United States Department of the Interior

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August 27, 2014

Cons. # 02ENNM00-2012-F-0021

Thomas Puto, Bridge Replacement Manager
U.S. Department of Transportation
Federal Highway Administration
Central Federal Lands Highway Division
12300 West Dakota Avenue, Suite 380A
Lakewood, Colorado 80228-2583

Dear Mr. Puto:

Thank you for your request to reinitiate the November 16, 2013, formal consultation with the U.S. Fish and Wildlife Service (Service) on the West Fork Gila River Bridge Replacement in Catron County, New Mexico (02ENNM00-2012-F-0021) for the narrow headed gartersnake (*Thamnophis rufipunctatus*) (gartersnake), a species recently listed as threatened under the Endangered Species Act (ESA) of 1973, as amended (16. U.S.C. 1531 et seq.). On June 24, 2014, we received your letter and an addendum to the Biological Assessment dated June 20, 2014, requesting formal conferencing for the gartersnake and its proposed critical habitat and a subsequent letter on July 17, 2014, requesting formal conferencing and reinitiation of November 16, 2013, biological opinion. You have requested reinitiation of formal consultation for the gartersnake and formal conferencing for proposed critical habitat. You confirmed that the addendum does not represent material changes to the project description for the proposed action, action area, or other conclusions of the 2012 Biological Assessment (BA) and supplemental emails used for the 02ENNM00-2012-F-0021 consultation, but specifically addresses potential effects to the gartersnake, its proposed critical habitat, and incorporates conservation measures for the gartersnake and its habitat into the action.

This reinitiation hereby incorporates by reference the 2012 biological assessment (BA) and the supplemental emails used for the final November 16, 2013, biological opinion, the final November 16, 2013 biological opinion, the June 20, 2014, Biological Assessment Addendum, and your letter dated July 17, 2014 with your effects determinations. This biological opinion is in addition to, and supplemental to, the November 16, 2013 biological opinion. The purpose of this project is to address the inadequate hydraulic capacity of the existing bridge to provide safer and more reliable vehicular access across the West Fork Gila River (project). The action area is 1.38 hectare (3.34 acres) of flood plain and channel of the West Fork Gila River located at latitude 33.2259 and longitude -108.251 in Catron County, New Mexico.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of designated critical habitat from 50 Code of Federal Regulations (CFR) 402.02. Instead, the Service relies on the statutory provisions of the ESA to complete the analysis with respect to critical habitat. The potential for destruction or adverse modification of critical habitat is assessed by determining the effects of the proposed Federal action on the primary constituent elements (PCEs) of critical habitat that are essential to the conservation of the species. These anticipated effects are then analyzed to determine how they will influence the function and conservation role of the affected critical habitat. This analysis provides the basis for determining the significance of anticipated effects of the action on critical habitat. The threshold for destruction or adverse modification is evaluated in the context of whether the critical habitat will remain functional to serve the intended conservation role for the species.

Consultation History

Technical assistance and informal consultation was initiated on October 19, 2011, when the Federal Highway Administration (FHWA) requested to have a scoping meeting to discuss development of New Mexico Highway 15 Bridge replacement. Several correspondences occurred to assist FHWA to complete their biological assessment. The FHWA submitted a BA for the project on December 19, 2012, requesting formal consultation on the effects of the replacement of the West Fork Gila River Bridge on NM15. Formal consultation was initiated on January 23, 2013, and the final biological opinion was issued on November 16, 2013. Additional correspondence between FHWA and Michelle Christman occurred throughout the consultation regarding the incorporation of conservation measures to minimize effects to the gartersnake and its habitat, although no formal conferencing for the species occurred at that time. The final November 16, 2013 biological opinion and this biological opinion are based on information provided in the BA, BA addendum, subsequent emails and telephone conversations between our staff, and data in our files. A complete administrative record of this consultation is on file at this office.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed action is located on the West Fork Gila River (River) near the Gila Cliff Dwellings National Monument in Catron County, New Mexico. The project area is on New Mexico State Highway 15 in the Gila National Forest (Forest) and Heart Bar Wildlife Area, about 70.8 km (44.0 mi) north of Silver City, New Mexico. The Gila Cliff Dwellings National Monument is also accessed via this route. The legal is located at New Mexico, New Mexico Meridian; latitude/longitude 33.2259, -108.2514 (North American Datum 1983); and UTM zone 12 (X, Y) 756150 N, 3679696 E (Figure 1).

FHWA proposes to replace the existing bridge with a new bridge of sufficient hydraulic capacity to prevent the types of failures that have been occurring. Preliminary design has identified replacing the existing 29 meter (m) (95 feet (ft)) bridge with a new three-span, precast concrete

prestressed girder bridge approximately 62 m (205 ft) in length. Piers can be either solid wall type or individual columns and with the unpredictability of the flow direction in the future, individual column piers will likely be used. Piles and drilled shafts are the two principal foundation types for this type of soil. Upon completing the geotechnical investigation, recommendations will be provided for the foundation type to be used.

It is anticipated that the road will remain open during construction to maintain access to the Gila Cliff Dwellings. The existing bridge will remain in place until a new bridge is constructed approximately 4 to 6 m (15 to 20 ft) downstream of the existing structure. Based on the current location of the wetted channel, the proposed bridge would be perpendicular to the streambed and the piers and abutments would be outside of the current existing stream channel. However, it is acknowledged that stream movement may occur prior to construction. Embankment stabilization measures and abutment protection likely in the form of riprap, wire-enclosed riprap, or concrete block revetment will be provided. In addition, it is anticipated that an at-grade weir (approximately 52 to 61 m (170 to 200 ft) long and a few feet wide) outside the stream channel, but within the floodplain, will be hardened to provide for erosion control in case of very large storm events.

Once the new bridge and roadway approaches are constructed, traffic movement will be transferred to the new bridge and the existing bridge will be demolished. The surrounding riprap and embankment up to the new bridge will be excavated and removed, and the existing piers and abutments will be cut below grade and backfilled. The stream channel will be widened and graded to match the hydraulic opening of the newly constructed bridge, with a transition upstream and downstream being provided. The stream channel will be regraded and restored to natural contours. The new bridge opening will be substantially wider, allowing for greater future movement of the stream channel within the floodplain and greater flood capacity.

Where construction activities will affect the wetted channel through excavation or demolition, the channel will be diverted and separated with some type of barrier. A preliminary design drawing for the project is provided (Figure 1). It is estimated that approximately 914 square meter (m^2) (3,000 square feet (ft^2)) of the wetted channel will be impacted from removal of the existing bridge, stream diversion, and regrading/restoring the stream channel.

Roadway realignment may result in minor changes in habitat including removal of grasses, forbs, and some shrubs. Scrub-shrub and riparian habitat along the West Fork Gila River may be affected by project activities. The effects are expected to be minor since construction activities and widening will occur in areas that have been previously disturbed. Standard construction equipment will be used. Construction is anticipated to last 9 to 12 months. Fish and amphibians will be salvaged from the project area and translocated upstream. This will be accomplished by enclosing the project area with block nets at the upstream and downstream ends and then capturing fish and amphibians in the project area using multiple-pass electrofishing and seining. The block nets will remain in place during in-stream project implementation to prevent fish from re-entering the project area.

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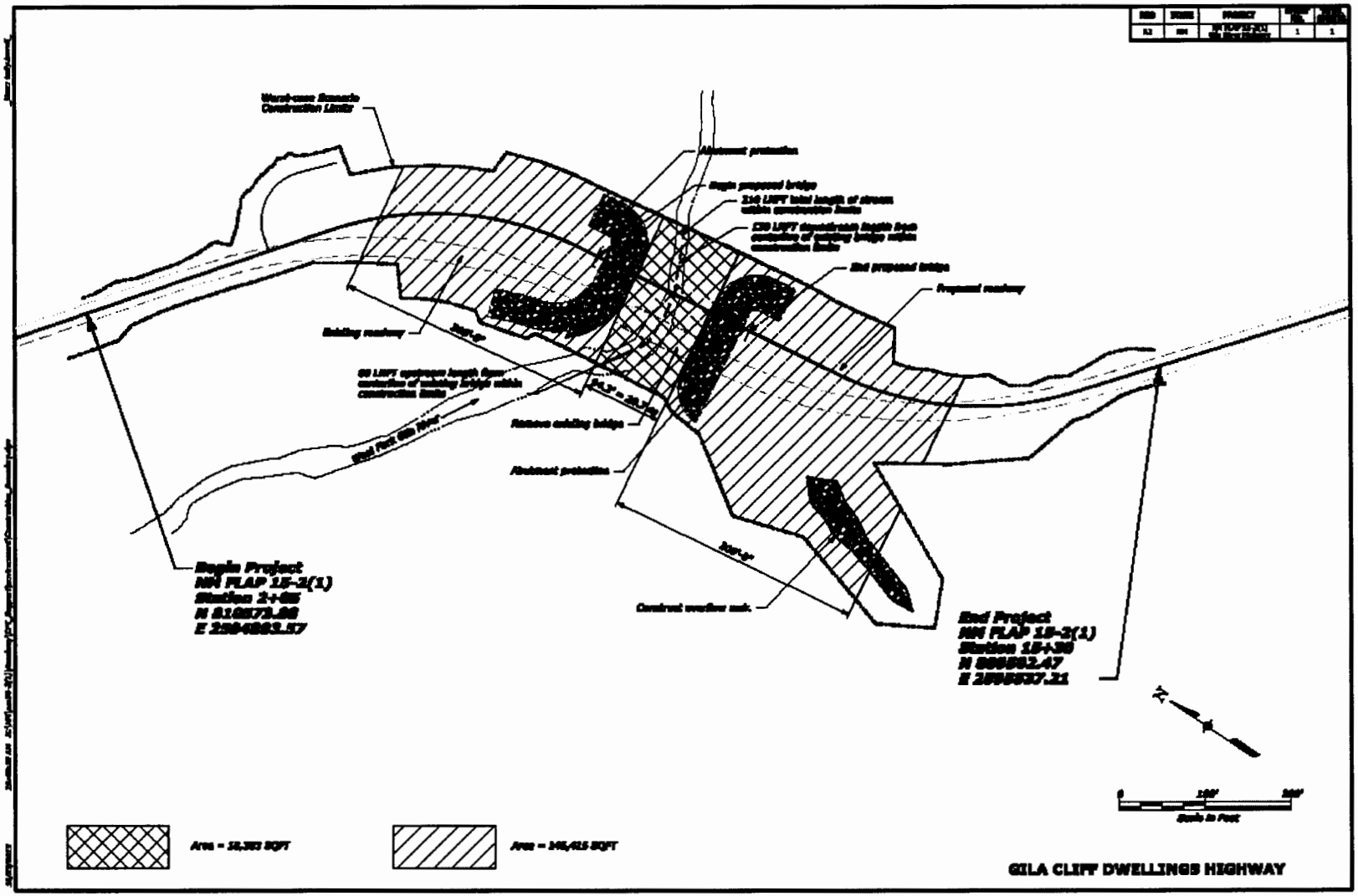

Figure 1. Construction boundary limits for the New Mexico High 15 Bridge Replacement Bridge Replacement.

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Conservation Measures

The FHWA will implement the following measures either as part of the action, or, as required in the final biological opinion (November 16, 2013) to minimize impacts to federally listed species potentially occurring in the action area:

1. The contractor(s) employed for the proposed work attend a preconstruction meeting, which will include specific instruction on the implementation of terms and conditions of the final biological opinion (November 16, 2013) and this biological opinion.

2. A figure showing the project boundary of the allowed disturbance under the incidental take statement will be included in project plans (construction limits). This figure and the terms and conditions will be posted and available on site at all times during construction.

3. Both upstream and downstream construction limits shall be clearly marked for construction crews to avoid disturbance outside the project area.

4. During low flow conditions, detour roads shall be constructed in a manner such that stream flow is maintained or redirected.

5. Prior to construction occurring in the wetted channel, fish, amphibians, and snakes will be salvaged from the project area and relocated outside the action area. A block net will be installed upstream and downstream of the project area when construction occurs in the wetted channel to exclude fish and amphibians. The block nets will be maintained and kept free of debris during use to prevent damage that would allow fish and amphibians to enter the project area.

6. Prior to construction beginning, narrow-headed gartersnakes will be salvaged/moved from the project area and translocated outside the action area, and exclusionary fencing will be placed to prevent or minimize potential re-entry during construction. Fencing will be placed and maintained through construction, regardless if narrow-headed gartersnakes are yielded during capture efforts.

7. To the extent practicable, FHWA will complete as much in-stream construction activity as possible outside the months of August and September in an effort to minimize impacts to gartersnake dispersal. If work must be completed in the stream during the months of August and September, a qualified biologist will re-survey the project area and translocate any found gartersnakes outside the action area.

8. Motorized equipment shall be confined to areas outside of the wetted channel, with the exception of activities related to bridge removal, channel bank protection, and road

rerouting construction. The detour road shall be used to transport equipment from one side of the river rather than crossing the wetted channel.

9. Soil disturbance and vegetation clearing will be limited to the maximum extent possible.

10. Temporary work roads should not cause erosion and sedimentation of New Mexico Highway Bridge 15 or alteration of the streambed. Work roads shall be made of nonerosive rock materials to minimize siltation.

11. Once a work road is no longer needed, fill material shall be removed and the natural contours of the stream channel and bank restored to the maximum extent possible.

12. Vegetation appropriate to the project area shall be established in areas disturbed during construction as soon as possible.

13. Water needed for construction and restoration shall be obtained from a source other than the river, and shall not come from any surface water or natural body of water, to avoid the introduction of aquatic pathogens.

14. Spill response materials, such as booms and absorbent pads will be available on-site at all times during the project. Any spill will be reported to appropriate agencies, including the Service.

15. All construction equipment will be inspected for fluid leaks prior to construction.

16. All construction equipment will be washed prior to construction to prevent the introduction of invasive species seeds from earthmoving or hauling.

17. Time spent in the wetted channel will be minimized to the maximum extent possible to reduce disturbance to aquatic species.

18. All in-stream work will be scheduled to occur during historical low-flow periods. Flow will be diverted around the in-channel work area using barriers.

19. Prior to construction occurring in the wetted channel, fish, amphibians, and snakes will be salvaged from the project area and translocated outside the action area.

20. A block net will be installed upstream and downstream of the project area when construction occurs in the water to exclude fish, amphibians, and snakes. The block nets will be maintained and kept free of debris during use to prevent damage that may allow passage of fish and amphibians.

21. The project will adhere to all terms and conditions under the Clean Water Act, such as the U.S. Army Corps of Engineers Section 404 permit and 401 water quality certification from the New Mexico Environment Department (NMED).

STATUS OF THE SPECIES

Narrow-headed gartersnake

A summary of the species and its habitat can be found in the final rule for listing published on July 8, 2014 (79 FR 38677) and proposed Critical Habitat published on July 10, 2013 (78 FR 41549), and the associated Appendix A, "Current Population Status of Northern Mexican and Narrow-headed Gartersnakes in the United States" (Service 2013). These documents are hereby incorporated by reference.

The narrow-headed gartersnake ranges from north-central Arizona southeastward to southwestern New Mexico, and from northern Chihuahua to northern Durango, Mexico. In New Mexico, the species is confined to Catron, Grant, and Hidalgo counties where it reaches the northern and eastern edge of its overall distribution. It is a habitat specialist, occurring only in shallow, swift-flowing, rocky rivers and streams of the San Francisco and Gila River drainages. It feeds almost exclusively on fish. Within New Mexico, extensive surveys suggest a disappearance of the species from the area of the San Francisco Hot Springs in Catron County near Glenwood, the site of a previously robust population. Surveys from 2009 indicate that populations of narrow-headed gartersnakes under investigation at the Heart Bar Wildlife Management Area in Catron County, and the Gila River Bird Area near Cliff, Grant County, may be persisting at very low numbers or possibly extirpated. 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 heavy siltation, stream channelization, and the elimination of undercut banks. Streambed siltation may cause impaction of streambed rocks and eliminate habitat, as has been speculated in the disappearance of a robust population of the species at San Francisco Hot Springs. In central Arizona, population declines were associated with presence of non-native "spiny-rayed" fishes (i.e., the sunfishes *Micropterus* and *Lepomis*, family Centrarchidae), habitat destruction and modification due to increased recreation and siltation. Loss of native fish species and increases in non-native spiney-rayed fishes are considered a primary threat to the gartersnake. Localized mortality has been observed in association with channel-altering flood events, direct predation by humans, and roadkills. Narrow-headed gartersnakes exhibit highly specialized life history traits, including feeding almost exclusively on fish, use of specific habitats for foraging (clear, rock-boulder strewn streams), evolved mechanisms for increased underwater visual and foraging capabilities, and low dispersal capacity. These traits render the species to be highly susceptible to environmental change, especially climate change. Critical habitat in New Mexico is proposed for the San Francisco River drainage in Catron County, including the Tularosa River, Saliz Creek, South Fork Negrito Creek, Whitewater Creek, and Dry Blue Creek tributaries; and in the upper Gila River basin downstream to the Arizona state line, including the forks, Gilita Creek, Iron Creek, Little Creek, Diamond Creek, Black Canyon, and Turkey Creek tributaries.

ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the Act, when considering the effects of the action on federally listed species, we are required to take into consideration the environmental baseline. Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. We are specifically incorporating by reference the environmental baseline for spikedace and loach section from the final biological opinion (November 16, 2013) and applying the information to the narrow headed gartersnake.

Description of the Action Area

The action area for the project includes the area affected by the construction of the roadway, bridges and approaches where direct and indirect effects to federally listed species may reasonably be expected to occur. Given that the project occurs within the River flood plain and channel, and that the drainage features within the project site flow into the River, the action area includes approximately 1.35 hectares (3.34 acres) area affected by construction activities. However, only 0.17 hectares (0.42 acres) of that area will directly effects the River, which is approximately 64 m (210 ft) linear distance of stream habitat. This area encompasses a segment of the River, which is considered to be occupied by the gartersnake directly in the immediate project area or adjacent.

The aquatic habitat in the action area consists of a complex of riffles, runs, pools and overbank/backwater areas with a mixture of silt, sand, gravel, cobble, and detritus substrate.

The majority of the vegetation consists of upland shrubland dominated by sand sagebrush (*Artemisia filifolia*), and rubber rabbitbrush (*Ericameria nauseosa*) with a blue grama (*Bouteloua gracilis*) and sand dropseed (*Sporobolus cryptandrus*) understory. Other upland communities observed within the action area consist of pinyon-juniper woodlands and ponderosa pine woodlands. Riparian woodland occurs within the upstream limits of the action area and is dominated by narrowleaf (*Populus angustifolia*) and Fremont cottonwood (*P. fremontii*). Much of the riparian woodland adjacent the action area was burned during the 2011 Miller fire. Riparian shrubland also occurs along the River. Bluestem willow (*Salix irrorata*) and regenerating narrowleaf and Fremont cottonwood (less than 6 m (20 ft) tall) are the dominant species of the shrubland. Other shrubs in riparian areas include sandbar willow (*S. exigua*), sand sagebrush, and rubber rabbitbrush, obligate wetland, and facultative upland or obligate upland species. Small fringe wetlands also occur within the action area. Dominant plant species along wetland fringes consist of cattail (*Typha* spp.), Emory's sedge (*Carex emoryi*), water speedwell (*Veronica anagallis-aquatica*), water crowfoot (*Ranunculus aquatalis*), field mint (*Mentha arvensis*), lady's thumb (*Persicaria maculosa*), Kentucky bluegrass (*Poa pratensis*), fowl bluegrass (*Poa palustris*), and creeping spikerush (*Eleocharis palustris*).

Status of the Species and Status of the Critical Habitat within the Action Area

The status of the species within the action area is not well understood, with a single recent observation of a gartersnake in the action area in 2011. While the status of the gartersnake in the action area may not be well-studied at this time, the area is not known to house a robust population of gartersnakes. On the small scale of the action area, the individual observation could have been either a resident snake, or a snake dispersing through the habitat. On a larger scale, approximately 37.2 stream miles (59.9 kilometers) of the West Fork Gila River and 5,169 acres (2,092 hectares) are proposed as critical habitat and considered occupied. Within the proposed action area, the amount of proposed critical habitat is approximately 3.34 acres (1.35 hectares). The proposed critical habitat is sparsely vegetated with upland and riparian shrubs as described above. Historically, the West Fork Gila River maintained large populations of bullfrogs and nonnative, spiny-rayed fish. As a result of ash and sediment flows following the 2012 Whitewater-Baldy Complex Fire, these harmful nonnative species may have been reduced (bullfrogs) or possibly eliminated (spiny-rayed fish). The West Fork Gila River subunit contains sufficient physical or biological features, including PCEs 1(aquatic habitat characteristics), 2 (terrestrial habitat characteristics), and 4 (absence or low level of harmful nonnative species), but PCE 3 (prey base) may be deficient. Special management may be required to maintain or develop the physical or biological features, including the preventing the reinvasion of harmful nonnative species and the reestablishment of native prey lost as a result of the 2012 Whitewater-Baldy Complex Fire. Moreover, effects from the Whitewater-Baldy Complex Fire to the gartersnake and its habitat have not been assessed.

Factors affecting the Species' Environment within the Action Area

Factors affecting the species' environment are addressed in the final November 16, 2013, Biological Opinion for spikedace and loach minnow. Because the narrow headed gartersnake is a highly aquatic gartersnake, is strictly piscivorous, and is affected by the same threats as native fish (loss of native fish and increases in non-native fish are the primary threats facing the narrow headed gartersnake), we are incorporating and applying the description of factors affect spikedace and loach minnow's environment within the action area section to the narrow headed gartersnake.

EFFECTS OF THE ACTION

Direct Effects of the Action

Suitable habitat for the narrow-headed gartersnake occurs within the project's action area, and the narrow-headed gartersnake was documented in the action area in 2011. FHWA will minimize direct effects to the gartersnake with preconstruction surveys and trapping to attempt to capture narrow-headed gartersnakes in the action area and translocate them outside of the action area. FHWA will also place exclusionary fencing on the upstream and downstream ends of the work area, extending into the uplands, to prevent or minimize potential for re-entry into the construction area during construction. Fencing will be placed and maintained through

construction, regardless if narrow-headed gartersnakes are yielded during capture efforts. To the extent practicable, FHWA will also complete as much construction activity as possible outside the months of August and September in an effort to minimize impacts to young narrow-headed gartersnake dispersal. If work must be completed in the stream during the months of August and September, a qualified biologist will re-survey the project area and translocate any found gartersnakes outside the project area. Despite these measures, some individuals may be missed, as this species is highly secretive, well-camouflaged, and difficult to detect when present. Furthermore, snakes that are not detected or captured during pre-construction work will still be present in the construction area and may be injured or killed from the construction machinery. Finally, the fencing barriers will be placed to reduce the opportunities for snakes to enter the construction area during construction (either those already outside of the action area, or those translocated outside of the action area), but may still evade the fencing barrier and return to the construction area. Any snakes that enter the area subsequent to erecting the fencing barrier may also be injured or killed.

Indirect Effects of the Action and Effects of the Action on Proposed Critical Habitat

Because the indirect effects of the action are linked to effects to the proposed critical habitat PCEs, we have combined the indirect effects of the action and the effects of the action on proposed critical habitat analyses. In general, individuals may be indirectly affected by the project through temporary or permanent alteration of habitat, including removal or modification of adjacent riparian habitat and cobble, gravel substrate, alteration of aquatic habitat, and potential for sediment and erosion to alter habitat or through affecting fish prey species.

This species is strongly associated with clear, rocky streams, using predominantly pool and riffle habitat that includes cobbles and boulders (Rosen and Schwalbe 1988, pp. 33–34; Degenhardt et al. 1996, p. 327; Rossman et al. 1996, p. 246; Ernst and Ernst 2003, p. 417); however, bankline vegetation is also important. Narrow-headed gartersnakes prefer to use shrub and sapling-sized plants for thermoregulating (basking) at the waters' edge (Degenhardt et al. 1996, p. 327). The action area includes riffle and run habitat with an average depth of 0.5 feet, and pool habitat with an average depth of 2.5 feet. The action area generally does not contain the greater depth pool habitat (deeper than 40 inches) that has been associated with higher densities of narrow-headed gartersnakes (Rosen and Schwalbe 1988, p. 35). Bankline vegetation is sparse in the project area, with the riparian area at the existing bridge currently confined due to the short length of the bridge. Adequate erosion and sediment control will also be used throughout construction, and revegetation of disturbed areas with native vegetation will occur following construction. The project itself is expected to benefit the habitat over the long term by providing a bridge structure of substantially increased length, thereby increasing the floodplain in this area. The intent of the project is to increase stability and prevent the repeated failures that have occurred in the past, which has involved loss of roadway embankment and delivery of sediment to the river. This increased stability and revegetation will likely benefit the species in the long-term, but have short-term, temporary negative impacts. You have specifically identified the following (Table 1) potential impacts to gartersnake proposed critical habitat and PCEs with measures to eliminate, reduce, or repair features affected by the action.

Table 1. Impacts and proposed mitigation measures for PCEs within the project area.

PCE	Impact	Mitigation
1) Stream habitat, which includes: a) Perennial or spatially intermittent streams with sand, cobble, and boulder substrate and low or moderate amounts of fine sediment and substrate embeddedness, and that possess appropriate amounts of pool, riffle, and run habitat to sustain native fish populations; b) A natural, unregulated flow regime that allows for periodic flooding or, if flows are modified or regulated, a flow regime that allows for adequate river functions, such as flows capable of processing sediment loads; c) Shoreline habitat with adequate organic and inorganic structural complexity (e.g., boulders, cobble bars, vegetation, and organic debris such as downed trees or logs, debris jams), with appropriate amounts of shrub- and sapling-sized plants to allow for thermoregulation, gestation, shelter, protection from predators, and foraging opportunities; and d) Aquatic habitat with no pollutants or, if pollutants are present, levels that do not affect survival of any age class of the narrow-headed gartersnake or the maintenance of prey populations.	Temporary modification of 1.35 ha (3.34) acres proposed designated critical habitat. Temporary alteration of microhabitat will occur from construction activities within the stream channel. No permanent change to stream gradient will occur. In stream construction activities may result in short-term, temporary increase in substrate and embeddedness downstream. Long-term beneficial impact by reduction of sediment and embeddedness in the action area. Temporary effect to stream flows will occur from diversion of primary base flows during construction. The project will not permanently alter the base flows of the West Fork Gila River. Removal of vegetation along the WFGR banks which may affect shelter and foraging habitat, habitat for egg deposition, thermoregulation or basking areas, and habitat for prey. Revegetation of the shoreline along an increased length of bridge will provide long-term benefits. Temporary increase in pollutant levels from construction equipment.	Time spent in the open water channel will be minimized to the greatest extent possible to reduce disturbance to aquatic species. Spill response materials, such as booms and absorbent pads will be available on-site at all times during the project. Any spills will be reported to appropriate agencies. All construction equipment will be washed prior to construction to prevent introduction of invasive species seeds from earthmoving or hauling.

PCE	Impact	Mitigation
(2) Adequate terrestrial space (600 ft (182.9 m) lateral extent to either side of bankfull stage) adjacent to designated stream systems with sufficient structural characteristics to support life-history functions such as gestation, immigration, emigration, and brumation.	Removal of vegetation along the WFGR banks which may affect shelter and foraging habitat, and habitat for prey. Revegetation of the shoreline along an increased length of bridge will provide long-term benefits.	Prior to construction occurring, snakes will be salvaged from the project area and translocated outside the action area where adequate food supplies exist. Also, exclusionary fencing will be placed to prevent or minimize potential for snakes re-entering the project area from other areas containing adequate food supplies. Soil disturbance and vegetation clearing will be limited to the greatest extent possible.
(3) A prey base consisting of viable populations of native fish species or soft-rayed, nonnative fish species.	Short-term loss or reduction of food sources due to in-stream construction activities.	Prior to construction occurring, snakes will be salvaged from the project area and translocated outside the action area where adequate food supplies exist. Also, exclusionary fencing will be placed to prevent or minimize potential for snakes re-entering the project area from other areas containing adequate food supplies.
(4) An absence of nonnative fish species of the families Centrarchidae and Ictaluridae, bullfrogs (*Lithobates catesbeianus*), and/or crayfish (*Orconectes virilis*, *Procambarus clarki*, etc.), or occurrence of these nonnative species at low enough levels such that recruitment of narrow-headed gartersnakes and maintenance of viable native fish or soft-rayed, nonnative fish populations (prey) is still occurring.	Project will have no effect on non-native aquatic species levels.	

There will be temporary impacts to approximately 3.3 acres of proposed designated critical habitat; this will constitute approximately 0.006% of proposed designated critical habitat in the Upper Gila River Subbasin unit and 0.002% of the overall proposed designated critical habitat. In the long term, it is anticipated that habitat conditions will be improved over the existing conditions and that any effects to PCEs and habitat will be temporary. Therefore you

have determined, and we agree, that the project will not destroy or adversely modify proposed critical habitat of the narrow-headed gartersnake.

Effects of the proposed action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The Service anticipates that the local population of narrow-headed gartersnakes occupying that portion of the River within and immediately downstream of the action could be adversely affected by the project. These potential adverse effects may include temporary alteration of habitat, including removal or modification of adjacent riparian habitat and cobble, gravel substrate, alteration of aquatic habitat, and potential for sediment and erosion to alter habitat or through affecting fish prey species.

The PCEs are expected to return once the project is complete. Temporary effects to PCEs that may occur in the downstream of the action area include a reduction in the flow rate, substrate embeddedness, and affects to the prey base resulting from a decrease in the abundance of their aquatic food base (invertebrates), and increases in fine sediment. These downstream changes are expected to be temporary during project implementation, and are expected to return preconstruction conditions.

This project area would most likely maintain the proposed PCEs for the gartersnake now and in the future. Recurring effects to PCEs that may occur in the action area include changes to the flow, amount of fine sediment and substrate embeddedness, contaminants, and the aquatic food base. These effects would not measurably reduce the ability of the designated critical habitat to contribute to the recovery for gartersnakes.

The action's limited effects to the PCEs are not likely to appreciably diminish or preclude the role of the critical habitat in the survival and recovery of the species.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions on endangered or threatened species or designated critical habitat that are reasonably certain to occur in the foreseeable future in the action area considered in this biological opinion. Future Federal actions that are unrelated to the action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Cumulative effects analysis as stated here applies to section 7 of the ESA and should not be confused with the broader use of this term in the National Environmental Policy Act or other environmental laws.

Actions that may cumulatively affect gartersnakes in the action area include construction activities involving heavy equipment operating in the stream channel, temporary diversion of the stream, and gartersnake translocation activities. While these actions may require permits under the Clean Water Act, there are many examples of unpermitted activities on private lands inholdings within the action area.

Wildfires are another source of cumulative effects. Although these fires occur on Forest Service lands, they are started by lightning strikes, and are not planned. Consequently, the Forest Service does not consult on these fires except after-the-fact, as an emergency consultation. Therefore, the effects of these fires are not analyzed until after the action and impacts occur (i.e., ash flows).

CONCLUSION

Pursuant to 50 CFR 402.02, jeopardize the continued existence of means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

Narrow-headed Gartersnake

After reviewing the current status for the narrow-headed gartersnake, the environmental baseline for the action area, the effects of the project, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the narrow-headed gartersnake and is not likely to destroy or adversely modify proposed critical habitat. However, the project may result in the incidental take of gartersnakes and temporary negative impacts to designated critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting, or attempting to engage in any such conduct. Harass is further defined by us as intentional or negligent actions that creates the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Harm is further defined by us to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of the agency action is not considered a prohibited taking under the ESA

provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the FHWA so that they become binding conditions of any grant or permit issued to the applicants, as appropriate, for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by this incidental take statement. If the FHWA 1) fails to assume and implement the terms and conditions or 2) fails to require the applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FHWA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

Narrow-headed gartersnake

Based on the best available information for the gartersnake, the habitat needs of this species, the project description, and information provided by the FHWA, take is considered likely for the gartersnake during the proposed action. Take of the gartersnake is expected in the forms of harm and harass due trapping, capture, and translocation of snakes out of the action area. Injury, harm, or death due to heavy equipment is expected to be rare, but may occur if snakes avoid detection or capture during pre-construction surveys and trapping, or if snake evades the fencing barriers and enters the construction area. Although we expect a low likelihood of gartersnakes being present due to low densities in the action area, we anticipate that some individuals will be harassed. Harassment may occur through displacement from optimal habitat, reduction in prey base, and potential disruption of reproductive activities. Because of the presumed low density of this species in and around the action area, we anticipate the total number of gartersnake to be taken as a result of the proposed action to be small. We do not anticipate the number of gartersnakes to be harassed resulting from the removal from the action area to be more than 10 individuals. We do not anticipate any gartersnakes that are trapped, captured, or relocated to be injured or killed from those activities. Furthermore, because gartersnakes are difficult to detect because they are secretive, well-camouflaged, and small-bodied, it will be difficult to estimate the number of snakes that remain in action area and may be injured or killed by the action. However, because the best practicable and reasonable measures are being undertaken by FHWA to reduce the potential for gartersnakes to be present in the action area during construction and thus in harm's way, the number of gartersnakes remaining in the action area and susceptible to injury or mortality will be greatly reduced . Nevertheless, the number is not quantifiable, and thus we quantify the take in terms of habitat impacted. It is estimated that harm gartersnakes will occur over approximately 3.34 acres (1.35 ha) within the project area.

EFFECT OF THE TAKE

Narrow-headed Gartersnake

We have determined that the level of take described above is not likely to result in jeopardy to the gartersnake or destruction or adverse modification of its proposed critical habitat.

REASONABLE AND PRUDENT MEASURES

No additional reasonable and prudent measures are necessary for the action addressed in this biological opinion because the stated conservation measures in your BA and BA Addendum; and the reasonable and prudent measures, and non-discretionary terms and conditions found in the November 6, 2013 biological opinion minimize incidental take that might otherwise result from the proposed action . The effort to capture and keep gartersnakes out of harm's way will minimize take from construction activities, and the gartersnake should benefit in the long-term from the proposed project.

Reporting Requirements/Disposition of Dead or Injured Listed Animals

All reports should be electronically submitted via email to nmesfo@fws.gov. Contact the project biologist, Melissa Mata-Gonzales, at 505-761-4743 or melissa_mata@fws.gov, or if for gartersnakes, the NM lead biologist, Michelle Christman, at 505-761-4715 or michelle_christman@fws.gov. If neither are available, contact the front desk at 505-346-2525 for immediate help.

Upon finding a dead or injured listed animal, initial notification must be made to the Service's Division of Law Enforcement, 4901 Paseo Del Norte NE, Suite D, Albuquerque, New Mexico, 87113 (505-346-7828) within 3 working days of the finding. Written notification must be made within 5 calendar days and include the date, time, and location of the animal, a photograph, and any other pertinent information. Care must be taken in handling injured animals to ensure effective treatment and care and in handling dead specimens to preserve biological material in the best possible condition. If feasible, the remains of intact specimens of listed animals shall be submitted as soon as possible to the nearest Service or NMDGF office, educational, or research institutions (e.g., University of New Mexico, Museum of Southwest Biology) holding appropriate State and Federal permits.

CLOSING STATEMENT

This concludes formal consultation on the New Mexico Highway 15 Bridge replacement project. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may adversely affect listed species or designated critical habitat in a manner or to an extent not considered in this biological opinion; 3) the action is subsequently modified in a manner that causes an effect to a listed species or designated critical habitat that was not considered in this Biological Opinion; or 4) a new species

is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation of consultation with the Service.

We appreciate the FHWA's efforts to identify and minimize effects to federally listed species from this project. In future communications regarding this Bridge Replacement project please refer to consultation number 02ENNM00-2012-F-0021. If you have any questions or would like to discuss any part of this biological opinion, please contact Melissa Mata-Gonzales or Michelle Christman of my staff at (505) 761-4743 or melissa_mata@fws.gov or (505) 761-4715 or michelle_christman@fws.gov.

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Sincerely,

Wally Murphy
Field Supervisor

Enclosure

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, NM (electronic copy)
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, NM (electronic copy)
Federal Highway Administration, New Mexico Division, Greg Heitmann, Santa Fe, NM (electronic copy)
New Mexico Department of Transportation, Environmental Division, Black Rouxlau, Sante Fe, NM (electronic copy)

LITERATURE CITED

Abarca, F. J. 1987. Seasonal and diel patterns of feeding in loach minnow. Proceedings of the Desert Fishes Council 19:20.

Anderson, R. M. 1978. The distribution and aspects of the life history of *Meda fulgida* in New Mexico. New Mexico State University, Las Cruces, New Mexico.

Anderson, A. A., and D. A. Hendrickson. 1994. Geographic variation in morphology of spikedace, *Meda fulgida*, in Arizona and New Mexico. Southwestern Naturalist 39:148–155.

Arizona Game and Fish Department (AZGFD). 1996. Wildlife of species of concern in Arizona. Draft Arizona Game and Fish Department. Phoenix, Arizona. http://www.azgfd.gov/pdfs/w_c/heritage/heritage_special_concern.pdf. Accessed October 3, 2011.

Arizona State University. 2002. Lower Colorado River Basin fish database (SONFISHES). http://www.peter.unmack.net/gis/fish/colorado. Accessed December 5, 2011.

Armour, C.L., D.A. Duff, and W. Elmore. 1991. The effects of livestock grazing on riparian and stream ecosystems. Fisheries 16(1):7-11.

Barber, W. E., and W. L. Minckley. 1983. Feeding ecology of a southwestern cyprinid fish, the spikedace, *Meda fulgida* Girard. Southwestern Naturalist 28:33–40.

Barber, W. E., D. C. Williams, and W. L. Minckley. 1970. Biology of the Gila spikedace, *Meda fulgida*, in Arizona. Copeia 1970:9–18.

Belsky, A. J., and D. M. Blumenthal. 1997. Effects of livestock grazing on stand dynamics and soils in upland forests of the Interior West. Conservation Biology 11:315–327.

Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54:419–431.

Bestgen, K. R., and D. L. Propst. 1986. Red shiner versus native fishes: replacement or displacement? Proceedings of the Desert Fishes Council 18:209.

Bozek, M. A., and M. K. Young. 1994. Fish mortality resulting from delayed effects of fire in the Greater Yellowstone Ecosystem. Great Basin Naturalist 54:91–95.

Britt, K. D. 1982. The reproductive biology and aspects of life history of *Tiaroga cobitis* in southwestern New Mexico. M.S. Thesis, New Mexico State University, Las Cruces,

New Mexico.

Brown, D. K., et al. 2001. Catastrophic wildfire and number of populations as factors influencing risk of extinction for Gila trout (*Oncorhynchus gilae*). Western North American Naturalist 61:139–148.

Carveth, C. J., A. M. Widmer and S. A. Bonar. 2006. Comparison of upper thermal tolerances of native and nonnative fishes in Arizona. Transaction of the American Fisheries Society 135:1433–1440.

Chamberlin, T. W., R. D. Harr, and F. H. Everest. 1991. Timber harvesting, silviculture, and watershed processes. Pages 181–205 in W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, Maryland.

Christensen, N. S., et al. 2004. The effects of climate change on the hydrology and water resources of the Colorado River Basin. Climatic Change 62:337–363.

Church, J.A., et al. 2010. Sea-level rise and variability: synthesis and outlook for the future. Pages 402-419 in J. A. Church, P. L. Woodworth, R. Aarup, and W. S. Wilson, editors. Understanding sea-level rise and variability. Wiley-Blackwell, New York, New York.

Clary, W. P., and B. F. Webster. 1989. Managing grazing riparian areas in the intermountain region. USDA Forest Service Intermountain Research Station General Technical Report INT-263.

Clary, W.P., and D.E. Medin. 1990. Differences in vegetation biomass and structure due to cattle grazing in a northern Nevada riparian ecosystem. USDA Forest Service Intermountain Research Station Research Paper INT-427.

Comiso, J. C., C. L. Parkinson, R. Gersten, and L. Stock. 2008. Accelerated decline in the Arctic sea ice cover. Geophysical Research Letters 35(L01703):1–6.

Cooper, C. F. 1960. Changes in vegetation, structure, and growth of southwestern pine forest since white settlement. Ecological Monographs 30:129–164.

Desert Fishes Team. 2003. Status of federal and state listed warm water fishes of the Gila River Basin, with recommendations for Management. Desert Fishes Team Report Number 1. Phoenix, Arizona. http://www.nativefishlab.net/publications/DFT_Report_No1_Final.pdf. Accessed December 5, 2011.

Donahue, D. L. 2000. The western range revisited: removing livestock from public land to conserve native biodiversity. University of Oklahoma Press, Norman, Oklahoma.

Duce, J. T. 1918. The effect of cattle on the erosion of cañon bottoms. Science 47:450–452.

Erman, D. C., E. D. Andrews, and M. Yoder-Williams. 1988. Effects of winter floods on fishes in the Sierra Nevada. Canadian Journal of Fisheries and Aquatic Science 45:2195–2200.

Fausch, K. D., et al. 2001. Flood disturbance regimes influence rainbow trout invasion success among five Holarctic regions. Ecological Applications 11:1438–1455.

Fleischner T. L. 1994. Ecological costs of livestock grazing in western North America. Conservation Biology 8:629–644.

Gillett, N. P., et al. 2011. Ongoing climate change following a complete cessation of carbon dioxide emissions. Nature Geoscience 4:83–87.

Glick, P., B. A. Stein, and N. A. Edelson, editors. 2011. Scanning the conservation horizon: a guide to climate change vulnerability assessment. National Wildlife Federation, Washington, D.C. http://www.nwf.org/~/media/PDFs/Global-Warming/Climate-Smart-Conservation/NWFScanningtheConservationHorizonFINAL92311.ashx. Accessed December 14, 2011.

Gresswell, R. E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the American Fisheries Society 128:193–221.

Hendrickson, D. A., and W.L. Minckley. 1984. Ciénegas - vanishing climax communities of the American southwest. Desert Plants 6:130–175.

Hoerling, M., and J. Eischeid. 2007. Past peak water in the southwest. Southwest Hydrology January/February 2007:18–35.

Intergovernmental Panel on Climate Change (IPCC). 2007a. Synthesis Report. In Core Writing Team, R. K. Pachauri, and A. Reisinger, editors. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change, Geneva, Switzerland. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf. Accessed December 14, 2011.

Intergovernmental Panel on Climate Change (IPCC). 2007b. Summary for Policymakers. In S. Solomon, et al., editors. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf. Accessed December 14, 2011.

Kauffman, J. B. and W. C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications. A review. Journal of Range Management 37:430–438.

Karl, T. R., J. R. Melillo, and T. C. Peterson, editors. 2009. Global climate change impacts in the United States. Cambridge University Press. New York, New York. http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf. Accessed December 14, 2011.

Kundzewicz, Z. W., et al. 2007. Freshwater resources and their management. Pages 173–210 in M. L. Parry, et al., editors. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter3.pdf. Accessed October 3, 2011.

Leopold, A. L. 1921. A plea for recognition of artificial works in forest erosion control policy. Journal of Forestry 19:267–273.

Leopold, A. L. 1924. Grass, brush, timber, and fire in southern Arizona. Journal of Forestry 22:1–10.

Lytle, D. A. 2000. Biotic and abiotic effects of flash flooding in a montane desert stream. Archive fur Hydrobiologia 150:85–100.

Madany, M. H., and N. E. West. 1983. Livestock grazing – fire regime interactions with in montane forests for Zion National Park, Utah. Ecology 64:661–667.

Manning, M. R., et al. 2010. Misrepresentation of the IPCC CO_2 emission scenarios. Nature Geoscience 3:376–377. http://www.climate.unibe.ch/~joos/papers/manning10natg.pdf. Accessed December 14, 2011.

Marsh, P. C., F. J. Abarca, M. E. Douglas and W. L. Minckley. 1989. Spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*) relative to introduced red shiner (*Cyprinella lutrensis*). Arizona Game and Fish Department, Phoenix, Arizona.

Marsh, P.C., B.E. Bagley, G.W. Knowles,G. Schiffmiller, and P.A. Sowka. 2003. New and rediscovered populations of loach minnow, *Tiaroga cobitis* (Cyprinidae), in Arizona. The Southwestern Naturalist 48:666-669.

Matthews, W. J., and L. G. Hill. 1977. Tolerance of the red shiner *Notropis lutrensis* (Cyprinidae) to environmental parameters. Southwestern Naturalist 22:89–98.

McCullough, D. A. 1999. A review and synthesis of effects of alterations to the water

temperature regime on freshwater life stages of salmonids, with special reference to Chinook salmon. EPA 910-R-99-010. U.S. Environmental Protection Agency. Seattle, Washington. http://www.critfc.org/tech/EPAreport.pdf. October 3, 2011.

McKenzie, D., Z. Gedalof, D. L. Peterson, and P. Mote. 2004. Climatic change, wildfire, and conservation. Conservation Biology 18:890–902.

Medina, A. L., J. N. Rinne, and P. Roni. 2005. Riparian restoration through grazing management: considerations for monitoring project effectiveness. Pages 97-126 in P. Roni editor. Monitoring stream and watershed restoration. American Fisheries Society, Besthesda, Maryland.

Meehan, W. R., and W. S. Platts. 1978. Livestock grazing and the aquatic environment. Journal of Soil and Water Conservation 33:274–278.

Meehl, G. A., et al. 2007. Global climate projections. Pages 747–845 in S. Solomon, et al., editors. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter10.pdf. Accessed December 14, 2011.

Meisner, J. D. 1990. Potential loss of thermal habitat for brook trout, due to climatic warming, in two southern Ontario streams. Transactions of the American Fisheries Society 119:282–291.

Miller, D. 1998. Fishery survey report of Negrito Creek within the Gila National Forest, New Mexico. Western New Mexico University and U.S. Forest Service. Gila National Forest, Silver City, New Mexico.

Miller, R. R. 1961. Man and the changing fish fauna of the American southwest. Papers of the Michigan Academy of Science, Arts and Letters 46:365–404.

Miller, R. R., J. D. Williams, and J. E. Williams. 1989. Extinctions of North American fishes during the past century. Fisheries 14:22–38.

Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, Arizona.

Minckley, W. L., and J. E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species." Science 159:1424–1432.

Minckley, W. L., and G. W. Meffe. 1987. Differential selection by flooding in stream-fish communities of the arid American Southwest. Pages 93–104 in W.E. Matthews and

D.W. Heinz, editors. Evolutionary and community ecology of North American stream fishes. University of Oklahoma Press, Norman, Oklahoma.

Molles, M. C. Jr. 1985. Recovery of a stream invertebrate community from a flash flood in Tesuque Creek, New Mexico. Southwestern Naturalist 30:279–287.

Morgan, I. J., D. G. McDonald, and C. M. Wood. 2001. The cost of living for freshwater fish in a warmer, more polluted world. Global Change Biology 7:345–355.

Nash, L. L., and P. H. Gleick. 1993. The Colorado River Basin and climatic change. EPA 230-R-93-009. U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Climate Change Division. Oakland, California. http://wwa.colorado.edu/colorado_river/docs/Nash_Gleick_EPA-1993.pdf. Accessed December 5, 2011.

New Mexico Department of Game and Fish (NMDGF). 2008. Threatened and Endangered Species of New Mexico: 2008 biennial review. Santa Fe, New Mexico. http://www.wildlife.state.nm.us/conservation/threatened_endangered_species/documents/2008BiennialReview.pdf. Accessed December 5, 2011.

New Mexico Department of Game and Fish (NMDGF). 2012. Gila Monitoring Database. Unpublished data (Excel file). Santa Fe, New Mexico.

New Mexico Department of Game and Fish (NMDGF). 2013. Gila Permanent Monitoring Site data for 2012. Unpublished data (Excel file). Santa Fe, New Mexico.

New Mexico Environmental Department (NMED). 2010. Water quality survey summary for the Gila and San Francisco River and selected tributaries. 2007. Surface Water Quality Bureau. New Mexico Environmental Department. Santa Fe, New Mexico. ftp://ftp.nmenv.state.nm.us/www/swqb/MAS/Surveys/Gila-SFR_SurveyReport2007.pdf. Accessed December 5, 2011.

New Mexico Office of the State Engineer. 2005. Potential Effects of Climate Change on New Mexico. Agency Technical Workgroup. Santa Fe, New Mexico. http://www.nmenv.state.nm.us/aqb/cc/Potential_Effects_Climate_Change_NM.pdf. Accessed December 5, 2011.

Ohmart, R. D. 1996. Historical and present impacts of livestock grazing on fish and wildlife resources in western riparian habitats. Pages 237–243 in P. R. Krausman, editor. Rangeland wildlife. Society of Range Management, Denver, Colorado.

Parmesan, C., and J. Matthews. 2006. Biological impacts of climate change. Pages 333–374 in M. J. Groom, G. K. Meffe, and C. R. Carroll, editors. Principles of Conservation Biology. Sinauer Associates, Inc. Sunderland, Massachusetts.

Paroz, Y. M., and D. L. Propst. 2007. Distribution of spikedace, loach minnow, and chub species in the Gila River Basin, New Mexico, 1908–2007. Report to U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation. New Mexico Department of Game and Fish, Conservation Services Division, Santa Fe, New Mexico.

Paroz, Y. M., D. L. Propst, and J. A. Stefferud. 2006. Long-term monitoring of fish assemblages in the Gila River, New Mexico (1988-2005). New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Paroz, Y. M., J. Monzingo, and D. L. Propst. 2009. Inventory of the East, Middle and West Forks of the Gila River 2005-2008. Santa Fe, New Mexico.

Pielke Jr., R., T. Wigley, and C. Green. 2008. Dangerous assumptions. Nature 452:531–532.

Pittenger, J. S. 2002. Final biological assessment and evaluation for the West Fork natural revetment and bioengineering project. U.S. Forest Service, Wilderness Ranger District, Gila National Forest, Catron County, New Mexico.

Pittenger, J. S. 2010. Biological assessment and survey report for proposed abutment repairs at the NM 15 Bridge crossing of the West Fork Gila River. New Mexico Department of Transportation, Catron County, District 1, New Mexico.

Platts, W. S. 1991. Livestock grazing. Pages 389–423 in Influences of forest and rangeland management on salmonid fishes and their habitats. W.R. Meehan, editor. American Fisheries Society Special Publication 19. Bethesda, Maryland.

Polyak, L., et al. 2010. History of sea ice in the Arctic. Quaternary Science Review 29:1575–1778.

Prinn, R., et al. 2011. Scenarios with MIT integrated global systems model: significant global warming regardless of different approaches. Climatic Change 104:515–537.

Propst, D. L. 1999. Threatened and Endangered Fishes of New Mexico. Technical Report No.1. New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Propst, D. L., and K. R. Bestgen. 1991. Habitat and biology of the loach minnow, *Tiaroga cobitis*, in New Mexico. Copeia 1991:29–38.

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, New Mexico.

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 17. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Propst, D. L., J. A. Stefferud, and P. R. Turner. 1992. Conservation and status of Gila trout, *Oncorhynchus gilae*. Southwestern Naturalist 37:117–125.

Propst, D.L., R.D. Larson, and A.L. Hobbes. 1998. Interactions of nonnative salmonids and native cyprinids in the Gila River drainage. Federal Aid Project E-35. New Mexico Department of Game and Fish. Santa Fe, New Mexico.

Propst, D. L., K. B. Gido, and J. A. Stefferud. 2008. Natural flow regimes, nonnative fishes, and native fish persistence in arid-land river systems. Ecological Applications 18:1236–1252.

Randall, D. A., et al. 2007. Climate models and their evaluation. Pages 589–662 in S. Solomon, et al., editors. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter8.pdf. Accessed December 14, 2011.

Raupach, M. R., et al. 2007. Global and regional drivers of accelerating CO_2 emissions. Proceedings of the National Academy of Sciences 104:10288–10293. http://www.pnas.org/content/104/24/10288.full.pdf+html?with-ds=yes. Accessed December 14, 2011.

Regonda, S. K., B. Rajagopalan, M. Clark, and J. Pitlick. 2005. Seasonal cycle shifts in hydroclimatology over the Western United States. Journal of Climate 18:372–384.

Rinne, J. N. 1989. Physical habitat uses by loach minnow, *Tiaroga cobitis*, in southwestern desert streams. Southwestern Naturalist 34:109–117.

Rinne, J. N. 1996. Short-term effects of wildfire on fishes and aquatic macroinvertebrates in the southwestern United States. North American Journal of Fisheries Management 16:653–658.

Rinne, J. N., and D. Miller. 2006. Hydrology, geomorphology and management: Implications for sustainability of native Southwestern Fishes. Review in Fisheries Science 14:91–110.

Rixon, T. F. 1905. Forest conditions in the Gila River Forest Reserve, New Mexico. U.S. Geological Survey Professional Paper No. 39. Washington, D.C. http://ir.library.oregonstate.edu/xmlui/handle/1957/11301. Accessed December 5, 2011.

Savage, M., and T. W. Swetnam. 1990. Early and persistent fire decline in a Navajo ponderosa pine forest. Ecology 70:2374–2378.

Schreiber, D. C., and W. L. Minckley. 1981. Feeding interrelationships of native fishes in a Sonoran desert stream. Great Basin Naturalist 41:409–426,

Schulz, T. T., and W. C. Leininger. 1990. Differences in riparian vegetation structure between grazed areas and exclosures. Journal of Range Management 43:295–299.

Seager, R., et al. 2007. Model projections of an imminent transition to a more arid climate in SW North America. Science 316:1181–1184.

Smith, K., and M. E. Lavis. 1975. Environmental influences on the temperature of a small upland stream. Oikos 26:228–236.

Solomon, S., et al. 2007: Technical Summary. In S. Solomon, et al., editors. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-ts.pdf. Accessed December 14, 2011.

Southwest Endangered Species Act Team (SWAT). 2008. Chiricahua leopard frog (Lithobates [Rana] chiricahuensis): Considerations for making effects determinations and recommendations for reducing and avoiding adverse effects. U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico. 75 pp.

Stefferud, J. A., and J. N. Rinne. 1996. Effects of floods on fishes in the upper Verde River, Arizona. Proceedings of the Desert Fishes Council 28:80–81.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2004. Changes in snowmelt runoff timing in western North America under a "business as usual" climate change scenario. Climate Change 62:217–232.

Sublette, J. E., M. D. Hatch, and M. Sublette. 1990. The Fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico.

Swetnam, T. W. 1990. Fire history and climate in the southwestern United States. Pages 6–17 in J. S. Krammes, technical coordinator. Effects of fire management on southwestern natural resources: proceedings of the symposium, November 15-17, 1988, General Technical Report RM-191. U.S. Forest Service, Tucson, Arizona.

Swetnam, T. W., and C. H. Baisan. 1996. Historical fire regime patterns in southwestern United States since AD 1700. Pages 11–32 in C. D. Allen, technical editor. Fire effects in

southwestern forests: proceedings of the second La Mesa fire symposium. General Technical Report RM-GTR-286. U.S. Forest Service, Fort Collins, Colorado.

Swetnam, T. W., and J. H. Dieterich. 1985. Fire history of ponderosa pine forests in the Gila Wilderness, New Mexico. Pages 390–397 in J.E. Lotan J. E. Lotan, B.M. Kilgore, W.C. Fischer, and R.W. Mutch, technical coordinators. Proceedings: symposium and workshop on wilderness fire. General Technical Report INT-182. U.S. Forest Service., Forest and Range Experiment Station, Ogden, Utah.

Tellman, B., R. Yarde, and M.G. Wallace. 1997. Arizona's changing waters: how people have affected the rivers. Water Resources Research Center, College of Agriculture, University of Arizona, Issue Paper 19. 198 pp.

Tibbets, C. A., and T. E. Dowling. 1996. Effects of intrinsic and extrinsic factors on population fragmentation in three species of North America minnows (Teleostei: Cyprinidae). Evolution 50:1280–1292.

Touchan, R., T. W. Swetnam, and H. Grissino-Mayer. 1995. Effects of livestock grazing on pre- settlement fire regimes in New Mexico. Pages 268–272 in J.K. Brown, R.W. Mutch, C.W. Spoon, and R.H. Wakimoto, technical coordinators. Symposium on fire in wilderness and park management. Missoula, Montana, 30 March to 1 April, 1993. General Technical Report INT-320. U.S. Forest Service, Ogden, Utah.

University of Nebraska-Lincoln. 2013. U.S. Drought Monitor. http://droughtmonitor.unl.edu/. Accessed July 23, 2013.

U.S. Fish and Wildlife Service (Service). 1986a. Endangered and threatened wildlife and plants; final rule to determine *Tiaroga cobitis* to be a threatened species without critical habitat. Federal Register 51:39468–39478.

U.S. Fish and Wildlife Service (Service). 1986b. Endangered and threatened wildlife and plants; final rule to determine *Meda fulgida* to be a threatened species without critical habitat. Federal Register 51:23769–23781.

U.S. Fish and Wildlife Service (Service). 1991a. Loach minnow (*Tiaroga cobitis*) recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (Service). 1991b. Spikedace, *Meda fulgida*, Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (Service). 1994a. Notice of 90-day and 12-month findings on a petition to reclassify spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*) from threatened to endangered. Federal Register 59:35303-35304.

U.S. Fish and Wildlife Service (Service). 1994b. Endangered and threatened wildlife and plants; designation of critical habitat for the threatened loach minnow (*Tiaroga cobitis*). Federal Register 59:10898–10906.

U.S. Fish and Wildlife Service (Service). 1994c. Endangered and threatened wildlife and plants; Designation of critical habitat for the threatened spikedace (*Media fulgida*). Federal Register 59:10906-10914.

U.S. Fish and Wildlife Service (Service). 2001. Revised Biological Opinion on transportation and delivery of Central Arizona Bridge Replacement Water to the Gila River Basin (Hassayampa, Agua Fria, Salt, Verde, San Pedro, Middle and Upper Gila Rivers and Associated Tributaries) in Arizona and New Mexico and its potential to introduce and spread nonnative aquatic species. Arizona Ecological Services Office, Phoenix, Arizona. http://www.usbr.gov/lc/phoenix/biology/azfish/pdf/RevisedBOCAP.pdf. Accessed December 5, 2011.

U.S. Fish and Wildlife Service (Service). 2005. Endangered and threatened wildlife and plants; reclassification of Gila trout (*Oncorhynchus gilae*) from endangered to threatened with special regulations. Federal Register 70:24750–24764.

U.S. Fish and Wildlife Service (Service). 2007. Chiricahua Leopard Frog (*Rana chiricahuensis*) Recovery Plan. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, NM. 149 pp. + Appendices A-M.

U.S. Fish and Wildlife Service (Service). 2012. Endangered and threatened wildlife and plants; endangered status and designation of critical habitat for loach minnow and spikedace; final rule. Federal Register 77:10810–10932.

U.S. Forest Service (Forest Service). 2002. Environmental assessment: West Fork natural revetment and bioengineering project. Wilderness Ranger District, Gila National Forest, Minbres, New Mexico.

U.S. Forest Service (Forest Service). 2013. Gila National Forest GIS Data, Fire history polygons. http://www.fs.usda.gov/detail/r3/landmanagement/gis/?cid=stelprdb5203027 Accessed 09/13/2013

Vives, S. P., and W. L. Minckley. 1990. Autumn spawning and other reproductive notes on loach minnow, a threatened cyprinid fish of the American Southwest. Southwestern Naturalist 35:451-454.

Westerling, A. L., H. G. Hidalgo, D. R. Cyan, and T. W. Swetnam. 2006. Warming and earlier spring increase Western U.S. forest wildfire activity. Science 313:940–943.

Widmer, A. M., C. J. Carveth, and S. A. Bonar. 2006. Upper tolerance of loach minnow under

acute, chronic, and fluctuating thermal regimes. Transaction of American Fisheries Society 135:755–762.

Williams, D. D., and H. B. N. Hynes. 1976. The recolonization mechanisms of stream benthos. Oikos 27:265–272.

Williams, J. E., et al. 1985. Endangered aquatic ecosystems in North American deserts with a list of vanishing fishes of the region. Journal of the Arizona Nevada Academy of Science 20:1–62.