

Cooke's Peak woodlandsnail, *Ashmunella macromphala*

Distribution: This species is 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: *Ashmunella macromphala* persists at the type locality where it occurs on public land (Bureau of Land Management). The OK Canyon population of this species likewise occurs on BLM land bounded by state lands with private in-holdings to the east.

Threats: Due to its restricted range, this species is vulnerable to any form of soil disturbance (e.g., mineral mining) or vegetative cover removal (e.g. logging or grazing) that could result in adverse impacts to edaphic conditions and direct habitat loss in areas were this species is known to occur. Habitat loss from forest fire, deciduous woody plant diseases or insect pests, and global desertification 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 grazing 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. 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 hebardi* 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 a similar habitat located 50 m up-slope (Metcalf and Smartt 1997, NMDGF 1988).

Current Status: During recent surveys *O. pilsbryi* was remarkably abundant throughout an approximate 0.3 mile stream reach along contiguous limestone outcrops that constrict Mineral Creek to a narrow sinuous channel; several small (5-10 mm *w*) shells confirmed a reproducing population (Lang 2001). No empty shells or fragments were observed downstream of 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 general vicinity of its known distribution (NMGF 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. Fencing of the type locality would serve to protect this species' limited habitat.

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: 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 by motorized vehicle (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 desertification, 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. The Department should continue efforts with the Bureau of Land Management to secure occupied habitat.

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 riparian 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 (W.L. Minckley, pers. comm.). Minckley and DeMaris (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: 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 DeMaris' (2000) interpretation, the chub in Turkey Creek is *Gila intermedia.* Wildfire and associated ash flows during 2003 may have eliminated the Turkey Creek population. 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 dolomieui*) are probably the primary reasons for the greatly reduced range and abundance of Gila chub If it persists in Turkey Creek, wildfire and associated ash flows remain a threat to this population.

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Recommendation: No change in listing status is recommended. Surveys should be conducted to determine its status in New Mexico, particularly in Turkey Creek. 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.

Deleted: ¶

Literature Cited:

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.

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.

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 has declined significantly throughout its native range (Propst and Stefferud, 1994). In Chihuahua, it is 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 (*Micoropterus salmoides*) has 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 were stocked from 1999 through 2003 in the Mimbres River to augment extant populations. Chihuahua chub is listed as threatened by USFWS. A recovery plan for the species has been approved (USFWS, 1986), but critical habitat was not designated.

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 fish screen at outflow of 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 nonnnative salmonids from Mimbres River should be undertaken. Lands having suitable, or potential, Chihuahua chub habitat in Mimbres River 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 River 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). Throughout much of its range, the species was 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: 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). In New Mexico, the species is rare in the San Juan River (Ryden and Pfeifer, 1996), 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 DeMaris' (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 for at least 15 years. 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. The New Mexico Department of Game and Fish should work with Colorado Division of Wildlife to propagate and rear roundtail chub in a hatchery for repatriation to historical habitats in San Juan River basin. 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 restoration of roundtail chub. Surveys should be conducted to determine the current distribution and taxonomic status of *Gila*-species in the Gila River drainage. A comprehensive set of conservation and recovery actions should be compiled through the ongoing development of the interstate conservation agreement and rangewide conservation plan for 3 species of native fishes (including roundtail chub), and the subsequent development of a state recovery plan.

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.

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.

Platania, S.P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah. Icthyofaunal study of the San Juan River. New Mexico Department of Game and Fish, Santa Fe, 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.

Ryden, D.W. and F.K. Pfeifer. 1996. Adult fish community monitoring on the San Juan River, 1995 annual progress report. San Juan River Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

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: 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. Where still present, its abundance varies considerably seasonally and annually (Platania, 1993). 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 5 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. Rio Grande silvery minnow is federally listed as endangered and critical habitat designated. A recovery plan for the species has been approved (USFWS, 1999).

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 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. 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.

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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.
Edwards, R.J. and S. Contreras-Balderas. 1991. Historical changes in the ichthyofauna of the lower Rio Grande (Río Bravo del Norté), Texas and Mexico. The Southwestern Naturalist 36: 201-212.
Platania, S.P. The fishes of the Rio Grande between Velarde and Elephant Butte Reservoir and their habitat associations. Ichthyological Studies Program, Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM.
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).

Current Status: The 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). The population of Arkansas River shiner in the Pecos River is not protected by New Mexico or by USFWS. The species is federally listed as threatened (USFWS, 1998). Critical habitat for the species is proposed.

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 threatens 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) are being completed. A multi-year study to characterize status of South Canadian River drainage fishes, including Arkansas River shiner, was recently initiated. 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.
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: The 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: 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 livestock 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 ands updated assessment of the status of southern redbelly dace in New Mexico. The potential for New Mexico Department of Game and Fish 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. Okalahoma State University Press, Stillwater, OK.
Pflieger, 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). 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: 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. Individuals from these stockings survived at least 1 year (P.B. Holden & M. Golden, Bio/West, pers. comm.), but it is uncertain that they will recruit to the adult population. The Colorado pikeminnow is listed as endangered by the USFWS and receives protection by all states in which it formerly or currently occurs. Critical habitat for the species has been designated and in New Mexico includes the San Juan River from Farmington downstream to the Colorado border. 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. Strict regulations regarding use of bait fishes should be adopted and implemented in the San Juan River basin.

Literature Cited:

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: 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, AZGF pers. comm.). Poor watershed management (mainly overgrazing, 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 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 increase of crayfish populations can reduce habiat 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, is being 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:

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 historic 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: Blue sucker has declined throughout much of its native range (Moss et al., 1983). In New Mexico, it is 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.

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. 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.
Gelhbach, 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.
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 historic occurrence in New Mexico (Bednarz, 1979; Echelle and Echelle, 1980). Pecos gambusia occur almost exclusively in springs and spring run habitats with lithic or vegetative cover (Echelle et al., 1989).

Current Status: The range of Pecos gambusia has diminished in Texas (Echelle and Echelle, 1980), but it still occupies its historic New Mexico range. The species is federally listed as endangered and a Pecos Gambusia

Recovery Plan has been approved (USFWS, 1983).

Threats: Groundwater mining, habitat modification by livestock or spring run dredging, and nonnative predators are 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 occupies about 7 km of its historic Arizona range and currently occurs in about 105 km of mainly small headwater habitats in New Mexico. Planned 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 during the past 10 years. Local opposition to recovery activities delayed restoration efforts between 1993 and 1997. During 1997, Gila trout was repatriated to Mogollon Creek. This stream is the largest and most hydrologically complex drainage currently supporting Gila trout. Following wildfire elimination of nonnative salmonids in Black Canyon, a waterfall barrier was constructed by volunteers to protect about 16 km of upper Black Canyon. Between 1998 and 2003, Gila trout were annually stocked in the stream. Gila trout is federally protected as an endangered species and has an approved recovery plan. 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.

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, nonnative trout should be removed from West Fork Gila River drainage, West Fork Mogollon Creek, and Rain Creek in New Mexico, and suitable streams in Blue River drainage in Arizona and Gila trout 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.

Literature Cited:

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Mongraph 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 Archivum 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: 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; NMGF 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.

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: Arkansas River speckled chub has disappeared from about 90% of its historic 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* (Robins et al., 1991), but Sublette et al. (1990) use *Extrarius* as the generic epithet.

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

Recommendations: No changes in listing status are recommended. Systematic inventories of South Canadian Rivaer 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 Arkansas speckled chub to its hisdtorical 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. 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 Arkansa 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.

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 Musuem of Natural History, Raleigh, NC.

Spikedace, *Meda fulgida*

Distribution: The spikedace is endemic to the Gila River drainage of southwestern New Mexico, southeastern 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: The spikedace has been eliminated from most (>90%) of its historic Arizona range and persists there only in Aravaipa Creek, and Eagle Creek (Minckley, 1973; Barber and Minckley, 1966; Marsh et al., 1990). It

has not been found in the upper Verde River for at least 5 years (J.N. Rinne, USFS, 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 lower reaches of the West Fork Gila River and the Cliff-Gila Valley reach of the Gila River. It is frequently found near the mouth of the Middle Box upstream of Redrock and is irregularly found in portions of the East Fork Gila River (Propst et al., 1986; NMGF files). It has apparently been eliminated from Middle Fork Gila River, likely a consequence of predation by nonnative yellow bullhead, *Ameiurus natalis*, and smallmouth bass, *Micropterus dolomieui*. Spikedace is federally protected as a threatened species. Critical habitat was proposed and a final rule designating it was published in April 2000 (USFWS 2000). The rule designating critical habitat is currently being appealed in the federal court system.

Threats: Dewatering of riverine habitats, 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.

Recommendations: No change in listing status is recommended; however, the status of extant populations in New Mexico is apparently declining. A thorough inventory of the Gila River system in New Mexico is needed to evaluate the need to uplist spikedace to endangered under the NM Wildlife Conservation Act. A natural flow regime in Gila River should be maintained; additional depletions or diversion of the Gila River wihtin New Mexico should not occur. Nonnative fishes, particularly predators, should be removed from currently occupied and historical habitats of spikedace. No nonnative fishes should be stocked in Gila River drainage. Spikedace should be restored to San Francisco River. Cooperative efforts with Arizona Game and Fish Department, as well as several federal agencies, to conserve spikedace should continue. Strict regulations regarding use of bait fishes should be adopted and implemented in the Gila River basin.

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.

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.

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: 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 (C.W. Hoagstrom, pers. comm.). Drought during the past 3 years and desiccation of the Pecos River north of Roswell have diminished its abundance. Pecos

bluntnose shiner is federally listed as threatened with critical habitat and an approved federal recovery plan (USFWS 1992).

Threats: Primary threats to Pecos bluntnose shiner are large, extended reservoir releases to meet irrigation needs during the summer reproductive season, seasonal dewatering and artificially depressed river flows, channelization, loss of habitat diversity, and range fragmentation. If flows cannot be maintained, the species will continue to decline and it may warrant state listing as endangered.

Recommendations: No change in listing status is recommended. The cooperative effort among U.S. Fish and Wildlife Service, New Mexico Department of Game and Fish, U.S. Bureau of Reclamation, and Carlsbad Irrigation District 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 into future river management. Permanent surface flows should be maintained throughout currently occupied range of Pecos bluntnose shiner. The potential to restore Pecos bluntnose shiner to formally occupied habitat in Pecos River upstream of Sumner Reservoir should be investigated. Strict regulations regarding use of bait fishes should be adopted and implemented in the entire Pecos River drainage.

Literature Cited:

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.

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.

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.

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.

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: 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.

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. A thorough, systematic inventory of South Canadian River drained is needed. 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., R.E. Moss, and J.T. Collins. 1985. Assessment of dewatering impacts on stream fisheries om 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 has been eliminated from Sonora and much of its historic 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 reaches (<10 km) of the Tularosa and San Francisco rivers. A small population persists in the lower reaches of the West Fork Gila River and the population in the Cliff-Gila Valley has declined in the past 10 years (NMGF files). It has apparently been eliminated from Middle Fork Gila River (likely consequence of predation by nonnative yellow bullhead, *Ameiurus natalis*, and smallmouth bass, *Micropterus dolomieus*) and occurs irregularly in portions of East Fork Gila River. Elsewhere in the Gila-San Francisco drainage, it occurs irregularly or is absent. Loach minnow is federally protected as threatened. Critical habitat was proposed and a final designation was published in April 2000 (USFWS 2000). This rule is currently being challenged in the federal court system.

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 historic range of the species in New Mexico is needed to determine its current status. A natural flow regime in Gila River (including San Francisco River) should be maintained; additional water depletions or diversions within New Mexico 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 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 New Mexico Department of Game and Fish.

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, *Scartomyzon congestum*

Distribution: The historic 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 currently occupies only 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, Harris and Mayden (2001) argued that the putative genus *Scartomyzon* was phylogenetically embedded within *Moxostoma*. If their interpretation is accepted by The American Fisheries Society, *Moxostoma* will be restored as the genus nomen for gray redhorse. An ongoing study (scheduled for completion within next 18 months) will provide accurate characterization of the status of the species in New Mexico.

Threats: Range fragmentation (by dams), stream dewatering and modified flow regimes, and contaminants are probably the primary threats to the species in New Mexico. 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:

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.
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.
Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. TheUniversity 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 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.). The Pecos pupfish was proposed for federal listing as endangered (Federal Register 63:4608). However, the proposal was withdrawn and a conservation agreement for Pecos pupfish was adopted. 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.

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, and seasonal stream dewatering 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. The regulations need to be amended 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. 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.

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: The 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, the pupfish is common (Pittenger and Springer, 1996).

Current Status: White Sands pupfish occupies all of its limited historic habitat and has been established in Mound Spring and Malone Draw (Pittenger and Springer, 1999). A Cooperative Agreement for the Conservation of White Sands Pupfish has provided for its protection and monitoring of its status.

Threats: Habitat degradation by military activities, weapons testing, and introduction of crayfish and nonnative fishes (particularly predators) are the 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. A conservation agreement that offers strong protections for White Sands pupfish and their habitats should be renewed and implemented.

Literature Cited:

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.bbnm

Gila topminnow, *Poeciliopsis occidentalis*

Distribution: The Gila topminnow was historically 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: The Gila topminnow has been eliminated from almost all of its historic range. It currently persists in 11 scattered locations in Arizona, and the security of these is variable (Weedman and Young, 1997). The New Mexico population was eliminated by drought or floods during the 1950s. In 1989, Gila topminnow was stocked in a pond on the New Mexico Department of Game and Fish Red Rock Wildlife Management Area. The effort was apparently unsuccessful. Gila topminnow is federally listed as endangered.

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 on the New Mexico Department of Game and Fish Red Rock Wildlife Management Area should be renovated and stocked with Gila topminnow. 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: 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 disjunct areas; the springs, spring runs, and several impoundments on Bitter Lake National Wildlife Refuge, Cottonwood Creek, 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 New Mexico Department of Game and Fish.

Threats: Groundwater mining, 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 systematicsCa 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 occupies much of its historical New Mexico range, but its abundance has apparently declined. In addition, it 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, Etheostominatinae), 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

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. It reaches the extreme eastern edge of its range in southwest New Mexico (Platz 1988).

Current Status: *Rana yavapaiensis* is listed as a species of concern by USFWS (USFWS 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 NM/AZ 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., egg masses nor tadpoles have been reported from New Mexico. *Rana yavapaiensis* is considered to be very rare in New Mexico.

Threats: The causative agents for the decline of this species and other frogs, toads, and salamanders worldwide are 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, crawfish, and 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.

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, ABQ. 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. 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. 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 Sates and Mexico. USDI. Rocky Mt. Forest & Range Exp. Stat., Ft. Collins, Co. GTM RM-GTR-264.

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: The southern Rocky mountain form of *Bufo boreas* is currently classified as a "warranted but precluded" candidate species for federal listing (USFWS 2001). It 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. Additional surveys that concentrate on locating eggs, tadpoles, and new metamorphs should be carried out.

Threats: Several factors have contributed to the decline of the Mountain Toad 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. Any resource management activities that degrade alpine wetlands will negatively affect breeding habitat for boreal toads. If populations of *B. boreas* are found to exist in New Mexico, surveys for the chytridiomycete fungus should be conducted.

Recommendations: *Bufo boreas* should maintain its current listing as endangered. 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 changed from Boreal toad to 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).

NMDGF should continue work with the USFS to initiate a feasibility study to repatriate Mountain toads into historic habitat in 2005.

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, ABQ. xix + 431 p.
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.
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. 9 p.
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.
Utah Division of Wildlife Resources (UDWR). 1997. Utah sensitive species list. From Internet http://www.nr.state.ut.us/dwr/sensppl.htm
Woodward, B.W. and S. Mitchell. 1985. The distribution of *Bufo boreas* in New Mexico. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe. 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). 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. Based on locality records from Texas (Dixon 1987), *G. olivacea* may occur in Lea County in eastern New Mexico as well. The narrowmouth 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* 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 very limited, although they appear secure (Hammerson 1999). The species was not discovered in New Mexico until June 1986 (Degenhardt 1986).

Threats: Overgrazing and other habitat modifications (i.e., draining or filling low-lying areas) 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. The common name should be changed to Great Plains Narrow-mouthed Toad (Crother 2000). Roadside ditches within known or probable habitats for this species should be retained in a condition that allows for temporary holding of water following rainstorms or flood events.

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, ABQ. 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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro 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

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* is listed as a species of concern by Region 2 USFWS (USFWS 1996). The New Mexico Endemic Salamander Team has completed the Jemez Mountains Salamander Management Plan. This plan was approved and signed by NMDGF, USFWS, and USFS during January 2000, and was designed to provide guidance for management of the Jemez Mountains salamander on USFS lands, and to preclude the need for federal listing.

Threats: Current threats to the already fragmented populations of Jemez Mountains salamander are numerous. Several major habitat disturbances, both intentional and unintenrtional, have resulted in cumulative impacts to Jemez Mountains salamander habitat over the past few years. The actions include: 1) the occurrence of multiple stand-replacing wildfires in occupied and historic habitat, that reduce or eliminate forest canopy shading and forest floor coarse woody debris that Jemez Mountains salamanders require; 2) the subsequent salvage logging of occupied habitat on Sandoval Ridge, which failed to fully incorporate the recommendations of the New Mexico Endemic Salamander Team led by NMDGF; 3) the findings of significantly elevated microhabitat temperatures on the habitat severely burned during the Cerro Grande and Dome fires, 4) the proposed relocation of NM Highway 126 into occupied habitat, which also failed to fully address the mitigation measures proposed by the Salamander Team; 5) the low recapture rates at historic sites, possibly related to heavy reseeding of native and non-native greases after fires; and 6) the detection of a fungal infection from a specimen on the Valles Caldera, which causes great concern among biologists who have documented dramatic population declines of other amphibians in New Mexico (e.g., leopard frogs) from fungal infections. The reseeding of Jemez Mountains salamander study plots with native and non-native grasses that are persisting up to eight years post-burn have precluded the ability of the Salamander Team

to separate out the impacts of stand-replacing wildfire from the possible adverse effects of habitat conversion to dense grasslands.

Wildfire: There is a continued threat of additional negative impacts to populations of Jemez Mountains salamanders from human- and lightning-ignited wildfires, and escaped or poorly-planned (i.e., timing and intensity) prescribed fire. Salamander populations are known to be susceptible to fire-related effects, including loss of forest canopy, loss of microhabitat (such as downed logs and litter, or coarse woody debris), decreased forest humidity, desiccation of habitat, erosion, and filling in (by grass roots and sedimentation) of subterranean habitat utilized by salamanders. Recent post-fire management actions that have negatively impacted Jemez Mountains salamanders and their habitat include the mulching and reseeding of occupied habitat with fast-growing, soil-binding, native and non-native grasses.

The Dome Fire (1996) and the Cerro Grande Fire (2000) burned with moderate- and high-severity over approximately 33% of the "Essential" management zone as defined by the New Mexico Endemic Salamander Team Conservation Plan. Data collected on experimental plots after the Cerro Grande Fire suggest that, after 2 years, there were no differences in the number of salamanders found, or in the presence/absence of salamanders between non-burned and high-severity-burned historic sites. However there are problems with these between-site comparisons because of the inherent differences in salamander detection probabilities resulting from the fire-induced habitat differences. For example, the non-burned areas had complex habitat with vegetation and logs providing abundant cover, stabilized moisture, and temperatures; thus making detection of salamanders difficult. In contrast, the high-severity burn areas had a simplified habitat with few to no logs and vegetation, minimum available cover, with highly fluctuating temperatures and moisture. Average daily microhabitat temperatures measured under potential salamander cover objects in non-burn, low-, moderate-, and high-severity of the Cerro Grande Fire, were dramatically greater in the moderate- and high-severity than those in the low-severity and non-burn areas. These temperatures were above the thermal preferendum reported for the species (12.4º C), and some temperatures recorded in high-severity areas were above the reported critical thermal maximum (33.5º C). Thus, at least in the short term, the species is negatively affected by fire, and recent surveys suggest slowly declining populations. However it is difficult to distinguish the impacts of fire and the recent drought. As unnaturally high fuel loads continue to increase and the long-term drought continues, the threat of population declines due to catastrophic wildfire will continue.

Logging: Timber harvests by the USFS since 1980 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, tree thinning and fuel-break construction in the wildland-urban interface zones. Light thinning operations (e.g., thinning from below) would likely be beneficial to Jemez Mountains salamanders to the extent that they reduce potential for stand-replacing wildfires. However, fuel breaks are associated with heavier removal of tree density, canopy, and forest floor coarse woody debris, and could adversely impact Jemez Mountains salamanders in occupied habitats.

Recent (winter 2004) logging operations on habitat known to be occupied by the Jemez Mountains salamanders in the Lakes and BMG Wildfire timber salvage area removed numerous trees and opened the canopy to increased insolation. Although some large Douglas-fir snags were left or dropped as potential future Jemez Mountains salamander habitat, many larger trees that would ultimately create future Jemez Mountains salamander habitat were removed. This salvage logging operation will likely cause desiccation and increased soil temperatures in the terrestrial habitat. Results and analysis of Jemez Mountains salamander monitoring scheduled for late summer 2004 may help to better determine the effects of this action.

Road Construction: Roads and other development (residential, recreational, or commercial) will 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 relocate, widen and pave NM Highway 126 was contrary to the highway improvement alternative recommended by the Salamander Team, and will cause population

fragmentation and direct take of salamanders. The current alignment bisects 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*. Cummer et al. (2004) reported *Cladosporium spp*. from a single specimen of *P. neomexicanus*, however it is unknown if the fungus was superficial only or if its presence caused an infection in the specimen.

Mining: Mining activity in the Jemez Mountains is a minor threat to *P. neomexicanus* as most of the current mines are pumice mines. Areas that contain large deposits of pumice are generally not suitable for *P. neomexicanus* although specimens have been observed under logs next to existing mines. Strip mining could result in habitat destruction from road building, heavy machinery, overburden removal and deposition, pollution, blasting, and other associated activities.

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*, we lack quantitative population comparisons to definitively conclude whether the species is declining throughout its known range. However, observational 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. Size and apparent condition of salamanders observed during 2001-02 (Everett 2002) was reduced compared to previous findings. 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.

Recommendations: As a result of the numerous continued threats to *P. neomexicanus*, this species was upgraded from a listing status of threatened to endangered under the New Mexico Wildlife Conservation Act in September 2004. Uplisting of this species will protect against direct take, and help draw public attention to the needs of the species and to its current imperiled status. 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. The population on the Valles Caldera should be investigated further for the presence of fungal disease.

Literature Cited:

Cummer, 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 Alamaos, NM 13 p. + 3 appendices.

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.

Everett, E. M. 2002. Habitat characterization and environmental influences of the Jemez Mountains salamander (*Plethodon neomexicanus*). M.S. Thesis. New Mexico State University, Las Cruces. 55 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. 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. 4 p.

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). *Aneides hardii* may be locally abundant where essential microhabitat characteristics are available (NMGF files).

Current Status: The Sacramento mountain salamander is listed as a species of concern by USFWS (USFWS 1996), and as sensitive by the USFS (USFS 1999).

Threats: 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.

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 has 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.

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).

Recommendations: This species should maintain its current listing as threatened. NMDGF should continue to provide support for the New Mexico Endemic Salamander Team and its work to develop conservation measures for *A. hardii*.

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. 46 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.

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. 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. *Bufo alvarius* was not collected in New Mexico until the summer of 1961 (Cole 1962). 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* does not receive any formal protection elsewhere. 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 changed to Sonoran Desert Toad (Crother et al. 2003). Roadside and dirt tank habitats that provide habitat for this species should be protected against sedimentation or filling. Any evidence of illegal collecing should be investigated.

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. DeQuieroz, 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, ABQ. xix + 431 p.
Fouquette, M. J. 1970. *Bufo alvarius*. Cat. Amer. Amphib. Rept.:93.1-93.4.

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). It was first reported from New Mexico in 1950 (Shaw 1950) and is common only at Redrock Wildlife Area in Grant County (Beck 1994) 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.

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.

Current Status: *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 subspecies Reticulated Gila Monster, *H. s. suspectum,* occurs in New Mexico.

Threats: Threats to *H. suspectum* are largely from illegal collection and commercialization. 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. Any evidence of illegal collecing or take should be investigated.

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 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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro Oficial De La Federación, Mexico CDLXXXVII(10):2-60.

Shaw, C.E. 1950. The Gila monster in New Mexico. Herpetologica 6(2):37-39.

Gray checkered whiptail, *Aspidoscelis dixoni*

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 dixoni* in New Mexico is only 3 x 5 miles, where populations are fragmented by patches of unsuitable habitat. In New Mexico, *A. dixoni* 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. dixoni* is a rare lizard, although it may be locally common at elevations of 4265-4760 ft where suitable habitat occurs (Painter 1991, 1992). 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. dixoni* (Sias and Painter 2001).

Current Status: *Aspidoscelis dixoni* is listed as a species of concern by USFWS (USFWS 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. dixoni* is distinct from those in Trans-Pecos, Texas. Additionally, current studies of this species by herpetologists with 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).

Threats: Potential threats to this species include overgrazing, habitat alteration, chemical brush control, 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 re-assigned to the genus *Aspidoscelis*. The exteremely limited range of this species in New Mexico should be protected against any changes in land use that could result in significant habitat alteration.

Literature Cited:

Crother, B.I., J. Boundy, J.A. Campbell, K. DeQuieroz, 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-checkered whiptail (*Cnemidophorus dixoni*) on Bureau of Land Management lands in southwestern New Mexico. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe. 20 p.

Painter, C. W. 1992. Interim Report: Results of the 1991 survey for the gray-checkered whiptail (*Cnemidophorus dixoni*) on Bureau of Land Management lands in southwestern New Mexico. Unpubl. Rept. NM Dept. Game & Fish, Santa Fe. 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 tesselatus* 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. 12 p + 18 tables.

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 dixoni* complex (Sauria: Teiidae) in Texas and New Mexico. Texas J. Sci. 46(1):27-33.

Gray-banded kingsnake, *Lampropeltis alterna*

Distribution: *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). 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, lechugulla, acacia, mesquite, ocotillo, creosotebush, and various cacti. Small rodents and lizards are the primary

prey, although small treefrogs (*Hyla arenicolor*) may be eaten. 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: 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.

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 fully implement and monitor the effectiveness of actions within the completed recovery plan for this species.

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. 12 p + 3 maps.

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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro 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* is listed as a species of concern by USFWS (USFWS 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). The basis of this petition was cited as documented population declines, decreased range, and local extinction.

Threats: Threats throughout the range of this subspecies include loss of wetlands, urbanization, habitat alteration, pollution, livestock grazing, 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. Further efforts are needed if NMDGF is to gain access to private lands were this species has been known to occur.

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. 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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro Oficial De La Federación, Mexico CDLXXXVII(10):2-60.

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

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). Despite numerous surveys along the lower Pecos River drainage since 1988, fewer than 10 individuals of this species have been located (Painter 1991, 1993). The subspecies Blotched Watersnake, *N. e. transversa*, occurs in New Mexico.

Current Status: 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).

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 the acequia in Carlsbad are particularly susceptible to take (NMDGF files). It 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. The common name of this species should become plain-bellied watersnake (Crother 2000). NMDGF should seek funding to investigate the current status of this species.

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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro 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') and Peloncillo Mountains (5600-6200') (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 (i.e., Distinct Population Segments). 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* is listed as threatened by the USFWS (USDI 1991) and as a species of special concern in Arizona (Jeff Howland, AGFD nongame biologist, *pers. comm*.). A federal recovery plan was approved in 1985 (USFWS 1985). The Animas Mountains population is protected by private land ownership 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, AGFD, 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 seek funding to revise the Recovery Plan (USFWS 1985), which is almost 20 years old and much outdated.

Literature Cited:

Baker, D. G. 1991. An investigation of the natural history of he New Mexico ridgenose rattlesnake, *Crotalus willardi obscurus*. Unpubl. Rept. New Mexico Dept. Game and Fish, Santa Fe. 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. 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. gorguzi* 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).

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). It is primarily herbivorous.

Current Status: *Pseudemys gorzugi* 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).

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. Protections afforded this species through the state reptile and amphibian collection regulations should be vigorously enforced.

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 Sates: 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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro Oficial De La Federación, Mexico CDLXXXVII(10):2-60.

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). The range of *S. arenicolus* is a crescent-shaped area that varies from approximately 1-16 miles in width. Within this area, there is an estimated 655 square miles of occupied or potential habitat (Painter et al. 1999). *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). Ongoing studies have documented dispersal no more than 200 m away from sand dune blowouts where lizards were originally captured.

Current Status: *Sceloporus arenicolus* is listed as a candidate species by USFWS (USFWS 2001). "Candidate species" are species for which USFWS has sufficient information on the biological vulnerability and threats to the species to support proposals for listing as threatened or endangered under the Endangered Species Act. *Sceloporus arenicolus* receives no formal protection in Texas, where the distribution and the extent of habitat modification are unknown.

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. These activities have a local effect on populations of *S. arenicolus* in the vicinity of oil well pads; reducing these populations by an average of 39.8% 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*.

The sand dune lizard receives no protection from habitat degradation as a result of oil and gas exploration and extraction, or from other activities such as chemical control of shinnery oak dunes, on New Mexico State Trust lands. Since the 2002 Biennial Review 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: Based on continued threats from oil and gas exploration and extraction and from habitat fragmentation as a result of potential chemical brush control programs, *Sceloporus arenicolus* was uplisted to endangered in March 2005. Uplisting of this species will help draw public attention to the needs of the species and to its current imperiled status. Ongoing research should be completed regarding the establishment and maintenance of dispersal corridors through the shinnery oak matrix. The conservation recommendations and suggested mitigation measures from the Department's *Management Plan for the Sand Dune Lizard,* Sceloporus arenicolus *in New Mexico*, should be adopted and implemented by resource managers throughout sand dune lizard habitats in New Mexico.

Literature Cited:

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., C.W. Painter, D.S. Sias, and H.L. Snell. 1997. The range, distribution, and habitat of *Sceloporus arenicolus* in New Mexico. Final Rept. to New Mexico Dept. Game and Fish. 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. 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. 12 p.

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. 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. 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. 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. 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.

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 southern end of 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 destruction of the grasslands brought about by overgrazing (Bock et al. 1990).

Current Status: 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 know 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 overgrazing. Unregulated, excessive collecting may cause localized reductions in populations.

Recommendations: *Sceloporus slevini* should retain its status as threatened. Based on recommendations of Smith et al. (1996) the subspecies *Sceloporus scalaris slevini* in New Mexico should be elevated to full species rank; the common name should be Slevin's bunchgrass lizard (Crother 2000). Habitat management to maintain good-quality grassland habitats for this species are vital to its persistence in New Mexico.

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 subspecies Giant Spotted Whiptail, *A. b. stictogramma*, occurs in New Mexico.

Current Status: *Aspidoscelis burti* is listed as a species of concern by USFWS (USFWS 1996). It receives no formal protection in Arizona or Mexico.

Threats: Habitat alteration and overcollecting are the only major perceived threats to this species in New Mexico. Populations of *A. burti* in Guadalupe Canyon are healthy and stable (Painter and Tomberlin 1996) although they could be impacted by uncontrolled wildfire or by overgrazing of the riparian vegetation in there limited habitat.

Recommendations: *Aspidoscelis burti* should be retained as threatened. Following Reeder et al. (2002) and Crother et al. (2003) North American species in the genus *Cnemidophorus* should be re-assigned to the genus *Aspidoscelis,* and the subspecies *stictogrammus* should become *stictogramma*. The limited range of this species in New Mexico should be protected against any changes in land use that could result in significant habitat alteration.

Literature Cited:

Crother, B.I., J. Boundy, J.A. Campbell, K. DeQuieroz, 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, 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. 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* is peripheral in New Mexico, where it reaches the eastern and northern edges of its range. *Eumeces callicephalus* requires abundant and well-rotted leaf litter for forage areas and sites for egg-laying. It is secretive and rarely observed.

Current Status: No protection is afforded *E. callicephalus* in Arizona or Mexico.

Threats: Habitat alteration and overcollecting are the only perceived threats to this species in New Mexico. Populations of *E. callicephalus* in Guadalupe Canyon are healthy and stable (Painter and Tomberlin 1996) although the species could be impacted by uncontrolled wildfire or by overgrazing of the riparian vegetation in its limited habitat.

Recommendations: This species should maintain its current listing as threatened. Based on Crother (2000) the populations in New Mexico should be assigned to *callicephalus*. The limited range of this species in New Mexico should be protected against any changes in land use that could result in significant habitat alteration.

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* is distributed from southwest New Mexico and southern Arizona to Costa Rica. It reaches the extreme eastern edge of its range in southwest New Mexico where it is very rare and seldom encountered. In New Mexico, it is known from only 3 museum specimens (Degenhardt et al. 1996, Garrett and Painter 1992, Painter and Tomberlin 1996). The subspecies Northern Green Ratsnake, *S. t. intermedia*, occurs in New Mexico.

Current Status: *Senticolis triaspis* receives no formal protection in Mexico. It is protected from unregulated take in Arizona (AGFD 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 livestock grazing is also a threat.

Recommendations: *Senticolis triaspis* should maintain its current listing as threatened. Any evidence of illegal collecing or take should be investigated.

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). It feeds almost exclusively on fish (Fleharty 1967).

Current Status: *Thamnophis rufipunctatus* is listed as a species of special concern by USFWS (USFWS 1996). It is a species of wildlife of special concern in Arizona (AGFD 1996).

Threats: Major threats to this species are changes in water-use practices and heavy livestock overgrazing of streamside vegetation that results in alteration of habitat, including 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 (Fleharty 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., sunfishes, family Centrarchidae *Micropterus* and *Lepomis*), 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. Funding is needed to complete a study of the current status of this species in southwest 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.

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. 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.

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. 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 the Spring River in Roswell and at Bitter Lakes National Wildlife Refuge. 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 subspecies Arid Land Ribbonsnake, *T. p. diabolicus*, occurs in New Mexico.

Current Status: *Thamnophis proximus* 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 NWR 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 population near metropolitan Roswell. Road-killed individuals are occasionally encountered on the tour loop roads at Bitter Lake NWR.

Recommendations: *Thamnophis proximus* should maintain its current listing as threatened. Water management practices should be employed to maintain the aquatic and riparian habitats where this species occurs.

Literature Cited:

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.

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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro Oficial De La Federación, Mexico CDLXXXVII(10):2-60.

(Mottled) rock rattlesnake, *Crotalus lepidus lepidus*

Distribution: In New Mexico, this montane rattlesnake is known only from the Guadalupe Mountains in Eddy County and extreme eastern Otero County. It is uncommon and reaches the northern edge of its range in New Mexico (Degenhardt et al. 1966). *Crotalus lepidus lepidus* is a rare and localized inhabitant of the Guadalupe Mountains, rarely found away from rocky canyons or hillsides (Swinford 1992). Two subspecies of Rock Rattlesnake, *C. l. lepidus* and *C. l. klauberi*, occur in New Mexico; only *C. l. lepidus* is protected.

Current Status: *Crotalus l. lepidus* does not receive formal protection in Texas, although it is a Species Subject to Special Protection in the Republic of Mexico (SDS 1994).

Threats: Much of the habitat for *C. l. lepidus* in New Mexico occurs in Carlsbad Caverns National Park, therefore it appears to be secure except for illegal take within the Park. Outside of the Park, the habitat 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 illegal or over-collecting 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. 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, rasa y sujetas a protección especial, y que establece especificaciones para su protección. Diaro 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. 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 2003, there have been some 50 reports involving more than 60 individual birds, these from 15 of New Mexico's 33 counties, with most from large lakes or along major rivers, including the San Juan, Gila, Rio Grande, and Pecos drainages. Most brown pelicans that occur in New Mexico are the Pacific subspecies *P. o. californicus*, although the eastern *P. o. carolinenis* is also likely to occur.

Current Status: The species is federally-listed as endangered and was state-listed in 1983 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 8-year period 1990-1997, averaging over 3 individuals per year. Perhaps owing to stresses elsewhere (possibly related to weather-caused food shortages in coastal northwestern Mexico), brown pelicans made a remarkable showing in New Mexico in 1998, with up to 16 recorded during the year including up to 9 distributed among 3 sites (Elephant Butte, Sumner, and Brantley reservoirs) in the fall (Williams 1999). Following those unusually large numbers, however, none were found in New Mexico 1999-2000. More recently, however, two were detected in the Brantley-Avalon area, Eddy County, in spring 2001 and another was at Lake Avalon in spring 2002. Reports increased substantially in 2003, with sightings of single birds in 5 counties during that year.

Threats: An important factor in the decline of the species has been 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 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. Allen Press, Lawrence, KS. 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.

Williams, S.O. III. 1999. New Mexico: fall season 1998. North Am. Birds 53:86-88.

Aplomado falcon, *Falco femoralis*

Distribution: This grassland raptor occurs from the southwestern United States south to southern South America. 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.

Current Status: The northern subspecies, *F. f. septentrionalis*, is federally-listed as endangered. Following a documented nesting in southern New Mexico in 1952 (Ligon 1961), the species was very rarely reported in the state over the next 35 years. However, reports and verified records increased markedly by the late 1980s, including reports in 10 of the 11 years 1987-1997, these consisting of 14 records of up to 21 birds and including localities north to Socorro County (Williams 1997). This coincided with the 1992 discovery of thriving populations in nearby Chihuahua (Montoya et al. 1997), and raised hopes that natural recolonization of historic New Mexico range may be underway. That trend has continued, with records for each year 1998-2003, and was especially evident during the

period August-October 1999, which produced 6 credible reports of naturally occurring birds in 3 counties (Grant, Doña Ana, and Otero), including a juvenile that had been banded as a nestling in northern Chihuahua earlier in the year. Importantly, a resident pair was discovered in southern New Mexico in late 2000, and it nested unsuccessfully in 2001. In 2002, that pair maintained its breeding territory (and a second pair was observed elsewhere) and nested again, eventually fledging three young, the first successful nesting by native aplomado falcons in New Mexico and the United States in half a century.

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

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 natural recolonization. To proceed toward recovery, wildlife and habitat managers in New Mexico must soon decide among 3 options: 1) allow natural recolonization by native stock to proceed; 2) develop a captive flock from nearby Chihuahua stock for eventual release; 3) release captive birds of tropical southern Mexico origin into New Mexico. With multiple occurrences of wild birds of local origin, including successful nesting, experimental designation of released aplomado falcons throughout New Mexico may not be a viable option.

Literature Cited:

Hector, D. P. 1987. The decline of aplomado falcon in the United States. Am. Birds 41:381-389.
Ligon, J. S. 1961. New Mexico birds. Univ. New Mexico Press, Albuquerque, NM. 360 p.
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. 1990. Northern aplomado falcon recovery plan. U.S. Fish and Wildlife Service, Albuquerque, NM. 58 p.
Williams, S. O. III. 1997. Recent occurrences of aplomado falcons in New Mexico; is natural recolonization of historic range underway? New Mexico Ornithological Society Bull. 25:39.

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: 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 1990-2003, 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 destruction and alteration from livestock grazing, particularly 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. The Department should continue to work with land managers to protect alpine and timberline habitats for this species.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 829 p.
Bailey, F. M. 1928. Birds of New Mexico. New Mexico Dept. 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 unproven; unverified sightings from the Hatch and Portales areas in the 1850s and 1930s, respectively, (Allen 1952) may have been this species. 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 New Mexico.

Current Status: The whooping crane, a symbol of national and international efforts to recover endangered species, is federally-listed as endangered. The recovery efforts appear to be achieving success. According to the U.S. Fish and Wildlife Service, by September 2003 the world population of whoopers was up to 452 individuals, including 195 in the wild flock that migrates between Canada and Texas, 134 in several captive breeding facilities, 87 in an experimental, non-migrating flock in Florida, and 36 in an experimental flock that migrates between Wisconsin and Florida 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, non-essential" and all critical habitat designation 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 is presumed dead. It did not return to New Mexico in winter 2002-03, the first winter whooping cranes were absent from New Mexico since 1975.

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, the Department should initiate the necessary procedures to remove the species 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.

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, including in New Mexico (U.S.F.W.S. 1985), and is state-listed as consistent with the federal status. The species has been reported from New Mexico on only 7 occasions, most recently in April 2001 (Williams 2001).

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: No change in status is recommended. Protection of mudflat and sandbar habitats at New Mexico wetlands will benefit this and other migrant shorebird species.

Literature Cited:

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.

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. 1995. 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 only at or near Bitter Lake N.W.R. (Hubbard 1978); it occurs as a regular migrant in Eddy County and as an occasional visitor in other wetlands in at least 15 additional New Mexico counties.

Current Status: The interior-breeding population is federally-listed as endangered, and this includes the birds occurring in New Mexico. The state's breeding population has been quite small throughout much of the past 50 years, rarely exceeding 8 breeding pairs, and reproductive success has been poor. During the 10-year period 1990-1999, the breeding population averaged about 5-6 pairs each year, with continued poor productivity. In the four-year period 2000-2003, however, the breeding population increased to 10-11 pairs annually, and excellent productivity was achieved, with an annual average of 1.25 fledged young per pair. In addition, discovery of 5 least terns at Brantley Lake in June 2002 followed by 3 there June-July 2003 plus up to 10 at nearby Lake Avalon in July 2003 suggested these terns may be expanding into suitable habitat in Eddy County.

Threats: Loss or alteration of riverine habitats through inundation, chanalization, 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).

Recommendation: No change in status is recommended. The Department should continue to cooperate with other agencies to monitor the known nesting population, to search for additional populations, and continue to protect and manage habitat to benefit this species.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American Birds, 7th ed. Allen Press, Lawrence, KS. 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).

Current Status: The species formerly was resident in southern New Mexico (Ligon 1961) but is now only a rare visitor there. New Mexico reports for the 10-year period 1990-1999 averaged less than 4-5 birds per year, and with no documentation of nesting. Year 2000 was exceptional, with up to 15 birds detected at 9 localities and with indications of breeding in Hidalgo and Grant counties, but 2001 saw a return to the lower long term average. Reports increased again during 2002-2003, with a minimum of 17 birds detected at 10 localities in 5 counties (Hidalgo, Grant, Luna, Sierra, and Doña Ana), including vocal birds at one site in Grant and 2 sites in Hidalgo but with no confirmation of nesting.

Threats: The species prefers native shrublands at lower elevations, particularly in riparian areas; loss of these native habitats and/or the absence of water in them may be limiting this dove in the state.

Recommendation: No change in listing status is recommended. The Department should encourage the protection and enhancement of native habitats required by this species. The ban on hunting these small doves should be continued.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 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 Arizona and New Mexico (A.O.U. 1998).

Current Status: The species 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; surveys for listed species there 1987-2003 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).

Threats: Loss of native habitat in brushy desert canyons, through vegetation clearing, burning, or overgrazing, 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. The Department 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. Allen Press, Lawrence, KS. 829 p.

Bowers, R. K. Jr. and J. B. Dunning Jr. 1997. Buff-collared nightjar. *In* The birds of North American, No. 267. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C. 16 p.
Johnston, 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).

Current Status: The species breeds in New Mexico in only one canyon in the Peloncillo Mountains, where it has been present annually since 1991. Nonbreeding vagrants rarely occur elsewhere in southwestern New Mexico, including in the Animas Mountains (most recently in 2002) and in Catron, Grant, Sierra, and Otero counties.

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

Recommendation: No change in status is recommended. The Department should work with public and private land managers to protect nesting pairs from disturbance, and to preserve and enhance montane riparian habitats.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 829 p.
Hall, L. S. and J. O. Karubian. 1996. Breeding behavior of elegant trogons in southeastern Arizona. Auk 113:143-150.

Northern beardless-tyrannulet, *Camptostoma imberbe*

Distribution: This neotropical flycatcher occurs from Costa Rica north through Mexico; it reaches its northernmost limits in southeastern Arizona and southwestern New Mexico, where in New Mexico it summers regularly only in Guadalupe Canyon, Hidalgo County (A.O.U. 1998). It prefers dense stands of brushy vegetation such as mesquite and similar growth, typically along stream courses (Phillips et al. 1964, Oberholser 1974).

Current Status: This small flycatcher was detected each year on Department surveys in New Mexico's Guadalupe Canyon during the period 1987-2003, with nesting documented in both 2002 and 2003. The species may have benefited from the exclusion of livestock grazing 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 have yet to recover, with an annual average of only 1.5 territories during 1997-2003. 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 clearing, burning, and overgrazing.

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 is essential for maintaining this species in the state.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 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 *eximus* (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).

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 1993-2003 found about 300 summer territories in about 36 locales, primarily from the Rio Grande Valley westward. The majority of sites (n=24) were small, with only 1-5 territories each, and 9 sites had 6-20 territories; only 3 sites have had more than 20 territories and of those, only one has had more than 100. The largest population, that in the Cliff-Gila Valley (which once accounted for some 70% of the state's population) declined sharply during 2000-2003, losing over 40% of its population. However, increases were noted during that same period on federally managed lands in the Lower Gila Box and above Elephant Butte Reservoir.

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 March 1998 and submitted a draft recovery plan to the U.S.F.W.S. 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 habitat, including through control of cowbirds where appropriate.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 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.
Williams, S.O. III and D.A. Leal. 1998. Summary of willow flycatcher surveys in New Mexico during 1993-1998. Report to New Mexico Department of Game and Fish, Santa Fe. 5 p.

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, where in New Mexico it summers regularly only in Guadalupe Canyon. It was first discovered in Guadalupe Canyon in 1958 (Levy 1959), and with nesting documented in New Mexico in 1959 (Zimmerman 1960). In New Mexico, the species requires native broadleaf (cottonwood, sycamore) riparian habitats.

Current Status: Surveys in Guadalupe Canyon 1987-2003 found 1-3 territories annually, averaging 2.4 per year; however, only one territory was detected each year 2002 and 2003. Vagrants have been seen in summer at 3 additional Hidalgo County sites since 1994, although none since 2001, and with no evidence of breeding. In addition to New Mexico's listing, the species is listed by Texas as threatened.

Threats: Loss of broadleaf riparian woodland habitat is the principal threat to the very small New Mexico population.

Recommendation: No change in status is recommended. The Department should continue to monitor the small breeding populations, and to encourage public and private land managers to continue 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.

Literature Cited:

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, rarely, northeast to Colfax County. Nesting cormorants require stands of trees or shrubs that are free from human disturbance in or near water.

Current Status: In 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), 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 the Bosque del Apache N.W.R. area, and a few pairs nested there during the mid-990s. 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, 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. Allen Press, Lawrence, KS. 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. Neotropic cormorant. *In* The birds of North American, No. 137. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington,D.C. 24p.

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 have nested at 4 sites in 2 counties: at 3 in Colfax and one in Sierra (Williams 2000).

Current Status: An ongoing conservation success story, bald eagles throughout the lower 48 states (where breeding pairs have increased from 417 in 1963 to 5,750 in 1998) were 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). Mid-winter surveys conducted annually by the Department show that the number of bald eagles wintering in New Mexico has steadily increased since the late 1970s, from an annual average of 220 birds then to 450 by the mid-1990s. With the abandonment of the Sierra County territory in 1999, however, only 3 pairs of bald eagles nested in the state each year 1999-2003, and these and their habitats warrant the protection of continued state listing as threatened.

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

Recommendation: No change in state status is recommended. The Department should continue to monitor the breeding population, and to encourage maintenance and enhancement of the riparian/wetland areas where these eagles occur.

Literature Cited:

Hubbard, J. P. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society Publ. No. 6. 110p.

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 60:3600-36010.

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 is largely restricted to the San Francisco, Gila, and Mimbres drainages. It is rare but apparently 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 on 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 has declined in abundance as its riparian habitat has been reduced. In 1994-95, R. W. Skaggs (1996) surveyed the San Francisco, Gila, and Mimbres basins for the Department, and estimated a population of up to 80 pairs. Recent reports from the Gila Valley suggest the population there remains healthy. The statewide population may number about 100 pairs. The species is state-listed in Texas and Arizona.

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

Recommendation: No change in status is recommended. The Department should expand survey work for this riparian-obligate species, to include the development of a monitoring system to measure status and trends, and the Department 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. 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 Department of Game and Fish, Santa Fe. 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 very 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). In New Mexico, occupancy rates by any peregrine averaged 81% during 2001-2003; occupancy by pairs averaged 78% during the same period (Johsnon and Williams 2003). 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 2003, productivity remained 39% below its 1960-64 level and 19% below its 1984-88 average (Johsnon and Williams 2003).

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, Johnson 2001). In New Mexico, disturbance of nesting pairs and illegal taking are also threats (Johnson 1994, 2001).

Recommendation: The Department 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 Department, the U.S. Fish and Wildlife Service, and the U.S. Forest Service. In particular, the Department should work closely with U.S. Fish and Wildlife Service 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. 2001. The peregrine falcon in New Mexico--2001. Report to New Mexico Department of Game and Fish, Santa Fe. 17 p.
Johnson, T. H. and S. O. Williams III. 2003. The peregrine falcon in New Mexico—2003. Report to New Mexico Department of Game and Fish. 15 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.F.W.S. 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, DC.
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.

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

Distribution: The species occurs widely 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 of Hidalgo County, New Mexico (Ridgway and Friedmann 1946).

Current Status: Estimates for the Peloncillo Mountains population during 1982-96 fluctuated from fewer than 20 up to approximately 75 birds, but with no consistent trend and with some of the higher estimates including young birds; under optimum conditions, the adult population there probably numbers about 50 individuals. The Animas Mountains population has been estimated at about 30 birds. Individual flocks of 17 in the Animas Mountains December 1999 and 30 in the Peloncillo Mountains October 2001 indicate that populations in those 2 ranges are maintaining themselves. Reproduction was documented in the Peloncillo Mountains and in the Animas Valley in 2002-2003. 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 New Mexico include habitat loss from removal of vegetation, wildfire, livestock competition, lack of water sources, hybridization with non-native turkeys, and human killing and disturbance.

Recommendation: No change in status is recommended. 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:

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.

Whiskered screech-owl, *Otus trichopsis*

Distribution: This primarily Mexican and Central American species prefers pine-oak woodland (Marshall 1957) and occurs from the southwestern United States south to Nicaragua. First detected in the state in 1974 (Ligon and Brenowitz 1976), it has only very recently been found to be resident in New Mexico (Williams and Hubbard 1990).

Current Status: Beginning in 1990, a small population has been documented by Department surveys in Hidalgo County, with up to 15 occupied territories in 4 canyons in the Peloncillo Mountains in 2000 (Williams 2000); also, individuals have been reported from at least three sites in the Animas Mountains, most recently in May 2003. Owls abandoned one Peloncillo canyon following a prescribed fire in 1997, as none were located there in 1998 or 1999, but it was reoccupied in 2000.

Threats: In New Mexico, the species is restricted to areas of pine-oak and oak woodland in a few canyons in the Peloncillo and (possibly) Animas mountains; loss of this habitat, through vegetation removal or fire (both natural and

prescribed), is the principal threat. Human disturbance, particularly excessive exposure to playbacks of its vocalizations by bird watchers, could negatively impact these small populations.

Recommendation: No change in status is recommended. The Department should continue to survey for and monitor the limited New Mexico population, and to work with public and private land managers to protect pine-oak woodlands in Hidalgo County.

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).

Current Status: Recent Department-assisted surveys found this species to be resident in very small numbers in spruce-fir and similar habitats in the San Juan, Sangre de Cristo, and Jemez mountains (Stahlecker and Duncan 1995).

Threats: In New Mexico, the species occurs in small numbers and is restricted to areas of undisturbed spruce-fir and similar forests. Loss of such habitats, through timber harvest or other factors, is the main threat to the species (Hayward and Hayward 1993).

Recommendation: No change in status is recommended.

Literature Cited:

Hayward, G. D. and P. H. Hayward. 1973. Boreal owl *In* The birds of North America, No. 63. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C.
Stahlecker, D. W. and R. B. Duncan. 1995. 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 for the boreal owl in New Mexico. Condor 92:517-519.

Broad-billed hummingbird, *Cynanthus latirostris*

Distribution: This widespread Mexican species reaches its northern limit in the borderland 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 1989).

Current Status: In Guadalupe Canyon, the small (less than a dozen individuals) New Mexico population appears to have been relatively stable in recent years. In addition, in recent years there have been increasing reports from elsewhere in Hidalgo County plus from several additional counties, including confirmed records for Grant, Doña Ana, Eddy, and Valencia. In 1998, breeding was confirmed in the Skeleton Canyon in the central Peloncillo Mountains, the first for New Mexico away from Guadalupe Canyon (Williams 1998), and the species has occurred essentially annually there and farther north in Post Office Canyon since 1998.

Threats: Loss of riparian woodlands in Guadalupe Canyon and similar canyons in southwest New Mexico is the principal threat. Such losses could occur through fire, excessive livestock grazing, or clearing. Baltosser (1986) observed that snake predation was an important cause of nest failure.

Recommendation: No change in status is recommended. The Department should continue to monitor the status of the breeding population in Guadalupe Canyon, to search for additional populations elsewhere, and to encourage public and private land managers to protect riparian woodlands favored by this species.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 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. 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 canyons, and is found most commonly in the pine and pine-oak zones (Howell and Webb 1995).

Current Status: This species was discovered summering in the Animas Mountains in the mid-1970s (Hubbard 1978) and subsequently 1 bird was reported from the Peloncillo Mountains in 1979. However, the species then went unreported for 13 years, until 1992, when another was in the Peloncillo Mountains. The years 1993-95 produced a remarkable number of records, including from 2 sites in the Pinos Altos Mountains (Zimmerman 1994), 2 sites in the Sangre de Cristo Mountains (Williams 1993, 1994) and 1 site in the Manzano Mountains (in 2 years) as well as again in the Animas Mountains (Williams 1995). Breeding, however, remained undocumented during that period, and the species again went unreported 1996-1999. Only single birds were reported each year 2000, 2001, and 2003.

Threats: Loss or degradation of its preferred montane canyon habitat, through road-building, mining, pollution, wildfires, overgrazing, or lumbering are the principal threats to the species.

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

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 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.

Williams, S. O. III. 1993. New Mexico: summer season 1993. Am. Birds 47:1136-1138, 1163.

Williams, S. O. III. 1994. New Mexico: fall season 1994. Am. Birds 48:137-139.

Williams, S. O. III. 1995. New Mexico: summer season 1995. Field Notes 49:961-963.

Zimmerman, D. A. 1994. Observations on the white-eared hummingbird in New Mexico. New Mexico Ornithological Soc. Bull. 22:3-7.

Violet-crowned hummingbird, *Amazilia violiceps*

Distribution: This hummingbird of the Mexican highlands reaches its northernmost distribution in southeastern Arizona and southwestern New Mexico. It summers regularly only in mature, well-developed riparian areas of Guadalupe Canyon, where it nests exclusively in sycamores (Zimmerman and Levy 1960, Baltosser 1989, Williams 2002).

Current Status: The New Mexico population is small: since the mid-1980s rarely numbering more than a dozen individuals, these distributed among 2-5, rarely 7, locations within the New Mexico portion of Guadalupe Canyon and showing no detectable trend (Williams 2002). Occurrences in the late 1990s of individuals in 2 additional Peloncillo Mountains canyons plus 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. Singles documented at Anthony November 2001-February 2002 and Las Cruces February 2002 were the first known to winter in New Mexico.

Threats: Loss of low-elevation broadleaf riparian habitat in Guadalupe Canyon and elsewhere in southwestern New Mexico would threaten this tiny population. In particular, the recent land management emphasis on introducing fire onto public and private lands throughout the Peloncillo Mountains poses a significant threat if scarce big-tree riparian habitats are burned or food sources such as agaves are destroyed by fire. Baltosser (1986) identified avian nest predation as an important cause of reproductive failure.

Recommendation: No change in status is recommended. The Department 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 southwest 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, and New Mexico's Peloncillo Mountains appear to be one of its more important areas of occurrence. First detected in New Mexico in 1977 (Baltosser 1989), the species was found to be regular in Post Office Canyon near Rodeo during the 1980s and in Skeleton Canyon during the 1990s.

Current Status: The Peloncillo Mountains population is small; during the 1990s, it was estimated at about 20 breeding females. During the period 1987-2003, surveys by Department personnel and cooperators located the species in five Peloncillo Mountains canyons. Nesting was confirmed in the central Peloncillos 1995 and 1996, but those sites burned and were not reoccupied 1997-2002.

Threats: Loss of native habitat, including reduction of native food plants from burning or overgrazing, is the principal threat to the small New Mexico breeding population. The effect of fire on those habitats requires in-depth study.

Recommendation: No change in status is recommended. The Department should continue to survey for and monitor this species, and to work with land managers in protecting its preferred dry-canyon/hillside habitat.

Literature Cited:

Baltosser, W. H. 1989. Nectar availability and habitat selection by hummingbirds in Guadalupe Canyon. Wilson Bull. 101:559-578.

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.

Costa's hummingbird, *Calypte costae*

Distribution: This arid-land species of the southwestern United States and northwestern Mexico barely enters New Mexico in the extreme southwest, where it is a warm-season migrant and occasional breeder, particularly in Guadalupe Canyon (Baltosser 1989).

Current Status: 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-three birds were reported annually in southwestern New Mexico 2000-2003, 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 habitat in the Peloncillo Mountains, the lower Gila Valley, and elsewhere in southwestern New Mexico threaten the survival of the species in the state.

Recommendation: No change in status is recommended. The Department should continue to work with public and private land managers to protect and enhance this species' riparian and adjacent arid hillside habitats in southwest New Mexico.

Literature Cited:

Baltosser, W. H. 1989. Costa's hummingbird: its distribution and status. Western Birds 20:41-62.
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. North 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 resident in the lower Gila Valley and in southern Hidalgo County. Within the state, Gila woodpeckers require well-developed broadleaf riparian woodlands characterized by mature cottonwoods and/or sycamores.

Current Status: Department surveys 1987-2003 annually found 5-8 pairs in Guadalupe Canyon, and reports from additional southern Hidalgo County locales (including nesting in the Animas Valley) have been encouraging. Recent (1996-2002) observations on Deer Creek, 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. The species is state-listed as endangered in 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 fragmantation of remaining habitat patches, as mature but isolated cottonwood groves smaller than 20 ha (20 ac) are devoid of Gila Woodpeckers (Rosenberg et al. 1991). Also, breeding European starlings (*Sturnus vulgaris*) negatively impact this woodpecker by competing with it for nest cavities (Edwards and Schnell 2000).

Recommendation: No change in status is recommended at this time. The Department 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 riparian cottonwood woodlands. Prescribed fire that may kill large trees should be avoided in riparian woodlands.

Literature Cited:

Edwards, H. H. and G. D. Schnell. 2000. Gila Woodpecker. *In* The birds of North America, No. 532. Academy Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C.

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; it winters mainly in central and southern Mexico (Brown 1993). In 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, low, shrubby vegetation in riparian areas (Brown 1993).

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 (USFWS 1986). Declines have been noted also in Arizona (Phillips et al. 1964) and New Mexico (Hubbard 1978). New Mexico surveys and reports through 2003 indicate overall numbers remain very low and reproductive failure, often caused by cowbird parasitism, is unusually high. 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 1.5 in 1998-2003.

Threats: Loss or fragmentation of dense shrubby/woody riparian habitats--from urbanization, agriculture, grazing, 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. The Department 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. 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 Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C.

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. Report. 89:1-17.

Goldwasser, S., D. Gaines, and S. R. Wilbur. 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.

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 species 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 usually in habitat with a well-developed grass component.

Current Status: In New Mexico, populations have disappeared from some historic habitats but persist at others. Importantly, recent surveys have found the species in new areas and in unexpected numbers. Surveys on B.L.M. lands in San Juan, Rio Arriba, and McKinley counties 1997-1999 located the species at over 40 new localities, leading to the conclusion that the Gray Vireo may have been overlooked there in the past (Reeves 1999). Gray Vireos were detected in 10 New Mexico counties during 2002 and 2003, including 53 territories in the Manzano Mountains, Bernalillo County, 17 birds in the Sierra Larga area, Socorro County, and 88 birds in the Guadalupe Mountains, Eddy County. Nevertheless, based on degrees of threat and observed 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).

Threats: Threats include loss or alteration of quality juniper-grassland habitat, including through burning, clearing, or overgrazing, and an increase in nest-parasitism by cowbirds.

Recommendation: No change in status is recommended at this time. Identifying and maintaining quality juniper savannah and other occupied habitats should be a high priority.

Literature Cited:

American Ornithologists' Union. 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS. 829 p.

Reeves, T. 1999. Gray vireo distribution survey on B.L.M. Farmington District lands in McKinley, Rio Arriba, and San Juan counties, New Mexico: 1999 results and final report on three-year study. Report to Bureau of Land Management, Farmington District. 73 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.

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 (Tweit 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: In the Gila Valley, incidental observations in recent years suggest that numbers are reduced from 15-25 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 2003. 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 and/or degradation of native riparian habitats within its restricted New Mexico range. 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 cows from the San Pedro Riparian National Conservation Area, towhee densities in cottonwood-willow habitat more than doubled over 5 years (Krueper et al. 2003).

Recommendation: No change in status is recommended. The Department 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.
Tweit, 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.
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 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 well-developed grasslands (generally lacking woody vegetation) in the southern Animas and western Playas valleys (Williams 1991).

Current Status: Department breeding bird surveys, initiated in June 1987 specifically for this sparrow, suggest the New Mexico breeding population varies among years (Williams 1997). However, both the Animas and Playas populations have declined considerably since peak numbers were attained in 1992, the Animas population down 70% through 2003, and the Playas down an alarming 93% and nearing extirpation.

Threats: The main threat to the taxon's continued survival in New Mexico is loss and degradation of its native grassland habitat, primarily from excessive livestock grazing. Ill-timed fires (especially those occurring late spring-early summer) may severely depress recruitment.

Recommendation: No change in status is recommended at this time. The Department should continue to monitor the known population, to search for additional populations, and to encourage livestock grazing practices and burning programs that perpetuate suitable grassland habitat for this unique subspecies. In particular, consideration should be given to reducing stocking rates in times of drought.

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.

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 (AOU 1998, Green et al. 2002). It is primarily a migrant in New Mexico, occurring mainly in the eastern plains and southern lowlands, and it may winter in some locales (Hubbard 1978).

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). The species formerly was relatively numerous and widespread in New Mexico (Hubbard 1978) but in recent years is very rarely reported. Surveys by Department cooperators in 2000-2003 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 poor range management, conversion to croplands, invasion by exotic plant species, and shrub encroachment (Phillips et al. 1964, Oberholser 1974, Gossen et al. 1993, Green et al. 2002). In New Mexico, loss or degradation of grasslands from excessive livestock grazing is of particular concern.

Recommendation: No change in status is recommended. The Department should work with other agencies and organizations 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. Allen Press, Lawrence, KS. 829 p.

Goossen, J. P., S. Brechtel, D. DeSmet, D. Hijertaas, and C. Werschler. 1993. Canadian Baird's sparrow recovery plan. Recovery of nationally endangered wildlife, Report 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 Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, D.C.

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). Historically known to be resident in New Mexico only in the Animas Mountains, Hidalgo County, where it is largely confined, at least in the nesting season, to the limited coniferous forest there. 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 nearby Peloncillo and Big Hatchet mountains.

Current Status: Reported as "common" in the Animas Mountains in earlier years (Bailey 1928), but precise data are lacking. Surveys of suitable habitat in 1992, 1995, 1996, and 1997 found fewer than 30 adults each year; reproduction was confirmed in 1992, 1995, and 1997, including documentation of 22 young in the latter year. However, informal surveys found only 2 birds there in 2000, none in 2001, 5 singing males in 2002, and none in 2003. In late summer 2003, up to 5 adults and 2 juveniles were discovered in the Burro Mountains, Grant County, providing the first indication that a breeding population of these rare juncos may exist in New Mexico away from the Animas Mountains.

Threats: The small and restricted New Mexico population is vulnerable to habitat loss or modification. Recruitment may suffer in years when dry conditions suppress breeding.

Recommendation: No change in status is recommended at this time. A monitoring program is needed for this and other unique nesting species in the Animas Mountains. A survey to determine this junco's status in the Burro Mountains is scheduled for 2004. 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. Allen Press, Lawrence, KS. 829 p.

Bailey, F. M. 1928. Birds of New Mexico. New Mexico Dept. Game and Fish, Santa Fe, NM. 807 p.

Horvath, E. G. and K. A. Sullivan. 1988. Facultative migration in 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.

Varied bunting, *Passerina versicolor*

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

Current Status: Surveys and reports by Department personnel and cooperators during the period 1987-2003 indicate this species persists as a summer resident in local areas of Hidalgo and Eddy counties; additionally, it was found breeding in Dona Aña County and there were reports of vagrants in Grant, Luna, Socorro, Sierra, and Otero counties during this same period. The population remains small however, with the 2-5 occupied territories found annually in Guadalupe Canyon 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 5 canyons there, 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. Cowbird (*Molothrus* sp.) 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. The Department should continue to survey for and to monitor 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, 6th ed. Allen Press, Lawrence, KS. 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.

Williams, S. O. III. 1994. New Mexico: fall season 1994. Am. Birds 48:137-139.

MAMMALS

ENDANGERED

Arizona shrew, *Sorex arizonae*

Distribution: This recently described species (Diersing and Hoffmeister, 1977) is known from the Huachuca, Santa Rita, and Chiricahua Mountains of southeast Arizona (Hoffmeister, 1986), and portions of Chihuahua, Mexico (Caire et al., 1978). In New Mexico, the species only occurs in the Animas Mountains (Conway and Schmitt, 1978; Cook, 1986). In the Animas Mountains, communities occupied by this species include mesic woodlands with dominant tree species including Douglas fir (*Pseudotsuga menziesii*), quaking aspen *(Populus tremuloides*), and netleaf oak (*Quercus reticulata*). Plants associated with this species in Arizona include 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). Mature forest with ground cover, including live vegetation and woody debris, are important habitat features for this species (Simons and Van Pelt, 1999). The diet of shrews includes spiders and other invertebrates (Matthews, 1971). This is a terrestrial shrew that does not hibernate and forages in and under forest litter during alternating periods of activity during the day and night. Recent research in southern Arizona suggests that breeding occurs during late summer and fall (Simons and Van Pelt, 1999). The reproductive biology of this species is largely unknown, but the closely related Merriam's shrew (*S. merriami*) produces 5-7 young per litter (Armstrong and Jones, 1971).

Current Status: Although limited, information on New Mexico populations suggests that the Arizona shrew is a very rare and extremely localized species. Surveys conducted in 2001 documented the presence of the Arizona shrew at 2 locations within the Animas Mountains (Simons, unpub. data.). Investigations revealed that *Sorex arizonae* was reasonably abundant at several sites in southern Arizona (Simons and Van Pelt, 1999). The New Mexico Department of Game and Fish listed this species as endangered in 1978 (Jones and Schmitt, 1997).

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 under story vegetation and woody debris are the primary threats to the Arizona shrew in New Mexico.

Recommendation: The Arizona shrew should remain listed as endangered in New Mexico. Investigations of the species distribution and population status in New Mexico should be conducted.

Literature Cited:

Armstrong, D. And J. Jones, Jr. 1971. *Sorex merriami*. Mammalian Species, No. 2:1-2.

Carie, 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. Museum of Southwestern Biology, Occas. Pap. No. 4:30. June 1986.

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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.

Matthews. L. 1971. The life of mammals. Volume II. Universe Books. New York. 440 pp.

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 (1,550 to 9,300 feet) in at least 15 Mexican States (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 southwest 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 were identified as *L. nivalis* (Arita and Humphrey, 1988), and the presence of this species in the Animas Mountains was re-confirmed in 1992 (Hoyt et al., 1994) and 2003 (M. Bogan, personal communication). Mexican long-nosed bats inhabiting southwest New Mexico represent summer migrants from Mexico (Hoyt et al., 1994), and they are present only during summer months (M. Bogan, personal communication). In New Mexico, Mexican long-nosed bats inhabit upper desert scrub andpine-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 poorly known; however, they have been observed roosting 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. Eastrela (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; Eastrela, 1972; 1973; Gardner, 1977, Hensley and Wilkins, 1988; Davis and Schmidly, 1994). These bats primarily feed upon nectar and pollen, but may also eat some soft fruits and insects associated with flowering plants.

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, 1995; USFWS, 1994). The New Mexico Department of Game and Fish listed the species as endangered in 1975 (Jones and Schmitt, 1997). Population estimates for this species in New Mexico do not exist, and the species migratory habits and distribution are not fully understood. Hoyt et al. (1994) conservatively estimated that they netted 150 to 200 individuals of *Leptonycteris* in the proportion of 2:1, *L. curasoae* to *L. nivalis* in the Animas Mountains. A current study of *Leptonycteris* ecology in southwestern New Mexico should improve our understanding of the species.

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 listing status of Mexican long-nosed bats is recommended. Ongoing research in the Animas area will provide a more thorough understanding of the species' population status and habitat use in New Mexico.

Literature Cited

Arita, H. T. and S. R. Humphrey. 1988. Revisión taxonómica de los murciélagos mageyeros del género *Leptonycteris* (Chiroptera: Phyllostomidae). Acta Zoologica Mexicana (n.s.), 29:1-60.

Borell, A. E. and M. D. Bryant. 1942. Mammals of the Big Bend area of Texas. Univ. California Publ. Zool. 48:1-62.

Davis, W. B. and D. J. Schmidly. 1994. The mammals of Texas. Texas Parks and Wildlife. 338 pp.

Eastrela, D. A. 1972. Status of *Leptonycteris nivalis* (Phylostomatidae) in Big Bend National Park, Texas. Southwestern Naturalist 17:287-292.

Eastrela, 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 No. 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. The Museum of Southwestern Biology, The 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. Phyllostomitidae and Desmondontidae. Journal of Mammalogy. 44:44-63.
U. S. Fish and Wildlife Service. 1994. Mexican long-nosed bat (*Leptonycteris nivalis*) Recovery Plan. U. S. Fish and Wildlife Service, Albuquerque, New Mexico. 91 pp.
U. S. Fish and Wildlife Service. 1995. Endangered and threatened wildlife and plants. Federal Register 32 38453; September 30, 1988.

(Peñasco) least chipmunk, *Tamias minimus atristriatus*

Distribution: The least chipmunk ***(Tamias 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). Additionally, disjunct, isolated populations of the subspecies *Tamias minimus atristriatus* 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 chipmunk habitat in the Scaramento Mountains consisted of two distinct habitat types. Habitat of the James Canyon and Peñasco Canyon populations 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 of the Sierra Blanca population is more typical for least chipmunks, and includes high elevation talus slopes and glacial cirques surrounded by Englemann spruce (*Picea engelmanni*), 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 seeds, sunflower nuts (*Helianthus* spp.), gooseberry (*Ribes* sp.), wild strawberry (*Fragaria ovalis*), piñon nuts (*Pinus edulis*), and acorns of 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 Candidate list. The species was listed as threatened by the New Mexico Department of Game and Fish in 1983 (Jones and Schmitt, 1997). The species has not been confirmed in James Canyon or Peñasco Canyon since 1969 (Conley, 1970) despite intensive capture efforts in 1981-82 (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 *T. m. atristriatus* are restricted to high elevation talus slopes and the Sierra Blanca area. A survey conducted on Sierra Blanca in 1981-1982 estimated this Peñasco least chipmunk population at 15-20 individuals. A reported *Tamias minimus atristriatus* specimen captured in Sixteen Springs Canyon in 1996 was subsequently identified as a gray-footed chipmunk (*Tamias canipes*). Recent surveys by Frey found Peñasco least chipmunks in high elevation talus slopes in the northern Sacramento Mountains (J. Frey, personal communication, 2004) and on Buck Mountain (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 threatened by competition from the closely related gray-footed chipmunk (*Tamias canipes*), which appear to have replaced *T. m. atristriatus* in several areas (J. Frey, personal communication, 2004).

Recommendations: No change in the listing status of this species is recommended. Protection of known habitats in the Sacramento Mountains (including the Sierra Blanca Peak vicinity) and additional survey work are recommended.

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, 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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.

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. Museum of Southwestern Biology, Occasional Papers 5. 27 pp.

Yates, T. L. 1982. Status of the Peñasco chipmunk. New Mexico Department of Game and Fish, Contract 519-71-01, Preliminary report:1-3.

(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). The known distribution of 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 (Hubbard, et al., 1983; Frey, et al., 1995). In New Mexico, Arizona montane voles are known from the Centerfire Bog and Jenkins Creek areas in Catron County (Hubbard et al., 1983; Frey et al., 1995).

Arizona montane vole habitat in New Mexico consists of mesic sedge and grass meadows bordering small creeks and marshes at elevations around 6,800 feet. 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 Department of Game and Fish listed 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 microtine populations are known to fluctuate dramatically in response to habitat changes (Findley, et al., 1975). Surveys conducted along Jenkins Creek by NMDGF in 1998 and 2000 reconfirmed the presence of this species in this locality.

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. Much of the known habitat is located on private land.

Recommendations: No change in the listing status of this species is recommended. Efforts should be made to protect sensitive mesic meadow habitat on both public and private lands within on Jenkins Creek, Centerfire Creek, SA Creek, Stone Creek, Romero Creek, and other high-elevation riparian areas in west-central New Mexico.

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, xxii + 360 pp.

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, 2nd ed., 2: vi + 601-1181 + 90.

Hoffmeister, D. F. 1986. Mammals of Arizona. The 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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.

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 660 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 American, five of which occurred in the Southwest and Mexico: *C. l. baileyi*, *C. l. mogollonensis*, *C. l. monstrabilis*, *C. l. nubulis*, 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 (García-Moreno et al., 1996; Hedrick, 1995; Wayne, et al., 1992). There is a consensus among the scientific community that *C. l. baileyi* is a distinct subspecies of gray wolf based on morphological and genetic characteristics.

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 by 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 1372 m (4,500 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, over 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, unpub. 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 Department of Game and Fish listed wolves as endangered in 1975 (Jones and Schmitt, 1997). In 1978, McBride (1980) estimated that fewer than 50 Mexican 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 Mexican wolves remaining in the wild. Intensive investigation of reports of wolves along the U. S./Mexico border areas of NewMexico and Arizona has failed to provide any clear evidence of Mexican wolves in any of these areas (Wolock, 1994; Whitaker et al., 1995). There is a recovery plan for the Mexican wolf (USFWS, 1982). The Fish and Wildlife Service's recovery goal for Mexican wolves is to re-establish at least 100 wolves in 5,000 mi^2 of the subspecies historic range (USFWS, 1982). Background information concerning proposed 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 within the recovery zone, and for wolves from these releases to naturally disperse onto public lands in Arizona and adjacent New Mexico on the Gila National Forest.

Currently there are approximately 50-60 free-ranging Mexican wolves within the recovery area. Three small groups of these wolves are in New Mexico. Mexican gray wolves have been present continuously in New Mexico since about 2000, when wolves dispersed to New Mexico naturally after being released in Arizona, and other wolves were translocated to remote sites in the Gila Wilderness.

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. The Department should continue to cooperate in the on-going recovery activities of the U. S. Fish and Wildlife Service and other cooperators in order to actively monitor the status of the reintroduced Mexican wolves and their habitats.

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.

Brewester, 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, 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 authenticidad 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, 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, New Mexico. 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, California.
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, New Mexico. 38 pp.
Mech, L. D. 1970. The wolf: the ecology and behavior of an endangered species. Natural History Press. Doubleday Publ. Co., New York. 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, Arizona.
U. S. Fish and Wildlife Service. 1982. Mexican wolf recovery plan. U. S. Fish and Wildlife Service, Albuquerque, New Mexico.
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
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, 1995). 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, rocky, 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 Department of Game and Fish listed the *O. c. mexicana* subspecies, excluding the Peloncillo Mountains and Red Rock Wildlife Area populations, as endangered in 1980 (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 historical 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 are as follows: Prior to 1800: Zuni and Magdalena Mountains; Between 1850-1900: San Francisco River and Turkey Creek drainages and Burro Mountains; Early 1900s: Alamo Hueco, Animas, Peloncillo, and West Potrillo Mountains; 1940s to 1950s: Guadalupe and Sacramento Mountains and El Malpais area (NMDGF, 1995).

Currently, there are only six desert bighorn sheep populations in New Mexico (including the captive population at Red Rock), all but 2 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 190 individuals, with an additional 90 sheep at the Red Rock captive facility (NMDGF, 2003). Based on aerial and ground surveys, individual desert bighorn sheep population estimates are: Peloncillos (N=25); Hatchet (N =50); San Andres (N=60); Fra Cristobal (N=50-75); and Ladron (N=27).

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 threatened 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 down listing desert bighorn sheep from endangered to threatened as ≥250 free-ranging desert bighorn distributed among at least 2 distinct populations or metapopulations, each containing ≥100 individuals. Currently, there are no metapopulations within the State that meet the criteria of at least 100 individuals.

Threats: Factors currently threatening desert bighorn sheep populations in New Mexico include habitat loss or alteration due to natural succession and human activities, competition with domestic livestock, predation, disease, and human disturbance. Domestic sheep represent a serious threat to desert bighorn sheep because of the potential for the transmission of diseases (McCarty and Bailey, 1994). In the smallest populations, inbreeding and high predator-prey ratios may limit population increases. All of New Mexico's populations are almost certainly losing genetic diversity (National Research Council 1995:107). Desert bighorn sheep in the Chihuahuan Desert are the least secure bighorn sheep populations in the United States (Bailey, in prep.).

Recommendation: No change in the listing status of the Mexican 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 the results and recommendations of the PVHA.

Literature Cited:

Bailey, V. 1932. Mammals of New Mexico. North American Fauna, 53:1-412.
Bailey, J. A. Status of major ecotypes of bighorn sheep in the United States. In Prep.
Bavin, B. 1980. Post-release study of desert bighorn sheep in the Big Hatchet Mountains. Desert Bighorn Counc. 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.
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. 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., 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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.
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.
National Research Council, Committee on Scientific Issues in the Endangered Species Act. 1995. Science and the Endangered Species Act. Nat. Acad. Science, Washington, D.C. 162 pp.
New Mexico Department of Game and Fish. 2003. Plan for the recovery of desert bighorn sheep in New Mexico: 2003-2013. 58 pp.
Rominger, E. M. 2000. Status of desert bighorn sheep in New Mexico—1999. Paper presented at the Desert Bighorn Council annual meeting. Bullhead City, Arizona.
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. 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, Colorado. 314 pp.
Sands, J. L. 1967. Bighorn sheep. Pages 69-82 *in* New Mexico Wildlife Management. New Mexico Dept. Game and Fish, Santa Fe.
Secretaría de Desarrollo Social (SDS). 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determinia las especies y esubespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenzadas, raras y sujetas a protección especial, y que establece especifaciones para su protección. Diaro Oficial De La Federacón, México CDLXXXVIII(10):2060.
Shackleton, D. M. 1985. *Ovis canadensis*. Mammalian Species. No. 230, p. 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. 1985.

THREATENED

Least shrew, *Cryptotis parva*

Distribution: This widespread species 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 westerly extent of the Least shrew distribution, and the species was first discovered in the State in 1981 (Hoditschek et al., 1985). This species is known from three localities in eastern New Mexico including Tucumcari Lake, Grulla National Wildlife Refuge, and Bitter Lake National Wildlife Refuge (Hoditschek et al., 1985; Owen and Hamilton, 1986). Investigations of other potential habitats in eastern New Mexico, including the

Santa Rosa, Carlsbad, and Conchas Lake areas, failed to identify any other populations of Least shrew (Shuster, 1987).

The least shrew occupies a variety of habitats within the western portion of its range. The species inhabits riparian woodlands in southeast Colorado (Choate and Reed, 1988) and short grass prairie and mesic meadows in northeast 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 goodingii*) and cattails (*Typha agustifolia*) along the edge of Tucumcari Lake (Cully, 1983; Hoditschek et al., 1985). At Grulla National Wildlife Refuge, they were found in communities of alkali sacaton (*Sporobous airoides*), grama (*Bouteloua* sp.), and various forbs (Owen and Hamilton, 1986). 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 listed as threatened by the New Mexico Department of Game and Fish in 1985 (Jones and Schmitt, 1997). Known distribution in New Mexico is limited to three, small isolated populations in the eastern portion of the State. The species may also have been extirpated from historic habitat at Grulla National Wildlife Refuge as a result of recent drought conditions (J. Frey, personal communication, 2004).

Threats: As a result of the Least shrew's small, isolated populations and reliance on native mesic grasslands, this species is vulnerable to habitat loss and degradation resulting from natural habitat changes (i.e., drought) and human activities (i.e., water diversion, agriculture, and grazing).

Recommendation: No change in status of the least shrew in New Mexico is recommended. Surveys of known historic habitats and potential habitats should be completed to better ascertain the species distribution and population status in New Mexico.

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. New Mexico Department of Game and Fish, Contract 516-71-31. Final report: 1-68.

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. 467 pp.

Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 2nd ed., 1:xv +1-600 + 90.

Hoditschek, B. J. F. Cully, Jr. T. L. Best, and C. Painter. 1985. Least shrew (*Crypototis 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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.

Owen, R. D. And M. J. Hamilton. 1986. Second record of *Cryptotis parva* (Soricidae: Insectorivora) in New Mexico, with review of its status on the Llano Estacado. Southwestern Naturalist. 31:403-405.

Shuster, J. C. 1987. Distribution, relative population densities, and habitat of *Cryptotis parva* in New Mexico. New Mexico Dept. Game and Fish, contract 516.6-75-19. Final report: 1-20.

Southern long-nosed bat, *Leptonycteris curasoae*

Distribution: The southern long-nosed bat occurs from El Salvador and southern Mexico northward to southern Arizona and southwest New Mexico which represent the northern extent of the species range (Findley et al., 1975; Hall, 1981; Hoffmeister, 1986). In New Mexico, this species has been found in the Animas Mountains and Peloncillo Mountains in Hidalgo County (Findley et al., 1975; Baltosser, 1980; Hoyt et al., 1994).

Similar to the Mexican long-nosed bat, the southern long-nosed bat is a migratory species that is found in the United States (northern range limit) only during summer months (Hayward and Cockrum, 1971; Findley et al., 1975; Schmidly, 1977; Wilson, 1985; Hensley and Wilkins, 1988). Habitats utilized by the lesser long-nosed bat include forested canyons and adjacent desert grassland and shrub lands (Findley et al., 1975; Hoffmeister, 1986). The

species' diet consists of nectar, pollen, and soft fruits of agaves (*Agave* spp.) and various cacti, with insects being taken incidentally (Hensley and Wilkins, 1988). 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 represent the principle roosts sites for the southern long-nosed bat, but the species is also known to roost in trees, mines, culverts, and buildings.

Current Status: The southern long-nosed bat is listed as endangered by the U. S. Fish and Wildlife Service (USFWS, 1995). The New Mexico Department of Game and Fish added the species to the threatened list in 1975 (Jones and Schmitt, 1997). Few studies have been conducted on *Leptonycteris curasoae* in New Mexico, and species' ecology, population size, and potential threats are not fully understood. Hoyt et al. (1994) conservatively estimated that they netted 150 to 200 individuals of *Leptonycteris* in the proportion of 2:1, *L. curasoae* to *L. nivalis* in the Animas Mountains. The ongoing study in the Animas Mountains should provide information on *Leptonycteris curasoae* population status and ecology in New Mexico, and help to determine current threats to this species.

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

Recommendation: No change in status of the southern long-nosed bat is recommended. Ongoing research in the Animas are will provide a more thorough understanding the species' population status 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. New Mexico Department of Game and Fish, Contract 519-68-06, Final report: 1-73.

Eastrela, D. A. 1972. Status of *Leptonycteris nivalis* (Phylostomatidae) in Big Bend National Park, Texas. Southwestern Naturalist 17:287-292.

Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, xxii + 360 pp.

Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 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. Res. Sci. 1:75-123.

Hensley, A. P., and K. T. Wilkins. 1988. *Leptonycteris nivalis*. Mammalian Species No. 307:1-4.

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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.

Schmidly, D. J. 1977. The mammals of Trans-Pecos Texas. College Station: Texas A&M University Press. 225 pp.

Wilson, D. E. 1985. Status report, *Leptonycteris sanborni* Hoffmeister, Sanborn′s long-nosed bat. U. S. Fish and Wildlife Service, Off. End. Spec., Albuquerque, New Mexico, unpublished report:i-ii+1-36.

U. S. Fish and Wildlife Service. 1995. Endangered and threatened wildlife and plants. Federal Register 32 38453; September 30, 1988.

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., 1987). Nowhere within this range is the species considered to be abundant. In New Mexico, spotted bats have been found in 11 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.). All of these areas are located west of the Rio Grande River.

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). In New Mexico, spotted bats have been located in forested areas between 3,900 and 10,600 feet in elevation. Spotted bats may summer in forested areas and migrate through lower elevations during other seasons (Hoffmeister, 1986). New Mexico records of spotted bats are only from warmer months (April - September), but 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 listed as threatened by the New Mexico Department of Game and Fish 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 well 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.

Recommendations: No change in the listing status of the spotted bat is recommended. The Department should continue to encourage land management agencies to protect known foraging and roosting habitats. Surveys are needed to better identify the species' distribution, population trends, and threats in New Mexico.

Literature Cited:

Eastrela, D. A. 1973. Ecology of the 18 species of Chiroptera at Big Bend National Park, Texas. Northwest Missouri State University Studies. 43:1-165.

Fenton, M. D., D. C. Tennant, and J. Wyszecki. 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 ecoholocation 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. Wyszecki. 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, xxii + 360 pp.

Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 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. The Museum of Southwestern Biology, The 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.

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(3):447-453.

Western yellow bat, *Lasiurus xanthinus*

Distribution: The Western yellow bat occurs from southern California southward through Texas, Mexico, Central America, and South America (Hall, 1981). This species was recently reported from Big Bend National Park, Texas (Higginbotham et al., 1999). In New Mexico, the Western yellow bat 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). Formerly considerd to be a subspecies of the southern yellow bat (*Lasiurus ega*), genetic studies resulted in the designation of *Lasiurus xanthinus* as a distinct species (Baker, et al., 1988; Morales and Bickham, 1995)

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, southern 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. They have been recorded in New Mexico only in summer months (May-September), and likely migrate southward for the winter. Their diet is 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 listed as threatened by the New Mexico Department of Game and Fish in 1975 (Jones and Schmitt, 1997). The New Mexico populations are peripheral and believed to be of low density.

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

Recommendation: No change in status for this species is recommended. Population surveys and ecological studies of the western yellow bat in New Mexico should be encouraged.

Literature Cited:

Baltosser, W. H. 1980. A biological inventory of endangered species occurring in Guadalupe Canyon, Hidalgo County, New Mexico. New Mexico Dept. Game and Fish. Contract 519-68-06, Final report: 1-73.

Baker, R. J., J. C. Patton, H. H. Genoways, and J. W. Bickham. 1988. Genic studies of *Lasiurus* (Chiroptera: Verpertilionidae). Occas. Papers Mus., Texas Tech Univ. 17:1-15.

Barbour, R. W. and W. H. Davis. 1969. Bats of America. University of Kentucky, Lexington, 286 pp.

Cook, J. A. 1981. The bat fauna of the Animas Mountains in the summer of 1981. New Mexico Department of Game and Fish. Contract 519-69-04, Final report: 1-25.

Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, xxii + 360 pp.

Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 2nd ed., 1:xv +1-600 + 90.

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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.

Morales, J. C. And J. W. Bickham. 1995. Molecular systematics of the genus *Lasiurus* (Chiroptera: Verpertilionidae) 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.

White-sided jackrabbit, *Lepus callotis gaillardi*

Distribution: The white-sided jackrabbit (*Lepus callotis)* is a species that is nearly confined to Mexico, which represents the core distribution for this species. The subspecies *L. callotis gaillardi* occurs throughout the Mexican Plateau to Jalisco as well as southwest New Mexico (Findley et al., 1975; Hall, 1981). New Mexico is the only place in the United States where white-sided jackrabbits occur. This species is found only in the Animas Valley and very limited parts of the Playas Valley in southern Hidalgo County (Findley et al., 1975; Bednarz, 1977; Bednarz and Cook, 1984).

This elusive species was reported only a few times after its discovery along the Mexican-U.S. border in 1892 (Mearns, 1896) until two were collected in the Playas Valley in 1931 (Anderson and Gaunt, 1962). Bogan and Jones obtained a subsequent specimen in 1974. Later 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*), tabosa (*Hilaria mutica*), buffalo grass *(Buchole dactyloides*), wolftail (*Lycurus pheloides*), flatsedge (*Cyperus* spp.), snakeweed (*Gutierrizia sarothae*), soap-tree yucca (*Yucca elata*), and honey mesquite (*Prosopis glandulosa*). 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). In New Mexico, this species is typically observed in pairs at night via spotlight surveys.

Current Status: This species was listed as threatened by the New Mexico Department of Game and Fish 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 *L. callotis* 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 *L. callotis* sightings decreased by 50% compared to the findings of Bendarz (1977). Bednarz and Cook (1984) postulated that the decrease of *L. callotis* and increase of *L. californicus* and *S. auduboni* 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 *L. callotis* 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 *L. callotis* 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 *L. callotis* population from 1976 to 1995. Whether these surveys accurately reflected the overall New Mexico population of *L. callotis* is unknown.

Data from NMDGF surveys conducted between 1997 and 2002 have not been 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 *L. callotis* in this area remains uncertain. While the overall status of *L. callotis* 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, natural succession processes, and overgrazing 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 *L. californicus* and the competitive exclusion of L. *callotis* (Matson and Baker, 1986). Baker (1977) noted that livestock grazing might be one of the factors contributing to the decline of L. *callotis* and apparent replacement by *L. californicus*. Vehicles occasionally kill white-sided jackrabbits, but such mortality probably does not represent a significant threat to this species (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 status for white-sided jackrabbits is recommended. The Department should continue to conduct surveys to assess population status and tends. Private landowners are encouraged to employ non-detrimental livestock grazing practices within white-sided jackrabbit habitat. The relationship between U.S. and Mexican populations of L. *callotis* and population status in other portions of the species 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.

Bednarz, J. 1977. The white-sided jackrabbit: distribution, numbers, and biology in the grasslands of Hidalgo County. New Mexico Department of Game and Fish. Contract 519-64-25, Final report, 33 pp.

Bednarz, J. C. and J. A. Cook. 1984. Distribution and number of the white-sided jackrabbit (*Lepus callotis*

gaillardi) in New Mexico. Southwestern Naturalist. 29:358-360.
Bogan, M. A. and C. Jones. 1975. Observations of *Lepus callotis* in New Mexico. Proceedings of the Biological Society of Washington. 88:45-50.
Cook, J. A. 1981a. Distribution and numbers of white-sided jackrabbits (*Lepus callotis*) in the Animas Valley in summer 1991. New Mexico Department of Game and Fish. Contract 519-69-04, Final report, 13 pp.
Cook, J. A. 1981b. Distribution and numbers of white-sided jackrabbits (*Lepus callotis*) in the Animas Valley in summer 1991. New Mexico Department of Game and Fish. Contract 519-69-04, Addendum to final report, 8 pp.
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*. New Mexico Department of Game and Fish. Contract 51665-23. Final Report: 9 pp.
Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, 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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.
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. Proc. U. S. Nat. Mus., 17:551-565.

(Organ Mountains) Colorado chipmunk, *Tamias quadrivittatus australis*

Distribution: The Colorado chipmunk (*Tamias 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; Carie 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).

Chipmunks were discovered in the Organ Mountains in 1903 by O. B. Metcalf (Bailey, 1932), and were initially regarded as *Eutamias cinereicollis cinereus* by Howell (1929) and Bailey (1932). Findley et al. (1975) regarded chipmunks from the Organ Mountains to be gray-collared chipmunks (*E. cinereicollis*). Investigations of bacular morphology indicated a close phyletic relationship between the Organ Mountains chipminks and northern populations of *E. q. quadrivittatus* (Patterson, 1980). As a result of this work, the Organ Mountains population of chipmunks was given subspecific status as *E. q. australis* (Patterson, 1980). Chipmunks were discovered in the Oscura Mountains in 1977 and were assigned to *E. quadrivittatus* as an undescribed subspecies (Patterson, 1980); however, the sample size of four adults was insufficient to assign this population subspecific status.

The distribution of the Organ Mountains Colorado chipmunk is limited to the Organ Mountains in southern New Mexico (Patterson, 1980). Habitat for this species is restricted to 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 6,000 and 7,300 ft (Patterson 1980; Sullivan and Smartt, 1990). The distribution of the Oscura Mountains Colorado chipmunk is limited to the Oscura Mountains at the northern end of the Tularosa Basin 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 (*Cerocarpus 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 soaptree yucca (*Yucca elata*) (Sullivan, 1996).

These species, 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. Colorado chipmunks generally breed in late spring (Bailey, 1932; Patterson, 1980); however, *T. q. oscuraensis* appears 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) Colorado chipmunk appears to

have a reproductive pattern intermediate to *T. q. quadrivittatus* to the north and *T. q. australis* to the south (Patterson, 1980; Sullivan, 1996). The early spring conception pattern of *T. q. oscuraensis* (Sullivan, 1996) is similar to that reported for *T. q. australis* (Patterson, 1980) and appears to coincide with periods of reduced water stress and increased food production.

Current Status: The Organ Mountains Colorado chipmunk was listed as threatened by the New Mexico Department of Game and Fish in 1983 (Jones and Schmitt, 1997). In 1987, the New Mexico Department of Game and Fish proposed in the addition of the Oscura Mountains population 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 New Mexico Department of Game and Fish listed the Oscura Mountains population in 1988 (Jones and Schmitt, 1997). The isolated, Oscura Mountains population was described as a new subspecies, *T. q. oscuraensis,* in 1996 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.

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 Colorado 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 is recommended. It is recommended that provisions under the Wildlife Conservation Act be initiated to list the Oscura Mountains Colorado chipmunk, *T. q. oscuraensis,* as a threatened subspecies rather than continuing to list it as an undescribed subspecies under the (Organ Mountains) Colorado chipmunk.

Literature Cited:

Bailey, V. 1932. Mammals of New Mexico. North American Fauna, 53:1-412.

Carie, W., J. D. Tyler, B. P. Glass, and M. A. Mares. 1989. Mammals of Oklahoma. University of Oklahoma Press, Norman, 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, 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. 467 pp.

Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 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*). N. Amer. 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. The Museum of Southwestern Biology, The 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.

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. New Mexico Department of Game and Fish, Santa Fe, New Mexico, Contract 515.6-75-01, progress report: 1-6.

Southern pocket gopher, *Thomomys umbrinus*

Distribution: The distribution of the Southern pocket gopher is restricted to a few mountain ranges in southeast

Arizona and the Animas Mountains in New Mexico (Findley et al., 1975; Hinesley and Thaeler, 1977; Cook, 1982; Hoffmeister, 1986). In New Mexico, the species is found mostly at elevations above 7,200 feet in the Animas Mountains as well as Indian Creek, Upper Deer Creek, and Lower Deer Creek (Hinesley and Thaeler et al., 1977; Cook, 1982).

Pocket gophers eat roots of various plant species that are encountered as they dig their burrow systems. Gophers 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) found pregnant females between mid-March and early April, with 2-3 embryos in each specimen.

Current Status: The New Mexico Department of Game and Fish listed the southern pocket gopher as endangered in 1975 (Jones and Schmitt, 1997). The primary reasons for listing the species were endemism and its restricted distribution in New Mexico. There are no population estimates for this species.

Threats: Habitat disturbance or alteration, as well as activities such as rodent control, could threaten the New Mexico population.

Recommendation: No change in listing status of the southern pocket gopher is recommended. Population surveys should be conducted to determine population status in New Mexico.

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. University of New Mexico, M.S. thesis.

Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, xxii + 360 pp.

Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 2nd ed., 1:xv +1-600 + 90.

Hinesley, L. L. and C. S. Thaeler, 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. The Museum of Southwestern Biology, The University of New Mexico. 290 pp.

Meadow jumping mouse, *Zapus hudsonius luteus*

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* is endemic to New Mexico and Arizona (Hafner et al., 1981). Hafner et al. (1981) reported this subspecies in 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 *Z. h. luteus* in all 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).

In the Sacramento Mountains, soil moisture, vegetative cover characteristics and composition, and proximity of permanent water were similar to other *Z. h. luteus* 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 shrubs.

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). Studies have suggested that the species persists in fair numbers in the areas from which it has been reported in New Mexico. Zwank et al. (1997) captured meadow jumping mice in all

habitats that they surveyed at Bosque del Apache National Wildlife Refuge. Recent findings indicate that *Z. h. luteus* utilizes irrigation ditches adjacent to agricultural areas in the Rio Grande Valley (Morrison, 1990).

Threats: As a result of the species' reliance on limited mesic grassland 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, livestock grazing, and water diversions. These threats are likely to be more severe in montane portions of its distribution.

Recommendation: No change in listing status of the meadow jumping mouse is recommended. The Department should continue to encourage land managers to protect and enhance known and potential habitats, and to monitor the success of measures designed to mitigate habitat impacts from road construction and other factors. Future investigations should focus on whether this species merits removal from the threatened list in New Mexico.

Literature Cited:

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, 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. The Museum of Southwestern Biology, The 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.

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 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 north-central mountains including the San Juan Mountains and the Sangre de Cristo Range (Findley et al. 1975). Reports of marten in the Jemez Mountains have not been substantiated. American marten 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.) has been identified as preferred marten habitat throughout the species range (Clark et al., 1987). The marten summer diet 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 et al., 1987). The gestation period of 8-9 months is long due to delayed implantation. Martens may avoid large clearings such as clear cuts or burned areas (Koehler and Hornocker, 1977; Soutiere, 1979).

Current Status: The American marten was listed as threatened by the New Mexico Department of Game and Fish 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 1990's through the collection of road-killed specimens by NMDGF. The species was also reported from the Taos Ski Valley during 1997-99 (NMDGF files). Recent surveys conducted by a NMDGF 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, NMDGF captured and radiocollared several marten in the 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 populations is isolated from other populations in the Sangre de Cristo range. In this study, radiocollared marten

utilized mature spruce-fir forest and talus slopes at elevations between 10,000 and 11,500 feet in elevation.

Threats: The primary threats to American marten in New Mexico include habitat degradation through harvesting in mature/old-growth forests, fire, and destruction of talus slopes within the species'range. Marten are also very susceptible to trapping, although there is currently no open season for marten in New Mexico.

Recommendation: No change in listing status of the American marten is recommended. Studies to better determine species distribution in the state should be conducted. A better understanding marten habitat use, population status, and population isolation is need to inform forest management practices.

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, xxii + 360 pp.

Hall, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 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. The Museum of Southwestern Biology, The 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.