



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

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### Memorandum

To: Project Leader, U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation Office, Albuquerque, New Mexico

From: Field Supervisor, U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico

Subject: Biological Opinion on the Effects of Actions Associated with the Piscicide Project on the Upper West Fork Gila River

Thank you for your January 28, 2009, Intra Service Section 7 Biological Evaluation Form for a piscicide project on the upper West Fork Gila River for the removal of nonnative trout. The purpose of the project is to repatriate native Gila trout (*Oncorhynchus gilae*) into historic stream habitats. The Gila National Forest (Forest Service) in cooperation with the U.S. Fish and Wildlife Service (Service) and the New Mexico Department of Game and Fish (NMDGF) propose to renovate 21.3 miles of stream in the upper West Fork Gila watershed in designated wilderness by removing all brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) through the use of the piscicide, rotenone, followed by transport and stocking of Gila trout into the renovated waters.

This document transmits the Service's biological opinion (BO) for the threatened Gila trout and for the threatened Chiricahua leopard frog (*Lithobates [Rana] chiricahuensis*) (frog) pursuant to section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. § 1531 et seq.). Repatriation of the Gila trout into the treated streams is part of the action and they may be stocked as soon as the fall of 2009. The recovery action to collect and stock Gila trout in the wild is covered by a section 10 permit to the Fish and Wildlife Conservation Office. A collection permit from the State of New Mexico has also been obtained for the repatriation. In addition, Mora National Fish Hatchery and Technology Center has a section 10 (a)(1)(A) permit (for scientific purposes to enhance the propagation or survival of the species) to hold and raise Gila trout. However, a few wild Gila trout may exist in the action area and it is anticipated they will be killed as a result of this project. Consequently, you have determined that the action "may affect, is likely to adversely affect" Gila trout. You also determined that the rotenone treatment "may affect, is likely to adversely affect" the frog.

In addition you determined that the proposed project "may affect, is not likely to affect" the Mexican spotted owl (*Strix occidentalis lucida*) and that there will be no effect to the threatened loach minnow (*Tiaroga cobitis*), threatened spikedace (*Meda fulgida*), or the endangered

Southwestern willow flycatcher (*Empidonax traillii extimus*). In accordance with our new section 7 regulations effective January 15, 2009 (50 C.F.R. §402.13) we are declining to provide concurrence on these species.

### Consultation History

This BO is based on the information provided in the Intra Service consultation form dated January 28, 2009; the 2009 Supplement to the Environmental Assessment for Gila Trout Restoration in the Upper West Fork Gila River, Catron County, New Mexico: Considerations for addition of rotenone to the previous NEPA decision of 2003; the 2002 Biological Assessment and Evaluation for Repatriation of Gila Trout (*Oncorhynchus gilae*) to the Upper West Fork Gila River Drainage, Wilderness Ranger District, Gila National Forest, Catron County, New Mexico; the 2002 Environmental Assessment for Restoration of Gila Trout to the Upper West Fork Gila River, Catron County, New Mexico; and other sources of information available to the Service.

## BIOLOGICAL OPINION

### I. Description of Proposed Action

#### *Action Area*

The project area is located in the Gila Wilderness, Gila National Forest, in southern Catron County, New Mexico; no private or State lands are located in the project area. Included in the action area is the main stem of the upper West Fork Gila River from a natural waterfall barrier below White Creek Cabin upstream to the headwaters on the east slope of Whitewater Baldy. The Upper West Fork Gila River and its tributaries: Cub Creek, Packsaddle, Trail, White Creek, Rawmeat Creek, and Langstroth Canyon provide approximately 21.3 miles (mi) (34.25 kilometers [km]) of stream habitat (Table 1). The Upper West Fork is separated into two perennial segments which are divided by a 1.2 mi (2 km) long ephemeral reach between Turkeyfeather Creek and Whiskey Creek.

Table 1. Lengths of perennial and ephemeral stream segments in the project area.

| Stream Name                | Perennial Stream Length<br>miles (kilometers) | Ephemeral stream length<br>miles (kilometers) |
|----------------------------|---|---|
| Upper West Fork Gila River | 11.6 (18.6)                                   | 1.2 (2.0)                                     |
| Cub Creek                  | 4.3 (6.9)                                     | 0 (0)   |
| Packsaddle Canyon          | 0 (0)   | 0.5 (0.7)                                     |
| Langstroth Canyon          | 3.3 (5.4)                                     | 0 (0)   |
| Trail Creek                | 0 (0)   | 2.9 (4.6)                                     |
| Rawmeat Creek              | 0.5 (0.8)                                     | 2.8 (4.5)                                     |
| Lower White Creek          | 1.6 (2.6)                                     | 0 (0)   |
| Total                      | 21.3 (34.3)                                   | 7.3 (11.8)                                    |

The action area extends approximately one half mile below the waterfall barrier where the primary neutralization station will be set up.

### *Background*

The Service, in cooperation with the Forest Service and the NMDGF, proposes to renovate the upper West Fork Gila River using the piscicide CFT Legumine™ (rotenone). The purpose of the proposed action is to remove nonnative trout from 34.25 km (21.26 mi) of perennial stream habitat and increase the occupied range of Gila trout in the upper West Fork Gila drainage. Elimination of nonnative trout is necessary because these species prey upon, compete, and hybridize with Gila trout. Furthermore, the Whiskey Creek lineage of Gila trout would be protected by removal of nonnative trout from the upper West Fork Gila River and allowed to expand to additional stream reaches. The proposed action contributes to meeting delisting criteria for the Gila River Recovery Unit, as described in the Gila Trout Recovery Plan (Service 2003).

The first rotenone application is proposed for early summer 2009 (June) followed by a second application in late summer 2009 and possibly a third application in early summer 2010 if it is determined to be necessary. Application would occur during low flow periods after monsoon rains and snowmelt. Gila trout may be repatriated back into the treated area as early as the fall of 2009, if the second treatment in the summer indicates no nonnative trout remain in the system. If nonnative trout are killed in the second treatment, repatriation would not occur until after the 2010 treatment. Main and South Diamond Gila trout lineages propagated at Mora National Fish Hatchery and Technology Center will be stocked into the treated area.

Original piscicide application efforts began on the Upper West Fork Gila River in September 2003 and subsequent applications were made in 2004, 2005, and 2006. All treatments used antimycin, another piscicide. Subsequently, it was determined that the antimycin used was less potent than the label indicated. Nonnative trout survived the applications and persist within the upper West Fork Gila River. As a result, this project proposal intends to use the piscicide rotenone of known quality to ensure successful piscicide application to remove all nonnative trout.

Rotenone is an organic compound isolated from subtropical and tropical plants. It is a naturally occurring ketone ( $C_{23}H_{22}O_6$ ) that inhibits the use of oxygen at the cellular level in gill-breathing organisms. Rotenone would be applied according to label directions at a rate of 1 part per million (ppm) for a period of 4-8 hours. Rotenone would be applied using drip stations (Stefferd and Propst 1996) in stream reaches with continuous flow and with backpack garden sprayers in areas where streamflow mixing is absent or low. Rotenone decomposes in light and water, with a half-life of 0.5 - 7.5 days at 5 to 20 °C. Toxicity is lowered with increased pH, water temperature, and organic matter. Dissipation is faster in flowing water due to dilution, dispersion and photolysis.

### *Project Procedures and Implementation*

A comprehensive, step-wise treatment plan that meets state and federal regulations and label instructions will be written in advance and adhered to by all participating personnel during renovations. The treatment plan will encompass all aspects of pre- and post treatment work, calculations for application of rotenone and potassium permanganate, personnel and equipment needs, personnel safety, and contingencies (i.e. inclement weather and flooding).

A bioassay will be conducted within the project area one day prior to project implementation to determine drip station placement and ensure that a lethal concentration is deployed. A drip station will be prepared with the calculated application rate of rotenone. Five fish will be placed in live-cars below the drip station located at 200, 400, 600, 800, and 1000 m. Rotenone will be applied to the stream at the calculated drip rate and fish status recorded every hour. Response time of sentinel fish should be equal to the rotenone concentration (Loeb and Engstrom-Heg 1971).

Drip station placement will be determined by length of treatment (hours), water travel time, and distance to achieve 100% mortality for sentinel fish in the bioassay. However, drip station placement will not exceed 2 hours travel time per label directions. Stations will be 1-2 hours travel time apart (0.5 - 2 miles) to allow for four complete turnovers of water between stations. For accurate placement, all stream reaches will be measured with a hip chain and drip station locations flagged and location determined with a GPS unit. Rotenone will be applied up- to downstream to avoid movement of nonnative fish into untreated waters. Start and end times and amount of rotenone added to each station will be recorded.

Neutralization of the piscicide will occur at a natural waterfall barrier at the downstream end of the action area by applying potassium permanganate ( $\text{KMnO}_4$ ) at a rate of 1.0 part per million residual (Gilderhus et al. 1969, Gilderhus 1972). Potassium permanganate is anticipated to be applied at a rate of 3 ppm total: 1 ppm for background demand, 1 ppm to neutralize rotenone, and 1 ppm residual. For application, a 2.5% solution (24g  $\text{KMnO}_4$  in 1 L water) of potassium permanganate will be delivered from 5 gallon (19 L) drip stations. The primary neutralization station will be placed at the top of the waterfall to increase mixing, with a secondary station set 30 minutes travel time downstream in case complete neutralization has not occurred. To determine if residual potassium permanganate is achieved, a Chlorine Hach test, which is an acceptable surrogate for measuring potassium permanganate levels, will be used to test water above the secondary neutralization station.

The primary neutralization station will begin application one hour before rotenone reaches the area to ensure mixing and continue for 2 hours after all rotenone-treated water has passed the neutralization station. If the secondary neutralization is needed, as determined by residual tests and survival of sentinel fish, it will be continuously supervised during operation until 2 hours after all rotenone-treated water has passed the neutralization station. Sentinel fish in live cars will be used to determine if neutralization is achieved. Sentinel fish will be placed at the primary neutralization site, at the secondary site, and 30 minutes travel time downstream of the secondary site.

Personnel will be assigned to all piscicide application and neutralization stations and all stations will be manned continuously during the 4-8 hour application. Personnel will ensure proper function of the drip stations and take corrective actions as necessary. Personnel manning the neutralization stations will remain on site continuously up to 24 hours post-piscicide application.

Aquatic invertebrate and water quality monitoring will occur prior to and 24 hours after application of rotenone. Three Surber samples will be taken at six sites within the project area. Differences between pre- and post-treatment samples will be used to determine immediate effects on macroinvertebrate populations. Subsequent aquatic invertebrate samples will be taken one year post treatment to assess recovery of the macroinvertebrate community.

The day after completion of treatment with rotenone, all dead fish will be collected from stream reaches within the action area. Fish will be identified, enumerated, measured and weighed, and buried in pits dug on the floodplain to prevent ingestion by scavengers.

### *Conservation Measures*

The following measures will be implemented as part of the proposed action to minimize take of the Chiricahua leopard frog and Gila trout and potential effects to the environment:

- All project work that may result in forms of take of regulated native and exotic species will be conducted under Service and NMDGF permits, and will conform to all conditions of those permits.
- All field work shall conform to amphibian disease prevention protocols in the Chiricahua leopard frog Recovery Plan (Service 2007). Equipment will be disinfected between uses at different sites. Precautions will be taken to prevent spread or infection with chytrid fungus by not moving mud, water, or frogs from one site to another. If Chiricahua leopard frogs are handled, field personnel will disinfect their hands, as well. Equipment and personnel will be disinfected by rinsing with either: 1) 10 percent sodium hypochlorite (household bleach) or 2) quaternary ammonia (Service 2007).
- Rotenone will only be applied in accordance with a Pesticide Use Plan and by certified pesticide use applicators. Pesticide Use Plans are required by National Forest regulations and identify methods, sensitive areas, and precautions that will be taken to minimize or eliminate adverse effects to non-target species, resources, and people.
- Forest Service will designate a Chiricahua leopard frog coordinator who will organize and oversee all conservation measures related to the frog including coordination of the diurnal and nocturnal surveys, ensuring appropriate equipment and disinfectant is available for all activities, collection of chytrid fungus samples, repatriation of captured individuals, salvage of rotenone-exposed individuals, documentation of all occupied sites, and documentation of take.
- Pre-application Chiricahua leopard frog surveys will be conducted by expert personnel from Western New Mexico University, NMDGF, and/or Forest Service. These surveys will be conducted approximately 2 weeks prior to each piscicide application. Areas of suitable or occupied habitat will be recorded with GPS. Diurnal and nocturnal surveys

will be performed. Water quality and number of each life stage observed or collected will be recorded at each sample location. One to two days before any rotenone application the occupied sites will be revisited to capture and hold frogs in safe enclosures (described below).

- Adult frogs collected will be swabbed for chytrid fungus samples.
- Any egg masses, tadpoles, or adults discovered during pre-treatment surveys will be removed and temporarily held on-site to minimize piscicide impacts and repatriated after project completion.
- All frogs will be transported and held according to guidelines in the Chiricahua Leopard Frog Recovery Plan (Service 2007). Plastic kiddie pools will be used as holding enclosures. All containers will have approximately 13 cm of water and covering screens to prevent escapement and predation. Hiding and basking microhabitats will be provided using rocks and plant material. Each site locality of frogs would be held in a separate enclosure. After application of rotenone is complete, frogs would be returned to the original sample location.
- Off-channel aquatic habitat that might support frogs will be included in the pre-treatment surveys. Prior to the treatment, the off-channel habitats will be electrofished. Any habitat sampled and determined to be fishless will not have piscicide applied. Any frogs that are discovered through electrofishing will be captured and held as described above.
- During treatment it is possible that tadpoles not collected during pre-treatment surveys will be discovered. Some ability exists to salvage rotenone-affected individuals and revive them by placing them in fresh water (Finlayson et al. 2000). This technique was effective for the treatment of stock ponds in the San Rafael Valley occupied by Sonora tiger salamander (J. Rorabaugh, FWS, pers. com., August 2006), and should be utilized during this project.
- Within 24 hours of the rotenone treatment any backwater areas that were treated with rotenone will be surveyed to look for dead tadpoles or frog adults that may have not been detected in pre-treatment surveys and were subsequently killed by the treatment.
- All personnel must have or receive training on the importance and methods required to avoid transferring chytrid fungus among sites.
- To minimize adverse effects to Gila trout, pre-treatment surveys will be conducted in the upper West Fork Gila River and all captured Gila trout will be either held in temporary, off-stream refugia or relocated to Whiskey Creek. Lower Whiskey Creek is intermittent and translocated Gila trout from the upper West Fork Gila River will be transported via oxygenated container to Whiskey Creek and released in suitable habitat. Gila trout collected in the White Creek drainage (including lower Langstroth and Rawmeat creeks) will not be protected due to potential genetic contamination by rainbow trout.
- To reduce adverse effects to aquatic invertebrates, headwaters of tributaries, where fish are absent, will not be treated. Headwaters of tributaries of Rawmeat, Trail Canyon, Langstroth, White, and Whiskey Creeks will not be treated and will provide source populations of aquatic invertebrates for recolonization of species affected by rotenone.
- To mitigate indirect effects (inadequate food base) to Gila trout, fish will not be stocked until the macroinvertebrate community has recovered. Determination of recovery will be accomplished by monitoring pre- and post-treatment throughout the project area.

## II. Status of Species/Critical Habitat

### Chiricahua leopard frog

The Chiricahua leopard frog was listed as threatened without critical habitat on June 13, 2002, (67 FR 40790). Primary factors cited as the basis for listing include significant population declines as a result of destruction, alteration, and fragmentation of the species' aquatic habitats; disease; and predation by introduced aquatic predators, especially bullfrogs, crayfish, and predatory fish (67 FR 40790). Chiricahua leopard frogs are considered a Wildlife Species of Concern (WSC) in Arizona and a Species of Concern (SOC) in New Mexico. The Chiricahua leopard frog is listed as threatened in Mexico (Secretaria de Medio Ambiente y Recursos Naturales 2002). The distribution and status of the species in Mexico is unclear due to limited survey work and the presence of closely related taxa (especially *Lithobates lemosespinali*) in the southern part of the range of the Chiricahua leopard frog; however, several populations have been documented in Chihuahua in the last 2 years.

### *Distribution*

A total of 272 and 182 historical localities are documented for the species in Arizona and New Mexico, respectively (Service 2007). At the time of listing (2002) the species was known at only 87 and 41 localities in Arizona and New Mexico, respectively. The species is extant in most major drainages in Arizona and New Mexico where it occurred historically; with the exception of the Little Colorado River drainage in Arizona. It has also not been found recently in many rivers, valleys, and mountains ranges it once occupied, including the following in Arizona: White River, West Clear Creek, Tonto Creek, Verde River mainstem, San Francisco River, San Carlos River, upper San Pedro River mainstem, Santa Cruz River mainstem, Aravaipa Creek, Babocomari River mainstem, and Sonoita Creek mainstem. In southeastern Arizona, evidence suggests the species may be extirpated from the following mountain ranges or valleys: Baboquivari Mountains, Pinaleno Mountains, Chiricahua Mountains, Canelo Hills, Patagonia Mountains, and Sulphur Springs Valley. Moreover, the species is now absent from all but one of the southeastern Arizona valley bottom ciénega complexes. In many of these regions Chiricahua leopard frog has not been found for a decade or more despite repeated surveys. In Arizona, Chiricahua leopard frogs are present at approximately 80 sites; this total includes new observations since listing, dispersal observations, and sites established through recolonization and repatriation and recovery efforts.

In New Mexico, extant frog populations occur in each of the six major drainages where the species was found historically (Tularosa/San Francisco, Mimbres, Alamosa/Seco/Rio Grande, Gila, Playas, and Yaqui). Occurrences are characterized by few, mostly small, isolated populations. Monitoring suggests that many populations, which were once common, have been reduced to remnant populations or have been extirpated since 2002. For example, the metapopulation in the Deep Creek Divide area that was represented by nine local populations inhabiting earthen stock tanks as recently as the summer of 2002 and was reduced to a single site by 2006. One the eight extirpated sites was recolonized by the remaining site, with an observation of a single individual in 2007 and approximately 20 individuals in 2008. Some of

the extirpated sites once had very large numbers of individuals and prior to losses the area was considered a stable, functioning metapopulation. Chytridiomycosis (caused by the amphibian chytrid, *Batrachochytrium dendrobatidis*) appears to be responsible for the extirpations (Service 2007). This example highlights the dynamic nature of extirpation, recolonization, and risks of disease but importance associated with connectivity for the frog.

At the time of listing (2002) there were 41 sites in New Mexico that were thought to be occupied by the frog. Since that time 26 of these sites have become extirpated (unoccupied for at least 3 consecutive years). However, approximately 29 additional occupied sites were identified since listing. Of these 29, 11 are believed extirpated as well. Consequently, of the 70 known occupied sites since listing, 37 (53 percent) have become extirpated and 7 are considered dispersal observations (not an established population). It should be noted that because of the dynamic nature of local colonizations and extinctions and defining boundaries around sites, the enumeration of sites is approximate and variable through time. In 2008, approximately 25 populations were extant in New Mexico. One of these 25 populations is a functioning metapopulation made up of 7 to 10 occupied sites, that is referred to as a population because at the time of listing, it was one of the 41 known populations. Although recovery actions are being implemented (e.g., headstarting tadpoles for repatriation) the status of Chiricahua leopard frog in New Mexico has declined since the time of listing.

Threats to this species include predation by non-native organisms; disease; drought; floods; degradation and loss of habitat as a result of water diversions and groundwater pumping, poor livestock management, altered fire regimes due to fire suppression and livestock grazing, mining, development, and other human activities; disruption of metapopulation dynamics; increased chance of extirpation or extinction resulting from small numbers of populations and individuals; and environmental contamination. Predation by non-native species and the effects of the apparently introduced fungal skin disease, chytridiomycosis, are the primary limiting factors for recovery. The Chiricahua Leopard Frog Recovery Plan (Service 2007) contains a complete discussion of these threats and is included herein by reference.

### *Habitat*

The Chiricahua leopard frog is an inhabitant of cienegas (wetlands), pools, livestock tanks, lakes, reservoirs, streams, and rivers at elevations of 1,000 to 2,710 meters (3,281 to 8,890 feet) in central and southeastern Arizona; west-central and southwestern New Mexico; and in Mexico in the northern Sonora and the Sierra Madre Occidental of Chihuahua (Sredl et al. 1997, Degenhardt et al. 1996, Platz and Mecham 1979). In New Mexico, of sites occupied by the frogs from 1994 to 1999, 67 percent were creeks or rivers, 17 percent were springs or spring runs, and 12 percent were stock tanks (Painter 2000). In Arizona, slightly more than half of all known historical localities are natural river systems, a little less than half are stock tanks, and the remainder is comprised of lakes and reservoirs (Sredl et al. 1997). Sixty-three percent of populations extant in Arizona from 1993-1996 were found in stock tanks (Sredl and Saylor 1998).

Few studies of habitat use by Chiricahua leopard frogs have been completed. However, important general characteristics include permanent or nearly permanent water that is free of or



has low densities of non-native predators (Service 2007). Habitat heterogeneity within the aquatic and terrestrial environment is likely to be important: shallow water with emergent and perimeter vegetation provide egg deposition sites and tadpole and adult thermoregulation, basking, and foraging sites. Deeper water, root masses, and undercut banks provide refuge from predators and potential hibernacula (Service 2007). Most perennial waters supporting Chiricahua leopard frogs possess fractured rock substrata, emergent or submergent vegetation, deep water, root masses, undercut banks, or some combination of these features that frogs may use as refugia from predators and extreme climatic conditions (Service 2007). Chiricahua leopard frogs likely overwinter at or near breeding sites, although microsites for these hibernacula have not been studied. Other leopard frogs typically overwinter at the bottom of well-oxygenated ponds or lakes, and may bury themselves in the mud (Harding 1997, Nussbaum et al. 1983, Cunjak 1986).

A diversity of nearby aquatic sites and types of water (stream, tinajas, stock ponds of varying permanency, concrete drinkers and holding tanks, marshes and cienegas) is likely to enhance population persistence. Habitat diversity is important even within a single site. Springs and groundwater-fed streams are likely to offer superior habitat qualities, especially against winter cold or periodic drought. Ranid frogs are sensitive to pollutants (Sparling 2003). As a result, population persistence is likely greater in water that is not overly polluted by livestock feces or chemical pollutants (e.g., runoff from agricultural fields, ice-melting salts, aerial overspray).

Although historically the Chiricahua leopard frog was a habitat generalist, currently it is a habitat specialist in the sense that its breeding habitat now falls within a narrow portion of the continuum from small, shallow, ephemeral, and unpredictable waters to large, deep, predictable, and perennial waters. It is excluded from ephemeral habitats by its requirements for surface moisture for adult survival and a relatively long larval period (minimum of 3 months) and they are often excluded from perennial habitats by the presence of non-native predatory and competing species of fishes, American bullfrog, and crayfish. Thus, they are pinched between these two opposing sets of processes. In the Southwest, leopard frogs are currently so strongly impacted by harmful non-native species, which are most prevalent in perennial waters, that their occupied niche is increasingly restricted to environments that tend to be ephemeral and unpredictable. This increasingly narrow realized niche is a primary reason for the threatened status of the Chiricahua leopard frog (Service 2007).

#### *Life history and population dynamics*

Chiricahua leopard frogs have a complex life cycle consisting of eggs and larvae that are entirely aquatic and adults that are primarily aquatic. The male fertilizes the eggs as the female attaches a spherical mass to submerged vegetation. Numbers of eggs in a mass range from 300 to 1,485 (Jennings and Scott 1991) and apparently are correlated with female body size. Eggs generally hatch in 14 days, depending on temperature, and tadpoles metamorphose in three to nine months (Jennings 1988, 1990), but may overwinter.

Populations of the frog occurring in or near thermally stable habitats (warm or hot springs) may be reproductively active throughout the year. Jennings (1988, 1990) reported that reproductive

activity throughout the year in Alamosa Warm Springs in Socorro County, New Mexico, where the water temperature remained above 61°F (16°C). In sites with variable temperatures, egg masses have been reported in all months except January, November, and December, but reports of oviposition in June are uncommon (Zweifel 1968, Frost and Bagnara 1977, Frost and Platz 1983, Scott and Jennings 1985, Sredl and Jennings 2005). Zweifel (1968) noted that breeding in the early part of the year appeared to be limited to sites where the water temperatures do not get too low, such as spring-fed sites.

In New Mexico, the frog may exhibit seasonal fluctuations in relative abundance. Overall abundance increases with the metamorphosis of tadpoles in August and September, and is lowest from December through March (Degenhardt et al. 1996). Throughout the year, frog activity generally increases as the nocturnal water temperature increases (Jennings 1990).

Where several populations of Chiricahua leopard frog occur within close proximity (separated by five miles or less), functional metapopulations may exist. Metapopulations are considered critical to long-term survival of the species (Service 2007). Also critical are large populations, which are expected to experience relatively low extinction rates and may serve as source populations for colonization of nearby suitable habitats (Service 2007). Unfortunately, these large populations and metapopulations are the most likely to contract infectious disease because they are not isolated. This increases the concern about disease and underscores the importance of minimizing the likelihood of all methods of disease transmission.

Disruption of metapopulation dynamics is likely an important factor in regional loss of populations (Sredl et al. 1997, Sredl and Howland 1994). Chiricahua leopard frog populations are often small and habitats are dynamic, resulting in a relatively low probability of long-term population persistence. Historically, populations were more numerous and closer together. If populations were lost due to drought, disease, or other causes, extirpated sites could be recolonized via immigration from nearby populations. As the number of populations declined, populations became more isolated and were less likely to be recolonized if extirpation occurred. Also, most of the larger source populations along major rivers and in cienega complexes have disappeared.

The dispersal abilities of Chiricahua leopard frogs are important in determining the likelihood that suitable habitats will be colonized from a nearby extant population. Evidence shows substantial movements of leopard frogs and passive movement of tadpoles along stream courses. Current guidance, supported by scientific literature, suggests reasonable dispersal distances of Chiricahua leopard frogs of one mile overland, three miles within intermittent drainages, and five miles within perennial drainages. Dispersal of this species is largely thought to occur during the summer monsoon (Service 2007).

Degenhardt et al. (1996) reported that Chiricahua leopard frogs are shy, nocturnal and are quick to seek shelter when approached. During the day they usually rest hidden among the vegetation surrounding their aquatic habitat and are quick to enter the water. Degenhardt et al. (1996) reported that this species is the most aquatic of the New Mexico leopard frogs.

In a study of the stomach contents of 56 Chiricahua leopard frogs (9 had empty stomachs), invertebrates from 9 insect orders were documented, 4 of which (Coleoptera, Hemiptera, Diptera, Odonata) have members with aquatic life stages (Christman and Cummer 2006). The frogs did not specialize on any particular group of prey. Dipterans in the aquatic insect families of Dolichopodidae and Chironomidae were best represented, especially in frogs that were caught in the spring (March, April, May) (Christman and Cummer 2006). Aquatic hemipterans that were recorded in the stomach contents were Veliidae, Notonectidae, Belostomatidae, Gerridae, Corixidae, Mesoveliidae, and Naucoridae. Veliids, gerrids, and mesoveliid adults are adapted to skate on the water surface; notonectids and corixid adults live in the water column, although the adults can also fly; belostomatids crawl on the benthic substrate or hide in aquatic vegetation and detritus. Hemipterans were common in stomachs of frogs caught in the summer (June, July, August) (Christman and Cummer 2006). No mayflies (Ephemeroptera) stoneflies (Plecoptera), or caddisflies (Trichoptera) were recorded in the Chiricahua leopard frog stomachs (Christman and Cummer 2006). The tadpoles are herbivorous and likely feed on diatoms, phytoplankton, filamentous green algae, water milfoil, and duckweed.

In the last few years, the role of infectious diseases has been recognized as a key factor in amphibian declines in seemingly pristine areas (Daszak et al. 1999, Longcore et al. 1999, Carey et al. 2001). A fungal skin disease, chytridiomycosis has been linked to amphibian decline in many parts of the world (Berger et al. 1998, Speare and Berger 2000, Stuart et al. 2004), including the Chiricahua leopard frog in Arizona (Sredl 2000, Sredl and Caldwell 2000) and New Mexico (Christman et al. 2003). Chytridiomycosis is a highly virulent fungal pathogen of amphibians capable of causing sporadic deaths in some populations, and 100 percent mortality in other populations. Surviving individuals may be carriers. The inoculating dose is low; 100 zoospores are able to cause clinical chytridiomycosis within four weeks.

Some amphibian species appear highly susceptible to developing the disease, progressing to death, while other species appear less susceptible to disease manifestations (Service 2007). Berger et al. (1998) reported that chytridiomycosis and other amphibian diseases can be spread by transporting mud, water, or frogs from one site to another. In addition, disease can be spread by muddy or wet boots, nets, vehicles, or other equipment. The chytrid fungus is not known to have an airborne spore, but disperses among individuals and populations by zoospores that swim through water or during contact between individual frogs (Daszak 2000). If chytridiomycosis is a recent introduction on a global scale, then dispersal by global or regional commerce, translocation of frogs and other organisms, and travel among areas by anglers, scientists, tourists, animals, and others are viable scenarios for transmission of this disease (Halliday 1998; Daszak 2000, Morgan et al. 2007).

Additional information about the Chiricahua leopard frog can be found in Platz and Mechem (1984, 1979), Clarkson and Rorabaugh (1989), Sredl and Howland (1994), Jennings (1995), Degenhardt et al. (1996), Rosen et al. (1994, 1995), Sredl et al. (1997), Painter (2000), Sredl and Jennings (2005), Lemos-Espinal and Smith (2007), and Service (2007).

## Gila Trout

The Gila trout was originally recognized as endangered under the Federal Endangered Species Preservation Act of 1966 (March 11, 1967; 32 FR 4001), and Federal designation of the species as endangered continued under the Act (1973). Reasons for listing included hybridization, competition, and/or predation by non-native rainbow, cutthroat, and brown trout, and habitat degradation. No critical habitat was designated.

In 1987, the Service proposed to reclassify the Gila trout as threatened (October 6, 1987; 52 FR 37424). We withdrew our proposal for reclassification on September 12, 1991 (56 FR 46400) because: 1) Severe flooding in 1988 reduced the Gila trout populations in McKnight Creek by about 80 percent; 2) wild fires in 1989 eliminated Gila trout from Main Diamond Creek and all of the South Diamond drainage except Burnt Canyon, a small headwater stream; 3) propagation activities at hatcheries had not proceeded as planned, and fish were not available to replenish wild stocks; and 4) brown trout, a predator, was present in Iron Creek, which at the time was thought to harbor a relict population of Gila trout.

On May 11, 2005, we again proposed to reclassify Gila trout from endangered to threatened (70 FR 24750) with a special 4(d) rule to allow recreational angling to occur according to regulations set by NMDGF and Arizona Department of Game and Fish in collaboration with the Service. The final rule for the reclassification became effective on August 17, 2006 (71 FR 40657). The reclassification was justified on the basis of replication of the relict populations, the viability and security of the replicates, documented increases in population numbers, and the creation and use of appropriate management plans (i.e., broodstock management, evacuation plan, updated Recovery Plan). Conservation actions such as this proposed action have continued since the reclassification to further expand the occupied range of Gila trout.

### *Distribution*

The historical distribution of Gila trout is not known with certainty (Behnke 2002). It is known to be native to higher elevation streams in portions of the Gila River drainage, New Mexico. According to anecdotal reports, in 1896 Gila trout was found in the Gila River drainage, New Mexico, from the headwaters downstream to a box canyon, about 11.3 km (7 mi) northeast of Cliff, New Mexico (Miller 1950). By 1915, the downstream distribution of Gila trout in the Gila River had receded upstream to Sapillo Creek, a distance of approximately 25 km (15 mi) (Miller 1950). By 1950, water temperature in the Gila River at Sapillo Creek was considered too warm to support any trout species (Miller 1950). The earliest documented collections of Gila trout in the upper Gila River drainage were in 1939, from Main Diamond Creek (Miller 1950). New populations were sporadically found until 1992, when Gila trout was discovered in Whiskey Creek, a tributary to the upper West Fork Gila River (Service 2003).

Miller (1950) documented changes in suitability of habitats for Gila trout in the upper Gila drainage. Unregulated livestock grazing and logging likely contributed to habitat modifications noted by Miller (1950). The historical occurrence of intensive grazing and resulting effects on

the land are indicated in published reports dating back to the early 1900s (Rixon 1905, Rich 1911, Duce 1918, Leopold 1921, Leopold 1924). Logging activities also likely caused major changes in watershed characteristics and stream morphology. Rixon (1905) reported the occurrence of small timber mills in numerous canyons of the upper Gila River drainage. Early logging efforts were concentrated along canyon bottoms, often with perennial streams. Tree removal along perennial streams within the historical range of Gila trout likely altered water temperature regimes, sediment loading, bank stability, and availability of large woody debris (Chamberlin et al. 1991).

When the Gila trout was listed as endangered, it was thought that its range had been reduced to five streams within the Gila National Forest, New Mexico: Iron, McKenna, Spruce, Main Diamond, and South Diamond. In 1998, it was determined that the McKenna and Iron Creek populations were hybridized with rainbow trout and therefore, did not contribute to the recovery of the species because they were not genetically pure (Leary and Allendorf 1998, Service 2003). In 1992, another relict population was discovered in Whiskey Creek (Leary and Allendorf 1998). Consequently, there are four confirmed relict populations known today. All four original pure populations (Main Diamond, South Diamond, Spruce, and Whiskey Creeks) are replicated at least once.

#### *Status*

Surveys of the 10 existing populations indicate that the recovery efforts to remove nonnative fish and prevent their return to the renovated areas have been successful (Service 2003) (Table 2). Replicated populations in New Mexico are successfully reproducing, indicating that suitable spawning and rearing habitats are available. Replication efforts in Arizona have not been as successful. Young of the year Gila trout were planted in Dude Creek in 1999; however, the stream is presently fishless. Raspberry Creek was originally stocked with Spruce Creek lineage in 2000 (113, Age 0 fish). In May 2004, Gila trout were evacuated from Raspberry Creek due to the threat of ash flow from the KP wildfire. In November 2004, 14 fish were restocked into the uppermost portions. In 2008, a few adult Gila trout remained in Raspberry Creek but reproduction has not been documented since 2004. Raspberry and Dude Creek are not considered viable replicate populations at this time.

Table 2. Summary and status of streams inhabited by Gila trout. Relict lineages in **bold**.

| State | County | Stream Name               | Drainage       | km (mi) of stream inhabited |
|-------|--------|---------------------------|----------------|-----------------------------|
| NM    | Sierra | <b>Main Diamond Creek</b> | East Fork Gila | 6.1(3.8)                    |
| NM    | Grant  | McKnight Creek            | Mimbres River  | 8.5(5.3)                    |

|    |                   |  |                |            |
|----|-------------------|--|----------------|------------|
| NM | Grant             | Black Canyon                           | East Fork Gila | 18.2(11.3) |
| NM | Catron            | Lower Little Creek                     | West Fork Gila | 6.0(3.7)   |
| NM | Catron            | Upper White Creek                      | West Fork Gila | 8.8(5.5)   |
| NM | Sierra            | <b>South Diamond Creek<sup>1</sup></b> | East Fork Gila | 6.7(4.2)   |
| NM | Catron<br>(Grant) | Mogollon Creek <sup>2</sup>            | Gila River     | 28.8(17.9) |
| NM | Catron            | <b>Spruce Creek</b>                    | San Francisco  | 3.7(2.3)   |
| NM | Catron            | Big Dry Creek                          | San Francisco  | 1.9(1.2)   |
| NM | Catron            | <b>Whiskey Creek</b>                   | West Fork Gila | 2.6(1.6)   |
| NM | Catron            | Langstroth Canyon                      | West Fork Gila | 9.0(5.6)   |

<sup>1</sup> South Diamond Creek includes Burnt Canyon.

<sup>2</sup> Mogollon Creek includes Trail Canyon, Woodrow Canyon, Corral Canyon, and South Fork Mogollon Creek. Portions of the drainage are in Grant County, New Mexico.

Black Canyon, Main Diamond, South Diamond, Mogollon, Langstroth, and Spruce creeks were all surveyed in either 2007 or 2008 (Paroz and Propst 2008). Black Canyon, Main Diamond, South Diamond, and Mogollon creeks have stable populations with multiple year classes present (Paroz and Propst 2008). Langstroth was stocked in 2006 and while several of the original stocked adults were recovered, no young of year were captured. Spruce Creek was sampled in 2008 and fish were collected and taken to Mora National Fish Hatchery and Technology Center to create a Spruce Creek broodstock. Unfortunately, the fish collected experience high mortality and additional collections will need to be made before a broodstock can be established. Sheep Corral, a tributary to Sapillo Creek is not included in the Table 1 but was stocked with Main Diamond Gila trout in 2008. Sheep Corral once supported a population but it is thought that the drought in the early 2000s eliminated the population, probably because water temperature or

water quality became unsuitable. Little Creek is still recovering from the effects of a 2003 ash flow and is being stocked on a regular basis.

In 2007, following the downlisting of Gila trout from endangered to threatened (71 FR 40657), fish in excess of recovery needs have been stocked in recreational streams in the Gila National Forest. The first fishing season for Gila trout occurred in 2007. Black Canyon was opened 1 July through 30 September 2007 as a 'catch-and-release' fishery. Terminal gear was restricted to barbless single-hook artificial flies and lures. Effects of angling on the population are being monitored by NMDGF (Paroz and Propst 2008).

Biological information (i.e., physical description, distribution and threats, life history, and habitat characteristics) on the Gila trout can be found in our final rule for reclassification of the Gila trout with a special rule, published in the Federal Register on July 18, 2006 (71 FR 40657), and in the Gila Trout Recovery Plan (Service 2003). That information is incorporated by reference into this BO.

### **III. Environmental Baseline**

Under section 7(a)(2) of the Act, when considering the effects of the action on federally listed species, the Service is required to take into consideration the environmental baseline. Regulations implementing the Act (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress.

#### Status of the species within the action area

The Gila National Forest has a land base of approximately 3.3 million acres. This land base is drained by several major drainages with considerable occupied or potential habitat within the historic range of the frog and Gila trout.

#### Chiricahua leopard frog

Chiricahua leopard frogs are present in low numbers within the project area. Small populations were documented near the mouth of Turkeyfeather Canyon (Jennings 1995, Whiteman 2002) and there is an unconfirmed report near the West Fork Gila River confluence with White Creek. The White Creek locality is based upon an unverified report of frog calls near beaver ponds at the confluence of the West Fork Gila River and White Creek (J. Monzingo, USFS, pers. comm. 2008). Field surveys for the frog in the upper West Fork Gila were conducted by Charlie Painter (NMDGF), Randy Jennings (Western New Mexico University), and Bruce Christman (NMDGF) on 15-17 May 2001. A total of 28 tadpoles (B. Christman, pers. comm. 2009) and 6 adults were found (C. Painter, NMDGF, pers. comm. 2002). Two of the adults were observed at the mouth of Turkeyfeather Canyon (B. Christman, pers. comm. 2009). Twenty seven tadpoles were observed in a single pool in a large side pool of the West Fork Gila above White Creek. One of

the tadpoles was tested and was positive for chytrid fungus. All 27 tadpoles appeared to have significantly reduced keratin in their mouthparts (B. Christman, pers. comm. 2009), an indicator of probable chytridiomycosis infection. In May 2008, an adult leopard frog was photographed near the confluence of Cub Creek, in the heart of the project area. Review of the photo documentation by species experts confirmed the individual as a Chiricahua leopard frog (M. Christman, USFWS, pers. comm. 2008). Recent reports indicate that many of the pools in the area once occupied by the frog have been filled in with gravel and sediment subsequent to the Cub Fire in the summer of 2002. Whiteman (2002) reported on the presence of Chiricahua leopard frogs at Turkeyfeather Spring, located approximately 3 km upstream of the West Fork Gila River confluence and outside of the action area.

The status of Chiricahua leopard frogs has not been systematically evaluated for the upper West Fork Gila River since 2001 and subsequent to the Cub Fire (Whiteman 2002, Service 2007). Habitat may be limiting since spring seeps, partially connected backwaters, slough-like areas, and other low/no velocity areas are now rare along the upper West Fork Gila River, although the extent of habitat alterations subsequent to the Cub Fire has not been formally evaluated. Habitat for the frog is marginal in the upper portions of Langstroth Canyon, Trail Creek, Rawmeat Creek above the White Creek confluence, Johnson Canyon, and Cub Creek because of high gradient, bedrock substrate, and the lack of slow water areas. Occurrence of the frog has not been confirmed in any of these streams (Pittenger 2002). Cub Creek was surveyed for frogs by C. Painter and B. Christman in 2001 and no amphibians nor fish were observed. Cub Creek was also informally surveyed in June of 2001 during fish community inventories conducted by the Gila Trout Recovery Team, and no frogs were observed.

The action area is within the West-Middle Fork Management Area of Recovery Unit 6 (Service 2007). Because of the apparently unstable status of the frogs within this unit, all individuals have a high conservation value. Captive reproduction of frogs from this area is a high priority (Service 2007).

### Gila trout

Although the historical distribution of Gila trout is not known with certainty (Behnke 2002), based on the location of remnant populations, the Gila River drainage represents the core of the historical distribution. As described above, all viable populations currently occur on the Gila National Forest. Within the action area, the upper West Fork Gila River is for the most part unoccupied by Gila trout currently. Prior piscicide treatments from 2003-2006 eliminated all Gila trout from the main stem river. However, three tributaries to the West Fork Gila River, Whiskey Creek, Langstroth Canyon, and upper White Creek (status described above) are occupied by Gila trout. It is possible that since the last treatment Gila trout from these tributaries could have moved downstream and entered the West Fork Gila River. Electrofishing surveys within the project area which have been conducted to assess the status of nonnative fish in the project area have found very few Gila trout in the West Fork Gila River.



### **Factors affecting the species within the action area**

The project area is located in the Gila Wilderness east of Glenwood, in southern Catron County, New Mexico, and consists of lands administered by the Forest Service, Gila National Forest. The streams to be treated include the main stem of the upper West Fork Gila River from the waterfalls below White Creek Cabin upstream to the headwaters, and the tributaries of this reach of the West Fork Gila. The tributaries include Cub Creek, Packsaddle Canyon, Langstroth Canyon, Trail Creek, Rawmeat Creek, and White Creek below the waterfalls. Upper Rawmeat Creek, Trail Creek, and Packsaddle Canyon are ephemeral but may provide habitat for fish and amphibians during years with above average precipitation. However, they do not support resident populations of fish. Because both Gila trout and Chiricahua leopard frog depend on aquatic habitats the factors affecting the species within the action area described below apply to both species.

White Creek was described in detail by Stefferud et al. (1992) and most likely represents the general characteristics of the neighboring tributaries. White Creek flows through a V-shaped valley with steep sides. The channel gradient ranges from 3.8 to 5.7 percent. The floodplain width is less than 65.6 feet (20 m), the active channel width is less than 26.2 ft (8 m), and the wetted channel width is 6.6 to 9.8 ft (2 to 3 m). Depth averages 0.6 ft (0.2 m), but pools up to 3.3 ft (1 meter) deep are present. Pool to riffle ratio is 23:77 and the most common habitat types are step-run and low gradient riffle. Pools are primarily boulder formed plunge pools; habitat types formed by large woody debris are not common. The substrate composition is cobble to small boulder, and deposition of fine sediment is low.

Base summer flows range from less than 0.05 m<sup>3</sup>/s to 0.65 m<sup>3</sup>/s (1.8-23 cfs)(Brown et al. 2001). In general, stream flow is characterized by a snow-melt hydrograph. Snowmelt runoff typically begins in February, peaks in March, and gradually decreases through May. Base flow conditions prevail in June and July. Discharge usually increases in July through September from runoff created by summer thunderstorms. Sporadic periods of runoff from winter rains or mid-season snowmelt often results in flow slightly above base level in December and January.

Stream water quality is characterized by high dissolved oxygen levels, low turbidity, conductivity, and dissolved solids, and above-neutral pH. Channel gradient ranges from relatively low in the lower end of the West Fork Gila River to fairly high in the headwaters and tributary streams (4 to 8 percent). Channel substrate is typically dominated by gravel. However, bedrock, cobble, and boulders may be abundant in some reaches.

### Prior piscicide treatments

Piscicide application efforts began on the Upper West Fork Gila River in September 2003 and subsequent applications were made in 2004, 2005, and 2006. All treatments used antimycin. Subsequently, it was determined that the antimycin used was less potent than the label indicated. Nonnative trout survived the applications and persist within the upper West Fork Gila River.

Field studies of antimycin found no effect on leopard frogs and tadpoles at the standard application rate of 10 ppb typically used for fish removal (Schnick 1974). Chiricahua leopard frog continues to occupy the upper West Fork Gila River after the previous piscicide applications. However, because population numbers prior to treatment were not well documented, it is not possible to determine what effect if any these treatments had on populations of the frog. Because the potency of the antimycin was compromised, and because antimycin does not appear to affect the larvae at concentrations typically used in piscicide application (Schnick 1974, Little and Calfee 2008) frogs may not have been affected by the prior treatments.

### Livestock grazing

In the late 1800s and early 1900s, livestock grazing was uncontrolled and unmanaged over many of the watersheds that contain Chiricahua leopard frog and Gila trout, and much of the landscape was denuded of vegetation (Rixon 1905, Duce 1918, Leopold 1921, Leopold 1924, Ohmart 1996). Livestock grazing is more carefully managed now, which has resulted in less impact to streams occupied by Gila trout. Improved grazing management practices (e.g., fencing, retirement of allotments) have reduced livestock access to streams. Six of the 12 streams currently occupied by Gila trout are within Forest Service grazing allotments. However, the project area is within the Gila Wilderness and there are no active grazing allotments in this area.

Because of the negative impacts that livestock grazing can have on stream ecosystems, especially in situations when it is poorly managed, it is likely that both Gila trout and Chiricahua leopard frog populations were impacted in the early 1900s. Within the action area, grazing has not occurred since 1950s (Service 2006). Although there may be lingering indirect effects from historical grazing practices (e.g., loss of fine fuels, changes in plant composition, increased sedimentation), direct effects are no longer occurring.

### Timber harvest

Logging activities in the early to mid 1900s likely caused major changes in watershed characteristics and stream morphology (Chamberlin et al. 1991). Rixon (1905) reported the occurrence of small timber mills in numerous canyons of the upper Gila River drainage. Early logging efforts were concentrated along canyon bottoms, often with perennial streams. Tree removal, along perennial streams within the historical range of the frog, likely altered water temperature regimes, sediment loading, bank stability, and the availability of large woody debris (Chamberlin et al. 1991). Timber harvest is not allowed in wilderness or primitive areas in the Gila National Forest. Because the Gila Wilderness was set aside in 1924, the last timber harvest in the project area may have occurred in the early 1920s. Although there may be lingering indirect effects from historical timber harvest practices (e.g., reduction in large woody debris, changes in species composition), direct effects are no longer occurring.

### Fire

Severe wildfires capable of extirpating or decimating fish and or amphibian populations are relatively recent phenomena resulting from the cumulative effects of historical or ongoing grazing (removes the fine fuels needed to carry fire), fire suppression (Savage and Swetnam 1990, Swetnam 1990, Touchan et al. 1995, Swetnam and Baisan 1996, Belsky and Blumenthal 1997, Gresswell 1999), and climate change (Westerling et al. 2006). The absence of ground fires has allowed a buildup of woody fuels that precipitate infrequent yet intense crown fires (Swetnam and Baisan 1996). In 2003 alone, over 80,937 ha (200,000 acs) burned in the Gila National Forest (Southwest Interagency Coordination Center fire occurrence records). In ponderosa pine ecosystems, historic wildfires were primarily cool-burning understory fires with return intervals of 3-7 years (Swetnam and Dieterich 1985). Cooper (1960) concluded that prior to the 1950s crown fires were extremely rare or nonexistent in the region. Increased canopy cover within forest and woodland types, increased relative abundance of ponderosa pine, and invasion of mesa-top grasslands by alligator junipers are the result of a reduction in the frequency of tree-thinning surface fires (Miller 1999).

High-severity wildfires, and subsequent floods and ash flows have caused the extirpation of six populations of Gila trout since 1989. In 2002, the Cub Fire burned approximately 14,000 acres of the West Fork Gila drainage. The West Fork Gila River corridor from approximately 2 mi (3.2 km) upstream of the confluence of Turkeyfeather Creek into the headwaters was severely burned. The lower reach of Whiskey Creek and the West Fork Gila from approximately 0.9 mi (1.5 km) upstream of the Turkeyfeather confluence upstream to approximately 2.5 mi (4.0 km) upstream of the Whiskey Creek confluence were severely impacted by ash and debris flows that occurred in July 2002 after a thunderstorm. Lower Whiskey Creek is frequently intermittent and typically contains few fish (Brooks 2002). Upper Whiskey Creek, where the majority of the fish occur, was not affected by the Cub Fire.

In general, the effects of fire on amphibians are not known (Pilliod et al. 2003). It is expected that adults would retreat into the water if fire were present. Of greater consequence would be the effect of ash flows on eggs and tadpoles. In most situations adults likely could escape an ash flow but aquatic life stages would likely perish. However, changes to the habitat through sedimentation can alter or totally eliminate suitable habitat (Parker 2006). Following the 1994 Rattlesnake Fire in the Chiricahua Mountains of Arizona, a debris flow filled Rucker Lake, extirpating a well-established frog population. A population of leopard frogs (either Chiricahua or Ramsey Canyon leopard frogs) disappeared from Miller Canyon in the Huachuca Mountains of Arizona, after a 1977 crown fire in the upper canyon and subsequent erosion and scouring of the canyon during storm events (T. Beatty, Miller Canyon, pers. comm., 2000). In the Gila Wilderness, an ash flow after the Cub Fire filled in a wetland area at the confluence of Turkeyfeather Creek with the West Fork Gila effectively eliminating suitable frog habitat (J. Monzingo, Forest Service, pers. comm., 2009). Widespread and intense fires will remain a threat to the species in the project area, especially in light of the projected effects of climate change, described below.

#### Nonnative species

In the early 1900s, uncontrolled angling depleted some populations of Gila trout, which in turn encouraged stocking of hatchery-raised, nonnative species (Miller 1950, Propst 1994). Due to declining native fish populations, the NMDGF propagated and stocked Gila trout, rainbow trout, cutthroat trout, and brown trout during the early 1900s to improve angler success. Gila trout were propagated from 1923 to 1935 at the Jenks Cabin Hatchery in the Gila Wilderness, and through 1947 at the Glenwood Hatchery, but these programs were abandoned because of the hatcheries' poor accessibility and low productivity (Service 1984). After early stocking programs were discontinued, the nonnative trout species persisted and seriously threatened the genetic purity and survival of the few remaining populations of Gila trout. Recent efforts to recover the species have included eliminating nonnative salmonids from the species' historic habitat through piscicide applications, mechanical removal, and construction of waterfall barriers to prevent nonnative reinvasion.

Stocking and naturalization of nonnative trout within the project area and ensuing hybridization, predation, and competition are major causes for the imperiled status of the Gila trout (Service 2003). Rainbow trout have not been stocked in streams supporting Gila trout since 1923 but both brown trout and rainbow trout have become naturalized and are widespread in the project area. Introduction of nonnative trout has also been implicated in the decline of various frog species such as the mountain yellow-legged frog (*Rana muscosa*) in California (Knapp and Matthews 2000). Brown trout in particular, are predaceous and may feed on frog eggs and tadpoles. It is not known if Gila trout prey upon frog eggs and tadpoles. However, the two species evolved together so it is possible that the frog has life history strategies that minimize the effect of predation by Gila trout.

There are no other nonnative fish species, bullfrogs, or crayfish in the action area. Completion of the proposed project would provide habitat for both Gila trout and the Chiricahua leopard frog free of aquatic nonnative species.

### Climate change

Warming of the earth's climate is unequivocal, as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of glaciers and the polar ice cap, and rising sea level (IPCC 2007). The Intergovernmental Panel on Climate Change (IPCC) (2007) describes changes in natural ecosystems with potential wide-spread effects on many organisms, including freshwater fish. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution is dynamic, and dependent on a variety of factors, including climate (Parmesan and Galbraith 2004). Typically, as climate changes, the abundance and distribution of fish and wildlife change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007).

In the Colorado River basin, which includes the Gila watershed, widespread, reliable temperature

records are available for about the past 150 years. These records document an annual mean air surface temperature increase of approximately 2.5°F (1.4°C) over the past century with temperatures today at least 1.5°F (0.8°C) warmer than during the 1950 drought (NRC 2007, Lenart 2007). Udall (2007) found that multiple independent data sets confirm widespread warming in the West. Both in terms of absolute degrees and in terms of annual standard deviation, the Colorado River basin has warmed more than any region of the United States (NRC 2007). Predicting with certainty the amount of warming that may occur in the future is not possible; however, the IPCC (2007) has concluded that continued warming of the climate is unequivocal. Over western North America, median temperatures are projected to increase between 2.3°F (1.3°C) and 7.9°F (4.4°C) by 2100 depending on the rate of green house gas emissions (Christensen and Lettenmaier 2006).

The IPCC also projects that there will very likely be an increase in the frequency of hot extremes, heat waves, and heavy precipitation events (IPCC 2007). Climate forecasts project a northward shift in the jet stream and associated winter-spring storm tracks, which are consistent with observed trends over recent decades (CCSP SAP 1.1, 2006). This would result in future drier conditions for the Southwest and an ever-increasing probability of drought for the region (Trenberth et al. 2007).

In consultation with leading scientists from the Southwest, the New Mexico Office of the State Engineer prepared a report for the Governor (State of New Mexico 2006) which made the following observations about the impact of climate change in New Mexico: 1) warming trends in the American Southwest exceed global averages by about 50 percent; 2) models suggest that even moderate increases in precipitation would not offset the negative impacts to the water supply caused by increased temperature; 3) temperature increases in the Southwest are predicted to continue to be greater than the global average; 4) there will be a delay in the arrival of snow and acceleration of spring snow melt, leading to a rapid and earlier seasonal runoff ; and 5) the intensity, frequency, and duration of drought may increase.

Increased winter temperatures cause more precipitation to fall as rain instead of snow (Regonda et al. 2005). Snow covering small streams provides valuable insulation that protects aquatic life (Needham and Jones 1959, Gard 1963). Gard (1963) measured temperatures above, within, and below the snow at Sagehen Creek, California, a small Sierra Nevada mountain stream. He found that although there was a 35.4°C (63.8°F) diurnal air temperature variation, within the snow the temperature variation was only 1.3°C (2.3°F) and the water temperature in the stream below varied by only 0.3°C (0.55°F). Without the protective cover of snow, anchor ice (ice frozen on the stream bed) and frazil ice (ice crystal suspended in the water) can form, having negative impacts on overwintering trout or frogs.

Climate change is predicted to have four major effects on the cold water stream habitat: 1) increased water temperature; 2) decreased stream flow; 3) a change in the hydrograph; and 4) an increased occurrence of extreme events (fire, drought, and floods).

#### *Increased water temperature*

The IPCC states that of all ecosystems, freshwater ecosystems will have the highest proportion of species threatened with extinction due to climate change (Kundzewicz et al. 2007). Species with narrow temperature tolerances will likely experience the greatest effects from climate change and it is anticipated that populations located at the margins of species hydrologic and geographic distributions will be affected first (Meisner 1990). Water temperature influences the survival of salmonids at all stages of their life cycle. Alterations in the temperature regime from natural background conditions negatively affect population viability, when considered at the scale of the watershed or individual stream (McCullough 1999). Salmonids are classified as coldwater fish with thermal preferences centered around 15°C (59°F) (Shuter and Meisner 1992). High temperatures suppress appetite and growth, can influence behavioral interactions with other fish (Schrank et al. 2003), or be lethal (McCullough 1999). Salmonids inhabiting warm stream segments have higher probabilities of dying from stress (McCullough 1999). The temperature preferences and tolerances of Gila trout have not yet been determined and the possibility exists that they are more tolerant of warm temperatures than other salmonids. However, increased stress from elevated temperatures could lead to greater susceptibility to disease and reduced reproductive success.

Theoretically warmer water temperatures could be beneficial to the Chiricahua leopard frog because it appears that populations that occupy warmer water are less susceptible to chytrid fungus (Service 2007). In addition, it is possible that the populations that occupy the headwater, higher elevation areas of the West Fork Gila may be limited by a shorter growing season compared to lower elevation locations. Warmer water temperatures may decrease the development time of eggs and larvae, increase primary productivity leading to a longer growing season for the larvae, and ultimately increasing recruitment.

#### *Decreased stream flow*

Current models suggest a decrease in precipitation in the Southwest (Seager et al. 2007, Kundzewicz et al. 2007) which would lead to reduced stream flows and a reduced amount of habitat for Gila trout. Stream flow is predicted to decrease in the Southwest even if precipitation were to increase moderately (Nash and Gleick 1993, State of New Mexico 2005, Hoerling 2007). Winter and spring warming causes an increased fraction of precipitation to fall as rain, resulting in a reduced snow pack, an earlier snowmelt, and decreased summer base flow (Christensen et al. 2004, Stewart et al. 2005, Regonda et al. 2005). Earlier snowmelt and warmer air temperatures lead to a longer dry season. Warmer air temperatures lead to increased evaporation, increased evapo-transpiration, and decreased soil moisture. These three factors would lead to decreased stream flow even if precipitation increased moderately.

The effect of decreased stream flow is that streams become smaller, intermittent, or dry reducing the amount of habitat available for aquatic species. The loss of the Sheep Corral Creek population in the early 2000s is likely the consequence of the widespread drought the region was experiencing. A smaller stream is affected more by air temperature than a larger one, exacerbating the effects of warm and cold air temperatures (Smith and Lavis 1975). In addition,

fish caught in isolated pools are subject to increased predation from terrestrial predators. It is anticipated that a decrease in stream flow would also decrease the amount of habitat available to Chiricahua leopard frog, potentially increasing population isolation and fragmentation. Because frog populations in this Recovery Unit have been in decline and because the documented number of frogs in the action area is so few, increased fragmentation could lead population extirpation in this area.

### *Change in the hydrograph*

Another documented effect of climate change is that warming in the western United States has resulted in a shift of the timing of spring snowmelt. Stewart et al. (2005) show that timing of spring streamflow in the western United States during the last five decades has shifted so that the major peak now arrives one to four weeks earlier, resulting in less flow in the spring and summer. They conclude that almost everywhere in North America, a 10 to 50 percent decrease in spring-summer streamflow fractions will accentuate the seasonal summer dry period with important consequences for warm-season water supplies, ecosystems, and wildfire risks (Stewart et al. 2005). Rauscher et al. (2008) suggest that with air temperature increases of 3° to 5°C, snowmelt driven runoff in the western United States could occur as much as two months earlier than present.

The life history of salmonids is tied to the timing of runoff (Fausch et al. 2001). A change in timing or magnitude of floods can scour the streambed destroying eggs, or displace recently emerged fry downstream (Erman et al. 1988, Montgomery et al. 1999, Fausch et al. 2001). Similarly, unseasonal flooding could reduce suitable habitat for egg masses or tadpoles (Yarnell et al. 2007) or wash them downstream. A longer, drier summer also could reduce the amount of habitat availability (smaller pools and backwaters) or dry pools before tadpoles have the opportunity to metamorphose.

### *Increased occurrence in extreme events*

Extreme events such as drought, fires, and floods are predicted to occur because of climate change (IPCC 2007). It is anticipated that an increase in extreme events will most likely affect populations living at the edge of their physiological tolerances. The predicted increases in extreme temperature and precipitation events may lead to dramatic changes in the distribution of species or to their extirpation or extinction (Parmesan and Matthews 2006).

**Drought:** Although Gila trout evolved in the Southwest and have survived drought in the past, it is anticipated that a prolonged, intense drought would affect many Gila trout populations, in particular those occupying small headwater streams which are likely to dry or become intermittent. Gila trout populations are protected from downstream populations of nonnative trout by barriers. Downstream reaches are larger streams that historically could have provided refugia for populations threatened by stream drying. Downstream reaches are now occupied by nonnative trout. If Gila trout were to disperse downstream currently, they would be lost from their population once they passed over a barrier. However, based on the documented loss of

once occupied habitat (Miller 1950), downstream temperatures may already be marginally suitable and in the future, they may become too warm to be suitable for Gila trout. In addition to stream drying, there is a clear association between severe droughts and large fires in the Southwest (Swetnam and Baisan 1994), discussed below.

**Fire:** Since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970-1986. The total area burned is more than six and a half times the previous level (Westerling et al. 2006). In addition, the average length of the fire season during 1987-2003 was 78 days longer compared to 1970-1986 and the average time between fire discovery and control increased from 7.5 days to 37.1 days for the same time frames (Westerling et al. 2006). McKenzie et al. (2004) suggest, based on models, that the length of the fire season will likely increase further and that fires in the western United States will be more frequent and more severe. In particular, they found that fire in New Mexico appears to be acutely sensitive to summer climate and temperature changes and may respond dramatically to climate warming (McKenzie et al. 2004).

As discussed earlier, fire has had a major impact on several Gila trout populations in the action area. Although the effects of forest fire on Chiricahua leopard frog in the action area has not been documented, it does not mean that populations were not affected. While there is an emergency evacuation plan in place to rescue Gila trout populations threatened by forest fire, and it has been implemented successfully three times, it can take several years for the habitat to recover and reach the same levels of productivity. Increased frequency, intensity, or magnitude of forest fires as a result of climate change could have direct and indirect negative effects on Gila trout and frog populations.

**Floods:** Floods that occur after intense wildfires that have denuded the watershed are also a threat. As described above, several streams occupied by Gila trout have had populations of trout extirpated as a result of ash flows which occurred after fire (Rinne 1996, Brown et al. 2001). Consequently, an increase in rain on snow events, intense precipitation that is unseasonable, or heavy precipitation that occurs after fire could extirpate affected Gila trout and Chiricahua leopard frog populations.

#### **IV. Effects of the Action**

Effects of the action refer 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, that 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.

#### Chiricahua leopard frog



Prior surveys in the action area have found few frogs with the greatest number being a total of 28 tadpoles (B. Christman, pers. comm. 2009) and 6 adults in 2001 (C. Painter, NMDGF, pers. comm. 2002). Few frogs have been documented in the action area in recent years and it is unlikely that many will be encountered during this project.

Rotenone is variably toxic to amphibians, depending on their mode of respiration (i.e. gills, skin, buccopharyngeal, or lungs). Differences in sensitivity occur among taxa and lifestages. Larval, gill-breathing forms of amphibians are more sensitive to rotenone than adults (Table 3). Adults that are obligately aquatic or have high rates of cutaneous respiration are more sensitive as well. The range of lethal doses of rotenone-containing piscicides for amphibian larvae (0.0165-0.665 mg/L) overlaps to a large extent with lethal doses for fish (0.5-30. mg/L) (Chandler 1982, Fontenot et al. 1994; McCoid and Bettoli 1996). Cumulative mortality of Chiricahua leopard frog tadpoles (Gosner Stage 25) during 96 hour exposure of rotenone was zero for rotenone concentrations up to 0.5 mg/L and the 96 hr LC<sub>50</sub> was 0.79 mg/L ( $\pm$  0.15 mg/L) rotenone (Little and Calfee 2008, Table 4).

Table 3. Chemical toxicity of rotenone to frogs. (PAN Pesticides Database)

| Toxicity of rotenone to frogs (ppm) |           |             |                        |                        |
|-------------------------------------|-----------|-------------|------------------------|------------------------|
| Species                             | Lifestage | Formulation | 24 hr LC <sub>50</sub> | 96 hr LC <sub>50</sub> |
| Spotted frog                        | Adult     | 5% liquid   | 41.5                   | 9.65                   |
| Leopard frog                        | Adult     | 2.5% liquid | 24                     | 5.8                    |
| Tailed frog                         | Tadpole   | 5% liquid   | 0.04                   | 0.01                   |
| Leopard frog                        | Tadpole   | 5% powdered | 0.1                    | -                      |

Table 4. Cumulative mortality observed during 96 hour exposure of Chiricahua leopard frog tadpoles (Gosner Stage 25) to rotenone. N=12. (Little and Calfee 2008).

| Concentration<br>mg/L | Percent Mortality |       |       |       |
|-----------------------|-------------------|-------|-------|-------|
|                       | 24 hr             | 48 hr | 72 hr | 96 hr |
| 0                     | 0                 | 0     | 0     | 0     |
| 0.5                   | 0                 | 0     | 0     | 0     |
| 1.0                   | 90                | 90    | 95    | 95    |
| 2.0                   | 100               | 100   | 100   | 100   |
| 4.0                   | 100               | 100   | 100   | 100   |
| 8.0                   | 100               | 100   | 100   | 100   |

Generally mortality is absent in trials where adult frogs are exposed to rotenone concentrations used for fish removal (Fontenot et al. 1994; McCoid and Bettoli 1996, Grisak et al. 2007). Grisak et al. (2007) studied the response of Columbia spotted frog (*Rana luteiventris*) to rotenone and determined that piscicidal concentrations would not kill adults, as determined by 24- and 96-hr LC<sub>50</sub> tests. Based on the application rate of 1 ppm proposed for this project we do

not expect any direct mortality of adults from the rotenone. However, laboratory studies look at mortality and do not look at stress levels created, impacts to the immune system, or other temporary physiological effects that the frog may experience. Although the rotenone concentration that the frogs will be exposed to is far lower than the concentrations that have caused mortality in adults, we cannot assume that there would be no effect to them if they were exposed to the chemical. For example, other stressors such as chytrid fungus may render adult frogs more susceptible to piscicidal effects and exposure to rotenone may be an additional stressor that makes them more susceptible to the fungus.

Tadpoles are more susceptible to rotenone effects and concentrations significantly lower than the treatment concentration (1 ppm) may harm the tadpoles. However, tadpoles will likely occur primarily in low velocity, off channel environments which will be surveyed prior to treatment and piscicide application will only be used if fish are present. In addition, immediate and continuous degradation of rotenone applied to such a habitat would expose tadpoles to a decreasing concentration and less predictable rate of mortality than is recorded in a laboratory setting. At an application dose of 1ppm (equals 1 mg/L), 90 percent of the larvae died in 24 hours (Table 4). In a field setting, the concentration would be held relatively constant for 4-8 hours. After application is stopped the concentration of rotenone would immediately begin to decrease as sunlight, dilution, and organic matter acted on the substance. Consequently, the time that the tadpoles would be exposed to higher concentrations would be reduced compared to what is done in a laboratory setting.

Although salvage activities will be carried out prior to application of piscicides, and as many Chiricahua leopard frogs will be salvaged as can be found, it is not possible to ensure all individuals will be removed using live-capture techniques. A small number of tadpoles may remain in the treatment area where they could be exposed to the piscicide and killed. Those frogs exposed to rotenone, rescued, and placed in freshwater to recover would be harassed. Individuals that are found, captured through netting or electrofishing, and held in confinement also would be harassed.

We anticipate that implementation of the conservation measures will minimize harm to the Chiricahua leopard frog to the greatest extent possible. The removal of exotic trout from the West Fork and its project tributaries would reduce predation on frogs and tadpoles. Brown trout are very predaceous and feed on fishes, including other trout species that have been just stocked (Minckley 1973). Sublette et al. (1990) found that young brown trout feed principally on aquatic and terrestrial invertebrates in the drift, and larger individuals greater than 25 centimeters (9.8 inches) feed mainly on benthic invertebrates and small fish. Therefore, it is likely that larger brown trout also feed on frogs and tadpoles.

Concentrations of rotenone used to eliminate fish can temporarily reduce populations of some species of aquatic invertebrates, causing changes in macroinvertebrate community composition. Certain species of aquatic invertebrates are more sensitive to rotenone than others, and some take longer to recover than others (Engstrom-Heg et al. 1978). Most of the sensitive species are in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

The ability of aquatic invertebrates to survive a rotenone treatment depends on life history, oxygen requirements and habitat. In most cases, reduction of aquatic invertebrates was temporary with the majority of taxa recovering within 1-2 years (Binns 1967, Trumbo et al. 2000, UDWR 2002). The Green River, Wyoming had 130 miles of stream treated for 7 hours at 2.5-9.4 ppm rotenone. Recovery of the upper end began in one month, and began the following spring at the lower end. Only one taxon was missing after 2 years (Binns 1967). Cases where taxa were missing after 5 years treated streams at higher concentrations of rotenone and for longer durations than label requirements. The Strawberry River, Utah was treated for 48 hours at 3 ppm, two times label requirements. Consequently, only 46 percent of the invertebrate taxa recovered in the first year and 21 percent were still missing after 5 years (Mangum and Madrigal 1999). Engstrom-Heg et al. (1978) reported long-term impacts of rotenone are mitigated because those insects that were most sensitive to rotenone also tended to have the highest rate of recolonization. Short life cycles (Anderson and Wallace 1984), good dispersal ability (Williams and Hynes 1976) and generally high reproductive potential (Anderson and Wallace 1984) give aquatic invertebrates the capability for rapid recovery from disturbance (Jacobi and Deegan 1977; Boulton et al. 1992; Matthaei et al. 1996).

Preliminary observations from annual invertebrate sampling at six locations on the West Fork Gila River and its tributaries to monitor the effects of the prior antimycin treatments have been compiled (Jacobi 2006). A multi-metric assessment following approved Environmental Protection Agency (EPA) protocol was used to assess pre- and post-treatment aquatic macroinvertebrate communities. In comparison to pre-treatment community composition, the six sites varied from “non-impaired” (four sites), “moderately impaired” (one site) and “slightly impaired” (one site) after treatment. Generally, these initial results indicate that the most downstream location(s) within the treatment area showed more decreases in community attributes (e.g., percent reduction in standing crop, percent reduction in total taxa, and percent reduction in sensitive indicator species) than the sampling sites located upstream because they experienced higher concentrations of the piscicide.

Removal of fish by piscicide application usually results in an increase in the density of macroinvertebrates after initial declines post-application. This is primarily due to the absence of fish that consume macroinvertebrates (NMFWCO data from Mogollon Creek, 1996-1999, NMDGF data from Costilla Creek). Thus, there may be short-term impacts to food supplies for adult Chiricahua leopard frog. However, as discussed above, aquatic insect orders which are most sensitive to piscicides are mayflies, caddisflies, and stoneflies. Insects from these orders were not found in Chiricahua leopard frog stomachs (Christman and Cummer 2006). The insect orders which were most represented in the diet, dipterans and hemipterans both have life history adaptations that would reduce the effect of the piscicide on them. Veliids, gerrids, and mesoveliids all skate on the water surface and are air breathers; rotenone would have no effect on them. Although notonectids, corixids, and belostomatids live in the water they also depend on air obtained at the water surface, not from gills. In addition, adults in all these groups can fly allowing them to leave unsuitable aquatic habitat. For these reasons, it is anticipated that the treatment would have little effect on hemipterans. Dipterans could be affected by the treatment but many species within the order are tolerant to pollution, have a very short generation time, and

are good colonizers. Headwater reaches are not going to be treated and will therefore provide a source of colonizing insects. Therefore, we anticipate that dipterans would soon recolonize impacted areas.

Because adult Chiricahua leopard frog adults eat a wide variety of invertebrates, appear to eat aquatic insects in families that would be very tolerant to treatment, and because impacted areas would soon be recolonized it is anticipated that the temporary decline food production would have an insignificant effect on frog adults. Frog tadpoles are herbivorous and while some small invertebrates may be ingested incidentally, a reduction in aquatic macroinvertebrate density or a change in species composition would have an insignificant effect.

### Gila trout

Rotenone is a highly effective tool for removal of fish. It is absorbed through the gills and disrupts cellular respiration by inhibiting oxidative phosphorylation. It can be detected by fish and fish can reverse the effects of rotenone if they are exposed to fresh (i.e. untreated) water quickly. It is expected that there will be complete mortality of all native and nonnative fish exposed to treated water within the project area. Any Gila trout occurring in the treatment area during the piscicide application are not expected to survive.

Because streams in the action area have been treated before and no Gila trout have been stocked into the West Fork Gila River, very few trout exist in the system. However, Gila trout from Whiskey, White, or Langstroth creeks could have dispersed downstream into the West Fork Gila. Pre-treatment electrofishing surveys will be conducted in the upper West Fork Gila River to recover any Gila trout. No rainbow trout are in the upper reach of the West Fork Gila River to hybridize with the Gila trout so they will either be held in temporary, off-stream refugia or relocated to Whiskey Creek. Those moved to Whiskey Creek will be transported via oxygenated container and released in suitable habitat. Pre-treatment surveys will also be conducted in the White Creek drainage (including lower Langstroth and Rawmeat creeks). Gila trout from these areas will not be protected due to potential genetic contamination by rainbow trout. Some of these Gila trout may be pure, but it is not possible to determine in the field because hybrids and genetically pure trout can look very similar.

In previous piscicide applications in the treatment reaches on lower White Creek and the upper West Fork Gila River downstream of the Whiskey Creek confluence, fewer than 10 Gila trout were killed. No Gila trout mortalities were documented in the West Fork Gila River downstream of White Creek confluence. Given the previous mortalities documented in the proposed area, it is expected that no more than 10 Gila trout will be killed.

Disruption of the macroinvertebrate community may cause indirect effects on Gila trout. Aquatic insects comprise the most important component of the Gila trout's diet (Minckley and Milhalick 1981). Regan (1966) reported that adult flies, caddisfly larvae, mayfly nymphs, and aquatic beetles were the most abundant food items in stomachs of Gila trout in Main Diamond Creek. Both caddisflies and mayflies are very susceptible to rotenone so it is very likely that

there would be a decrease in the availability of suitable food immediately after treatment. However, there also will be no fish in the system after treatment, the aquatic invertebrate community is expected to recover quickly, and once fish are reintroduced, their abundance will be low; consequently, we anticipate the indirect effects of a temporary decrease in aquatic invertebrates to be insignificant to Gila trout.

## **V. Cumulative effects**

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. There are no State, tribal, or private inholdings within the project area. This project area is located in a roadless portion of the Gila Wilderness, and no cumulative effects from the actions of State, tribal, or private actions are anticipated. However, cumulative effects from climate change are expected.

The Intergovernmental Panel on Climate Change (IPCC 2007) report outlines several scenarios that are virtually certain or very likely to occur in the 21st century; these are that 1) over most land, there will be warmer and fewer cold days and nights, and warmer and more frequent hot days and nights, 2) areas affected by drought will increase, and 3) the frequency of warm spells/heat waves over most land areas will likely increase. The IPCC makes equally sobering predictions for ecosystems; the resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects), and other global drivers, and with medium confidence predicts that approximately 20-30% of plant and animal species assessed so far are likely to be at an increased risk of extinction if increases in global average temperature exceed 1.5 – 2.5°C (IPCC 2007).

Periods of drought in the southwest are not uncommon. However, the frequency and duration of dry periods may be altered by climate change. Anthropogenic climate change, and associated effects on regional climatic regimes, is not well understood, but the predictions for the Southwest indicate less overall precipitation and longer periods of drought. These species, along with their habitat, will almost certainly be affected in some manner by climate change; the magnitude and extent of the change cannot be quantified at this time.

## **VI. Conclusion**

After reviewing the current status of the frog and Gila trout, the environmental baseline for the action area, the anticipated effects of the proposed rotenone treatment, and cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the frog or Gila trout. No critical habitat has been designated for either species, thus none would be affected. We make these findings for the following reasons:

Chiricahua leopard frog

1. It is likely that very few and possibly no frogs may be found in the action area.
2. It is anticipated that the conservation measures that are part of the project proposal will provide a high level of protection for Chiricahua leopard frog egg masses, larvae, or adults that are encountered.
3. The frog occurs over a large area of southeastern Arizona, southwestern New Mexico, and northwestern Mexico. The proposed action affects a very small portion of the species' range.
4. Although there may be short-term adverse effects to the frog, removal of nonnative trout should improve frog recruitment and survival in the action area and be a long-term benefit.
5. There is no evidence that rotenone will have a direct effect on adult frogs. Although there may be indirect effects to adults through capture, handling, holding, or exposure to rotenone, based on prior surveys the number of adults that may be encountered is expected to be extremely low.
6. Potential off-channel suitable habitats for frogs in the action area that are not occupied by fish will not be treated with rotenone.
7. It is anticipated that very few tadpoles will be found. A very small number of tadpoles may be missed in the pre-treatment surveys, and not detected during treatment, and consequently, killed by the rotenone treatment.

#### Gila trout

1. Pre-treatment surveys will be conducted to retrieve and move genetically pure trout from the treatment area.
2. Although a small number of Gila trout may be killed by the project, removal of nonnative trout will expand the range of Gila trout by approximately 23 miles, directly contributing to the recovery of the species.

#### **Incidental Take Statement**

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Harass is defined in the same regulation by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take of a listed animal species that is incidental to, and not the purpose of, the carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of sections 7(b)(4) and 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act 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 implemented by the Service and their cooperators (NMDGF, Forest Service) so that they become binding conditions of any grant or permit issued to the applicants, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Service has a continuing duty to regulate the activity covered by this incidental take statement. If the Service or their cooperators fail to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

### **Amount and Extent of Take Anticipated**

We anticipate take of Chiricahua leopard frog will occur. We describe take in the forms of harassment and mortality.

**Harassment:** The forms of harassment described below will be short in duration, with pre-exposure behaviors resuming once the frogs are released back into their original environments. Given the limited area affected over a short duration, we do not expect these forms of harassment will lead to any long-term significant effects on behaviors such as breeding, feeding, or sheltering.

1. Chiricahua leopard frog is expected to exhibit an avoidance response to capture activities. Avoidance behavior, or fleeing from the disturbance, represents a disruption in normal behavior and an expenditure of energy that an individual animal would not have experienced in the absence of the proposed action.
2. The holding of frogs is expected to be an additional form of stress as they will be held in an unfamiliar environment with limited food availability for 24 to 48 hours.
3. Adults exposed to the piscicide rotenone will be subjected to a toxicant they would not otherwise experience if not for the project.
4. Tadpoles that are exposed to rotenone, captured, and placed in freshwater to recover will be harassed.
5. Pre-treatment electrofishing surveys for fish may incidentally stun a few frogs and tadpoles, a form of harassment.

The precise level of take from harassment resulting from this action cannot be precisely quantified, but should be 25 individuals or less.

**Kill:** In addition to harassment there is the possibility that mortality could occur to a few individuals from the proposed action as described below:

1. A small number of tadpoles may be missed in the pre-treatment surveys and collections, and killed by exposure to the rotenone.

2. Although unlikely, in the process of capture, a tadpole or an adult could accidentally be killed.

No more than two Chiricahua leopard frog individuals may be killed during this project.

We anticipate take of 10 Gila trout will occur in the following manner:

1. Gila trout not recovered in the pre-treatment electrofishing surveys will be killed. It is anticipated that fewer than 10 Gila trout will be taken.
2. Gila trout recovered in the upper West Fork Gila will be shocked, captured, handled, and transported. Harassment from these activities is covered under Recovery Permits held by the NMDGF and the Service. Take for these activities is not covered in this BO.

### **Reasonable and Prudent Measures**

No reasonable and prudent measures or terms and conditions are identified, as the conservation measures include all reasonable and prudent measures necessary to minimize incidental take.

### **Conservation recommendations**

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" has been defined as Service suggestions regarding discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's section 7(a)(1) responsibility. In order for the Service to be kept informed of activities that either minimize or avoid adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of the conservation recommendations below. The Service recommends the following conservation recommendations be implemented for the frog:

1. Monitor incidental take as it occurs. Submit a report to us that documents all frog occurrences within the project area, describes how the conservation measures were implemented, and documents all frogs captured or killed during the project.

### **REINITIATION - CLOSING STATEMENT**

This concludes formal consultation on the on the proposed action to chemically treat seven streams in the upper West Fork Gila Drainage, Catron County, New Mexico to remove exotic trout in order to reintroduce Gila trout. 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 affect listed species or critical habitat in a manner or to an extent not considered in this opinion;



(3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

We appreciate your continued coordination and support for the recovery of the Gila trout and protection of the frog. In future communications regarding this consultation, please refer to consultation #22420-2008-F-0143. Please contact Marilyn Myers or Michele Christman if you have any comments or questions at the letterhead address or at (505) 346-4761 or 346-4715.

/s/  
Wally Murphy

cc:

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