United States Department of the Interior

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Cons. # 2-22-03-F-553

Marcia R. Andre, Forest Supervisor
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Dear Ms. Andre:

Thank you for your January 27, 2003, "Biological Assessment/Evaluation for Restoration of Rio Grande Cutthroat Trout in the Las Animas Creek Watershed." The Gila National Forest (Forest) is proposing to establish a pure population of Rio Grande cutthroat trout in the Las Animas Creek watershed, as well as protect native Rio Grande suckers and Rio Grande chubs. The current non-native fish community, which consists of rainbow and rainbow-cutthroat hybrid trout and longfin dace, would be eradicated with the fish toxicant antimycin. Antimycin is an antibiotic registered by the Environmental Protection Agency for use as a piscicide and is lethal to some aquatic organisms by irreversibly blocking cellular respiration. The Forest, in cooperation with the New Mexico Department of Game and Fish (NMDGF) and Turner Ranch Properties (Ladder Ranch), propose to treat approximately 30 stream miles of the Las Animas and Cave Creek drainages in Sierra County, New Mexico.

In your assessment, the Forest found that implementation of this project "may affect, but is not likely to adversely affect" two federally threatened species: The bald eagle (*Haliaeetus leucocephalus*) and Mexican spotted owl (*Strix occidentalis lucida*). The U.S. Fish and Wildlife Service (Service) concurs with your determinations for these two species for the following reasons:

Bald eagle

- There are no nesting bald eagles in the action area. Additionally, if bald eagle nesting was discovered in the area, project activity would stop and the Forest would reinitiate consultation and/or would not continue implementation during the bald eagle nesting season.

- Bald eagles commonly winter on the Ladder Ranch portion of Las Animas Creek, and if a substantial number of fish carcasses were available, it is likely that bald eagles would forage

on them. Antimycin is not harmful to birds from exposure to water, drinking water, or ingestion of dead fish at proposed levels (Walker et al.1964; Schnick 1974). The quantity of dead fish that would have to be consumed to produce toxic effects is physiologically and physically impossible to reach. In addition, the availability of antimycin-exposed fish would be reduced by collection and burial.

- The potential for project activity to temporarily disturb foraging bald eagles is insignificant and/or discountable, because the eagles primarily forage at reservoirs located a significant distance downstream from the action area. Additionally, the project will not adversely affect roosting bald eagles, because most activities will occur during daylight hours while the birds are typically foraging at distant reservoirs. If alternative roosting sites should be needed, they are available along the creek downstream from the action area.

Mexican spotted owl

- Two "Protected Activity Centers" (PACs) for the Mexican spotted owl (owl) have been identified in the action area: East Curtis PAC and Gooseberry PAC. Roosting/nesting sites for these PACs are located in secondary drainages that flow into Las Animas Creek. The remainder of the action area is riparian restricted habitat, for which the owl recovery plan (U.S. Fish and Wildlife Service 1995) gives broad guidance to maintain and restore as owl habitat. The upper end of the unsurveyed Las Animas main-stem is potential nesting/roosting habitat. No nesting/roosting habitat occurs on the Ladder Ranch; however, owls may winter there.

- This project does not modify stand structure of owl protected or restricted habitat and stays within the guidelines of the owl recovery plan. The proposed antimycin treatment may cause the trampling of some herbaceous vegetation, but would not change the condition of any of the woody vegetation within the two designated PACs or within any of the riparian restricted habitat.

- Owl nesting habitat is not located in the riparian area where project implementation would occur, and their foraging activity is crepuscular or nocturnal, and most project activity would take place during the day. In addition, because owls and their primary prey are not dependent on aquatic food sources or the aquatic ecosystem, the removal of fish from the Las Animas system would not cause any negative effects. It is unlikely that activities associated with the proposed action would cause adverse effects to owls at any time of year.

Please contact the Service to verify that the above determinations and concurrence are still valid if: 1) Future surveys detect listed, proposed or candidate species in habitats where they have not been previously observed; 2) the project is changed or new information reveals effects of the actions to the listed species or their habitats to an extent not considered in this evaluation; or 3) a new species is listed that may be affected by this project.

The remainder of this biological opinion will deal with the effects of restoring Rio Grande cutthroat trout in the Las Animas Creek watershed on the threatened Chiricahua leopard frog (*Rana chiricahuensis*) (frog) pursuant to section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. § 1531 *et seq.*). The Forest has determined that the proposed action "may affect, is likely to adversely affect" the frog.

Consultation History

This biological opinion is based on information provided in the January 27, 2003, final biological assessment/evaluation for restoration of Rio Grande cutthroat trout in the Las Animas Creek watershed by the Gila National Forest; discussions with and supplemental information provided by the Forest on May 5 and 27, 2003; supplemental information from Ladder Ranch biological staff on July 1 and July 16, 2003; information contributed by ranid frog experts on July 24 and July 28, 2003; and other sources of information in Service files. An administrative record of this consultation is on file at the New Mexico Ecological Services Field Office (NMESFO) in Albuquerque.

As described in the assessment, the Ladder Ranch agreed to construct a fish migration barrier on their private land prior to commencement of antimycin treatment to prevent reinvasion of the restored area by non-native fishes. The barrier would be located approximately 12.75 miles (20.52 kilometers) downstream from the Forest boundary and consist of a concrete structure designed as a physical barrier to non-native fish at lower flows and a velocity barrier during high flow events. The barrier would span the active flood plain of Las Animas Creek and be anchored to bedrock on each side of the channel. Because the activity would occur on private land rather than on Forest land, the Black Range District Ranger does not have authority or jurisdiction over this action. Ladder Ranch staff concluded that the fish barrier would not impact any listed species, and they completed its construction in June 2003 (C. Kruse, Turner Enterprises, Incorporated, pers. comm., 2003). Because this activity has already been completed, it will not be analyzed as part of the proposed action in this opinion.

BIOLOGICAL OPINION

I. Description of the Proposed Action

The Forest is proposing to establish a pure population of Rio Grande cutthroat trout and protect native Rio Grande suckers and Rio Grande chubs in the Las Animas Creek watershed. The current non-native fish community, which consists of rainbow and rainbow-cutthroat hybrid trout and longfin dace, would be eradicated with the commonly used fish toxicant, antimycin (Gresswell 1991; Stefferud et al. 1992; Tiffan and Bergersen 1996). Reintroducing native Rio Grande cutthroat trout without complete rainbow trout removal would result in a hybrid swarm and loss of the pure native trout genotype, as these two species lack full reproductive isolation. In addition, the assessment states that longfin dace may compete with the native suckers and chubs for space and food (Minckley 1973), and this competition may lead to decline or local extirpation of native Rio Grande chubs (Calamusso 1998).

The Las Animas Creek action area is located in Sierra County, New Mexico, Townships 14 and 15 south, Range 9 west; Township 14 south, Range 8 west; and Townships 14 and 15 south, Range 7 west, from upstream to downstream. The stream corridor within the project area is approximately 27 miles (43.5 kilometers) from the headwaters of Holden Prong downstream to the proposed barrier site on the Ladder Ranch, although actual chemical treatment would occur on only 26 miles (41.8 kilometers), as the uppermost 2 miles (3.2) kilometers are currently barren of fish. The effects of antimycin treatment may extend in the stream current for a short portion beyond the barrier site on the Ladder Ranch. Only that portion of Cave Creek located on the Ladder Ranch contains trout and will require treatment, for a total treatment length of 30 miles (48.3 kilometers). Cave Creek is located in Township 15 south, Range 7 west.

Because sunlight, water chemistry, and organic matter can influence antimycin toxicity, the exact concentrations to be used would be determined by conducting bioassays of water chemistry under field conditions. Because antimycin is generally lethal to trout and char in dosages from 6 to 12 parts per billion (ppb) under most field conditions, applied dosages would not exceed 12 ppb. In areas where the stream is flowing, calibrated drip stations would deliver the required dosage of antimycin to the stream. These stations would be spaced approximately 1,000 feet (304.8 meters) apart along the stream channel and would be coordinated to maintain the concentration of antimycin in the water column. Antimycin decomposes naturally in the environment by hydrolysis, with sunlight intensity, stream turbulence, and water chemistry influencing the speed of decomposition; therefore, there would be a need to increase concentrations with drip stations along the stream corridor. Simultaneous with these drip treatments, individuals would also treat any isolated pools manually with surface applicators by spraying dilute antimycin on the surface or injecting it into the pool.

The project area would be divided into segments treated over approximately 7 days, and the entire stream would be treated during the fall or winter seasons in any year beginning fall 2003 through 2007. Stream flows during the fall and winter low-flow periods generally do not exceed 1 to 2 cubic feet per second, and several thousand feet of stream channel can be dry or contain isolated pools, which would be treated with sprayers. Treatment would begin in the headwater segment and progress downstream; field crews would confirm successful treatment of a segment within 48 hours of treatment with electroshocking surveys. If it is determined that all targeted individuals were not removed from the stream, the segment would be retreated prior to progressing further. A maximum of up to three treatments, the original plus up to two additional treatments, would be conducted if needed in a given stream segment during a treatment cycle.

At the fish barrier, residual antimycin would be neutralized with potassium permanganate, a common oxidizing reagent for detoxification (Marking and Bills 1975). Because organic matter in the water can bind potassium permanganate, actual concentrations needed to neutralize antimycin, generally 1 part per million, would be determined with bioassays under field conditions at the time of treatment. A primary detoxification station would be established to dispense potassium permanganate at the downstream end of the treatment section at least 2 hours before antimycin reaches the barrier. A secondary site would be located downstream to further neutralize the water, if needed. Live trout would be located below each station to test the

success of detoxification. The stations would run for 8 hours after the last antimycin-laced water passes the barrier. Potential impacts may occur for a short distance downstream from the detoxification station, as time is required for potassium permanganate to mix in the water and neutralize the antimycin. Antimycin and potassium permanganate would be applied in accordance with antimycin protocols approved by the State of New Mexico.

Prior to the application of fish toxicant, native fish would be removed from Las Animas Creek and held locally in tanks or unaffected pools in the treatment area or transported to other temporary locations (e.g., livestock tanks or other streams) on the Ladder Ranch. Currently, these species are found from the barrier upstream to approximately the Water Canyon confluence. While all individuals would not be captured prior to treatment, sufficient numbers to restock the stream after treatment would be temporarily removed.

During treatment, and in accordance with NMDGF protocol, all visible fish mortalities would be collected and buried at strategic locations in the floodplain along each treatment section, including some in the wilderness area. Many mortalities sink or are trapped under substrate, thus not all individuals would be collected. While it has been shown that ingesting fish exposed to antimycin is not harmful at the concentrations discussed here, fish would be collected to limit the exposure of scavengers to antimycin, to prevent attraction to a temporary food source, and for aesthetic reasons.

Once bioassays indicate that antimycin has left the treatment area, electroshocking surveys would be performed immediately upon completion of treatment, as well as 6 months post-treatment (or for some period of time after antimycin treatment has been completed and prior to introduction of Rio Grande cutthroat trout) to ensure that all non-native fish were eliminated. If it appears that treatment was successful, Rio Grande chubs and Rio Grande suckers would be restocked into the stream. Once the 6-month survey confirms successful extirpation of the non-native salmonid population, genetically pure Rio Grande cutthroat trout would be stocked into the stream during the month of July following successful treatment, as well as in subsequent years, until it is agreed among the cooperators that stocking is no longer necessary. The NMDGF would provide disease-free, genetically pure Rio Grande cutthroat trout of the Rio Grande lineage from their hatchery system. If, during post-treatment surveys, species that were targeted for removal were found, the stream would be retreated following the protocol outlined above.

This project would be conducted by approximately 15 to 20 individuals employed by the Forest, NMDGF, and the Ladder Ranch. The application of antimycin would be under the supervision of a certified pesticide applicator. While treating the upper section in the wilderness area, all applicable laws regarding wilderness activities would be followed.

The Forest proposed incorporating the following conservation measures for the frog:

- Because tadpoles could be present in the water column during the proposed antimycin treatment in fall, there is potential for harm due to antimycin toxicity. To minimize harm to

frogs, trained herpetologists would collect frogs and tadpoles prior to treatment and hold them in off-channel sites or move them upstream to a previously treated segment. Tadpoles may be held for 24 to 48 hours. If a stream section needs to be retreated, tadpoles may be relocated to another part of the stream. When tadpoles are moved, the water temperature between the area from where the frogs are being taken and the area where frogs are being held would be tempered to within a few degrees of each other to avoid any temperature shock or undue stress on the frogs and/or tadpoles. If frogs and/or tadpoles are abundant, holding buckets and/or areas would not be overloaded. To avoid damaging the skin of tadpoles, holding nets and dip nets with a soft mesh would be used.

- Because bullfrogs (*Rana catesbeia*) are a non-native species and a competitor with and predator of the frog, this species would not be removed.

- The proposed action includes electroshocking surveys to determine the success of the treatment. This activity has the potential to harm frogs and tadpoles. To minimize this potential, electroshocking survey crews would be instructed to watch for frogs and tadpoles and would be required to stop shocking until the frog can be flushed out of the area being shocked and/or until the frog or tadpole is held in a dip net while shocking proceeds.

- Chytrid skin fungus (*Batrachochytrium dendrobatidis*), which has been documented to be responsible for frog population declines, can survive in wet or muddy environments and could conceivably be spread by the implementation of the proposed action. To prevent the transfer of chytrid fungus, all equipment, boots, nets, and buckets that have been previously exposed to water at another location would be disinfected prior to use in Las Animas Creek with a 10 percent chlorine bleach solution or ammonia.

II. Status of the Species

The frog was federally listed on June 13, 2002, as a threatened species without critical habitat (U.S. Fish and Wildlife Service 2002). Leopard frogs (*Rana pipiens* complex), long considered to consist of a few highly variable species, are now recognized as a diverse assemblage of more than 2 dozen species (Hillis 1988), with many species described in the last 20 years. Platz and Platz (1973) demonstrated that at least three distinct forms of leopard frogs occurred in Arizona, including the southern form, which was subsequently described as the Chiricahua leopard frog (Platz and Mecham 1979).

This new species was distinguished from other members of the *Rana pipiens* complex by a combination of characters, including a distinctive pattern on the rear of the thigh consisting of small, raised, cream-colored spots or tubercles on a dark background, dorsolateral folds that were interrupted and deflected medially, stocky body proportions, relatively rough skin on the back and sides, and often green coloration on the head and back (Platz and Mecham 1979). The species also has a distinctive call consisting of a relatively long snore of 1 to 2 seconds in duration (Davidson 1996; Platz and Mecham 1979). Snout-vent lengths of adults range from 54 to 139 millimeters (2.1 to 5.4 inches) (Platz and Mecham 1979).

The frog is an inhabitant of cienegas (wetlands), pools, livestock tanks, lakes, reservoirs, streams, and rivers at elevations of 3,281 to 8,890 ft (1,000 to 2,710 m) 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 species 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). Based on Painter (2000) and the latest information for Arizona, the species is still 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 and possibly the Yaqui drainage in New Mexico. It has not been found recently in many rivers, valleys, and mountains ranges, 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, no recent records (1995 to the present) exist for the following mountain ranges or valleys: Pinaleno Mountains, Peloncillo Mountains, Sulphur Springs Valley, and Huachuca Mountains. Moreover, the species is now absent from all but one of the southeastern Arizona valley bottom cienega complexes. In many of these regions, frogs were not found for a decade or more despite repeated surveys. Recent surveys suggest the species may have recently disappeared from some major drainages in New Mexico (C. Painter, New Mexico Department of Game and Fish, pers. comm., 2000).

In New Mexico, the frog occurs in southwestern New Mexico and is most common in the Gila and San Francisco River drainages (Degenhardt et al. 1996). Jennings (1995) stated that the Gila Wilderness in the Forest has the greatest potential for supporting additional extant populations and for securing an intact metapopulation that would have a good chance of long-term persistence. 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).

Populations of the frog occurring in thermally stable habitats (e.g., warm springs) may be reproductively active throughout the year. Jennings (1988, 1990) reported reproductive activity throughout the year in Alamosa Warm Springs in Socorro County, New Mexico, where the water temperature remained above 61°F (16°C). He also found that in a nearby stock tank with varying water temperatures, reproduction occurred only during late April through May, and again from mid-August through late September.

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

The food habits of the frog have not been studied in New Mexico, although like other leopard frogs it is likely that it eats a wide variety of insects and other arthropods (Degenhardt et al.

1996). Sredl and Jennings (in press) indicate that the tadpoles are herbivorous and likely feed on diatoms, phytoplankton, filamentous green algae, water milfoil, and duckweed.

Threats to this species include predation by non-native organisms, disease, drought, floods, degradation and destruction of habitat, water diversions and groundwater pumping, disruption of metapopulation dynamics, increased possibility of extirpation due to low numbers, and environmental contamination (U.S. Fish and Wildlife Service 2002). Numerous studies indicate that declines and extirpations of the frogs are at least in part caused by predation and possibly competition by non-native organisms, including fish in the family Centrarchidae (*Micropterus* spp., *Lepomis* spp.), bullfrogs, tiger salamanders (*Ambystoma tigrinum mavortium*), crayfish (*Oronectes spp.*), and several other fish species (Fernandez and Rosen 1996; Rosen et al. 1994, 1996; Snyder et al. 1996; Fernandez and Bagnara 1995; Sredl and Howland 1994; Clarkson and Rorabaugh 1989). For example, in the Chiricahua region of southeastern Arizona, Rosen et al. (1996) found that almost all perennial waters investigated that lacked introduced vertebrate predators contained frogs. In perennial waters with introduced predators, particularly fishes and bullfrogs, Chiricahua leopard frogs were generally absent (Sredl and Howland 1994).

Disruption of metapopulation dynamics is an important factor in the regional loss of populations (Sredl and Howland 1994; Sredl et al. 1997). Frog populations are often small, with dynamic habitats (appearing and disappearing), resulting in a relatively low probability of long-term population persistence. Historically, populations were more numerous and closer together. If populations disappeared due to drought, disease, or other causes, extirpated sites could be recolonized by immigration from nearby populations. However, as the numbers of populations declined and became more isolated, it is less likely the areas previously occupied would be recolonized. In addition, most of the larger source populations along the major rivers have disappeared. The species has been extirpated from about 75 percent of its historic localities in Arizona and New Mexico (Degenhardt et al. 1996).

Recent evidence suggests that a chytridiomycete skin fungi is partly responsible for observed declines of frogs, toads, and salamanders in Panama, Costa Rica, Brazil, Ecuador, Uruguay, Australia, New Zealand, Spain, Germany, South Africa, Kenya, Mexico, and the United States (Speare and Berger 2000; Longcore et al. 1999; Berger et al. 1998). Ninety-four species of amphibians have been reported as infected with the chytrid fungus (*Batrachochytrium dendrobatidis*) (Speare and Berger 2000). In Arizona, chytrid infections have been reported from the frog, Rio Grande leopard frog (*Rana berlandieri*), plains leopard frog (*Rana blairi*), lowland leopard frog (*Rana yavapaiensis*), Tarahumara frog (*Rana tarahumarae*), canyon treefrog (*Hyla arenicolor*), and Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) (Morell 1999; Sredl and Caldwell 2000).

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).

The disease, Postmetamorphic Death Syndrome (PDS), was implicated in the extirpation of frog populations in Grant County, New Mexico, as well as in other frog and toad species (Declining Amphibian Populations Task Force 1993). All stock tank populations of the frog in the vicinity of Gillette and Cooney tanks in Grant County disappeared within a 3-year period, apparently as a result of PDS. The syndrome is characterized by death of all or a majority of recently metamorphosed frogs in a short period of time. The syndrome appears to spread among adjacent populations, causing regional loss of populations or metapopulations.

III. Environmental Baseline

A. Status of the species within the action area

Las Animas Creek is one of the major drainages on the east side of the Forest that flows into the Rio Grande. This watershed is within the historical range of the frog. Surveys of the Las Animas drainage during the summer of 2001 documented four frogs in Cave Creek, and none in Las Animas Creek (Christman 2002). The documented population in the action area occurs along a section of Cave Creek that is located on the Ladder Ranch. Frog habitat in both creeks is being negatively impacted by bullfrogs (Christman 2002). Approximately 30 miles (48.3 kilometers) of potential frog habitat occurs within Las Animas and Cave Creeks in the action area.

B. Factors affecting the species environment within the action area

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.

The watershed area above the barrier on the Ladder Ranch is approximately 93 square miles (240.9 square kilometers). The Forest administers the upper 14 miles (22.5 kilometers) of stream, of which 9.3 miles (15 kilometers) is in the Aldo Leopold Wilderness Area, and the remainder is located on the Ladder Ranch. The only perennial tributary to Las Animas Creek above the barrier is Cave Creek. Cave Creek flows from its headwaters on the Forest through other private land holdings before entering the Ladder Ranch approximately 4 miles (6.4 kilometers) from its confluence with Las Animas Creek.

Flow conditions are typical for a southwestern stream, with elevated flows in the spring during snowmelt and again in late summer during monsoon season. Bankfull or channel forming flow on Las Animas Creek is estimated to be approximately 200 cfs. During low flow periods in summer and winter, the stream often flows underground, resulting in some reaches with surface flow and others with intermittent pools. Volumes of water in the flowing reaches are approximately 1 to 3 cfs during low flow periods.

Elevations across the study site range from 8,695 feet (2,650 meters) at the headwaters to approximately 5,000 feet (1,524 meters) at the barrier site. The upland area is generally forested and mountainous on the Forest segment of the stream, and rugged, desert shrubland on the Ladder Ranch. There is little wetland habitat within the action area; it mainly consists of aquatic habitats and adjacent riparian vegetation. These riparian habitats range from low (early) successional stage, such as near the confluence of Cave Creek and Las Animas Creek, to high (late) successional stage, exemplified by the mixed-conifer riparian habitat near the upper reaches of the drainage. Riparian vegetation grades from a Douglas fir (*Psuedotsuga menzesii*) and ponderosa pine (*Pinus ponderosa*) community, with some Arizona walnut (*Juglans major*) and narrowleaf cottonwood (*Populus angustifolia*) in the higher elevations, to Arizona alder (*Alnus oblongifolia*), Arizona sycamore (*Platanus wrightii*), and cottonwoods (*Populus* sp.) in the middle sections near the Forest and Ranch boundary, and finally changing to a cottonwood (*Populus fremontii*)-willow (*Salix gooddingii*) community on the Ladder Ranch (The Nature Conservancy 1995).

Stream habitat at higher elevations is predominately a step and pool system with channel gradients of three to six percent. In the lower reaches of the Forest and on the Ranch, the stream becomes more intermittent at low flows, with deeper pools maintaining perennial water, and a channel gradient of less than two percent. Substrates are generally gravels and cobbles, with sands and smaller fines found at the channel margins. Large boulders are distributed throughout the active channel as evidence of large, sediment mobilizing flows. Large woody debris and organic material is common and distributed throughout the system from the headwaters to the barrier site.

The macroinvertebrate community is dominated by *Diptera* (true flies), *Ephemeroptera* (mayflies), *Coleoptera* (beetles) and *Trichoptera* (caddisflies), which generally make up about 90 percent of the aquatic macroinvertebrate community (McGuire 1998). Other orders are also present, including *Coleoptera* (beetles), *Plecoptera* (stoneflies), and *Odonata* (dragonflies). Abundances of macroinvertebrates are generally low in Las Animas Creek when compared to abundances elsewhere on the Forest (Mangum 1985, Van Eimeren 1988). However, densities of macroinvertebrates vary considerably seasonally and spatially, and these numbers may represent the low of annual population cycles, as they were collected during the dryer summer months (McGuire 1998).

Designated uses within the action area include fish culture, irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, secondary contact, and warmwater fisheries. Water uses are primarily recreational (cold water fishing, camping) on the Forest, and bison (*Bison*

bison) watering on the Ladder Ranch, although livestock are seldom found in this area of the Las Animas drainage. The Ladder Ranch is the first adjudicated irrigator on the stream and diverts water just upstream from the barrier site. Agriculture and livestock watering become important uses downstream from the barrier site, where the Creek leaves the action area.

Approximately 25 percent of the water containing non-native trout in Las Animas Creek is found within the wilderness area. This area is managed by the Forest according to the intent of the Wilderness Act and objectives of the Gila National Forest Plan to preserve natural characteristics and ecosystem functions, as well as minimize human disturbance. Evidence of human impact is rare, with a decaying stock corral and invasive, non-native vegetation the most obvious signs of historical use. Little confirmed information is available regarding use of the Aldo Leopold Wilderness Area in the vicinity of the proposed project. Because of limited access, use of the upper Las Animas watershed along the stream corridor is likely limited to a few backcountry hikers, anglers, and hunters. Ladder Ranch personnel indicate that they rarely observe human activity within the drainage (S. Dobrott, Ladder Ranch Manager, pers. comm., 2002).

As described in the assessment, the Ladder Ranch agreed to construct a fish migration barrier on the Ranch prior to commencement of antimycin treatment to prevent reinvasion of the restored area by non-native fishes. The barrier spans the active flood plain of Las Animas Creek and is anchored to bedrock on each side of the channel (C. Kruse, Turner Enterprises, Incorporated, pers. comm., 2003). However, because of the geologic structure of the Las Animas valley (i.e., sufficient sediment input downstream from the barrier) and the ability of larger flow events to move sediment over the barrier, there should be minimal impact of the barrier on sediment recruitment or makeup in Las Animas Creek below the barrier.

Once the area behind the barrier fills with sediment, the structure would act similar to a small waterfall or step in the stream system, there would be little impoundment of water, and the barrier would not affect stream temperatures or volume and timing of flow downstream. Because the storage of sediment upstream from the barrier would reduce the streambed slope to nearly zero for about 400 feet (121.92 meters), there would be some reduction in stream power and ability to move larger sediment at this point.

The Turner Endangered Species Fund will be conducting a study funded by the Service on habitat use and movement of Rio Grande suckers on the Ladder Ranch, including Las Animas Creek. This project will provide information on the distribution, habitat use, and movement patterns of Rio Grande suckers for the development of a management plan for this species on the Ladder Ranch. The NMESFO consulted on this proposal on July 8, 2003, and incidental take of one frog was anticipated due to injury or death. The proposed electroshocking activities can adversely impact frogs by causing rigidity and muscle spasms that may result in internal injuries and increased susceptibility to predation.

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. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The proposed action should have little long-term effect on aquatic habitats and minimal impacts on riparian vegetation. Some riparian grasses may become trampled as piscicide applicators move up and down the stream corridor with gear and pack animals. However, these impacts would be small due to limited travel in any given area, and moving camp and pack animals' pasture daily would allow the vegetation to recover. Burial pits for fish mortalities would be excavated within the active flood plain in an area currently devoid of vegetation (e.g., gravel bars).

The proposed application of 8 to 12 ppb antimycin in the project area would result in mortality of all trout, which is the goal of the proposed project, as well as extensive mortality or elimination of longfin dace, and temporary removal of Rio Grande sucker and Rio Grande chub. The removal of non-native fish from Las Animas and Cave Creeks may, at least temporarily, reduce predation on frogs and tadpoles, because these species can predate eggs and tadpoles and reduce frog populations (Sredl and Howland 1994).

In areas with varying thermal regimes, frog reproduction generally takes place from late April through May and from mid-August through late September, and time from hatching to metamorphosis may be 8 to 9 months (Degenhardt et al. 1996). The timing of reproduction suggests that frog tadpoles could be present in the water column during the proposed action. Therefore, there is potential for some injury to or mortality of the species due to antimycin toxicity. Field studies of antimycin did not detect an effect on leopard frogs and tadpoles at the standard application rate of 10 ppb used for fish removal (Schnick 1974). However, some variation to this application rate may occur in this proposed action, because additional antimycin would be applied to side channels with backpack sprayers, and concentrations of antimycin in stream currents are likely to be difficult for piscicide applicators to precisely control. Lab exposure studies have not shown an effect on the northern leopard frog (*R. pipiens*) at concentrations up to 48 ppb (Lesser 1972). Tiger salamanders survived exposure at 80 ppb for 96 hours; while bullfrog tadpoles survived 20 ppb, but died when exposed to 40 ppb for 24 hours (Walker et al. 1964). In a laboratory experiment, leopard frogs showed 50 percent mortality at antimycin concentrations from 48 to 59 ppb (Lesser 1972, cited in Schnick 1974). It has been suggested that antimycin impacts on species are highly variable and influenced by water chemistry and temperature and iron concentrations (B. Rosenlund, U.S. Fish and Wildlife Service, pers. comm., 2003). Antimycin may be lethal to western boreal toad (*Bufo boreus boreus*) tadpoles at 7.14 ppb when exposed statically in a lake situation for less than 48 hours (B. Rosenlund, U.S. Fish and Wildlife Service, pers. comm., 2003).

The Forest has proposed measures to protect the frog. To minimize potential harm, trained herpetologists would collect tadpoles prior to treatment in each segment. Tadpoles would be moved to safe off-channel pools, aerated buckets or to previously treated habitats upstream of the collection site to minimize exposure to the piscicide. Because chytrid skin fungus has been responsible for declines of frogs, all equipment that has been previously exposed to water at another location would be disinfected prior to use in Las Animas Creek in order to prevent transfer of the chytrid fungus. Bullfrog tadpoles would not be salvaged prior to treatment and any treatment-related mortality would benefit the threatened frog by reducing numbers of a direct competitor and predator. However, some frog injury or mortality may result from this proposed action, either from exposure to antimycin or from handling stress. Capturing and holding frogs and tadpoles would cause harassment, but serious injury is not anticipated. It is unlikely that all frogs and tadpoles can be captured, so some injury may occur from antimycin treatment. In addition, except in thermal waters, in fall or winter, when this project is proposed to occur, frogs and tadpoles are much more difficult to survey for and detect (B. Christman, Ladder Ranch ranid frog biologist, pers. comm., 2003; C. Painter, NMDGF, pers. comm., 2003). Therefore, it is likely that many or most tadpoles present would not be collected during antimycin application.

Another potential effect of the proposed action is to reduce abundances of certain groups of aquatic invertebrates. Most studies have found that at proposed levels, antimycin is harmless in the long-term to most aquatic invertebrates found in streams and standing waters (Walker et al. 1964; Herr et al. 1967; Schnick 1974; Houf and Campbell 1977). A study in a Wisconsin trout stream found temporary reductions in aquatic invertebrates, including certain caddisflies, craneflies, mayflies and scuds (Jacobi and Degan 1977). However, concentrations of antimycin in this stream reached as high as 44 ppb, about 4 times higher than the proposed concentration for this project. Certain invertebrates could possibly be affected at the proposed levels of antimycin, including *Cladocera* and *Copepoda,* (zooplankton), *Amphipoda*, (scuds), and certain mayflies and caddisflies, although populations of these taxa are only diminished temporarily (Schnick 1974). Minckley and Milhalick (1981) found that a 10 parts per million antimycin treatment in Arizona reduced benthic invertebrate numbers almost 5-fold, but long-term effects to benthic invertebrates were minimal in respect to numbers, biomass, and diversity. That treatment level was 1,000 times more concentrated than the treatment proposed here. In contrast, the antimycin treatment (10 ppb) in Mogollon Creek in 1996, slightly reduced the number of benthic invertebrate numbers (J. Brooks, U. S. Fish and Wildlife Service, pers. comm. 2002), where the antimycin concentration was 1,000 times less than that used in 1981. After the treatment, the benthic community was dominated (greater than 80 percent composition) by immature mayflies and black flies (J. Brooks, U. S. Fish and Wildlife Service, pers. comm. 2002). Because of their short life cycles (Anderson and Wallace 1984), good dispersal ability (Pennack 1989) and generally high reproductive potential, aquatic invertebrates are capable of rapid recovery from disturbance (Jacobi and Deegan 1977; Boulton et al. 1992; Johnson and Vaughn 1995; Matthaei et al. 1996; Nelson and Roline 1996). Therefore, no invertebrate taxa are likely to be eliminated, and abundance typically recovers in 1 to 2 years.

Schnick (1974) found that aquatic insects were adversely affected by antimycin concentrations of 3.5 to 5 ppb (stonefly nymphs) and 10 to 40 ppb (immature mayflies, blackflies, caddisflies). Therefore, the application rate of 10 ppb of antimycin for the proposed project will most likely affect stoneflies, but not most other aquatic invertebrates. Aquatic insects comprise an important component of the frog's diet, and the adults feed primarily on emerging insects. We anticipate that the number of aquatic insects would most likely recover within 2 years; however, species composition may differ from pre-treatment species composition and may take several years to fully recover. Therefore, the reduction in numbers of invertebrates could have an adverse, short-term effect on food availability for the frog. However, the frog's ability to forage and feed on land, where prey availability should persist, should help minimize this adverse effect.

The proposed action also includes electroshocking surveys to determine the success of the treatment, and this activity has potential to harm frogs, tadpoles and eggs. Electroshocking is used primarily to electrically immobilize (stun) fish for capture, and this practice can also stun other vertebrates. Spinal injuries due to electroshocking have been demonstrated for brown trout (*Salmo trutta*), longnose suckers (*Catastomus catostomus*), and rainbow trout (*Oncorhynchus mykiss*) (Kocovsky et al. 1997), and electroshocking caused increased mortality of rainbow trout eggs (Dwyer et al. 2002). Electroshocking activities could impact frogs by causing rigidity and muscle spasms that may result in injury or death. Rigidity from electroshocking can lead to internal injuries, and a reduction in an individual's ability to move could also increase its susceptibility to predation. To minimize this potential, the Forest would instruct electroshocking crews to watch for frogs and tadpoles and to stop shocking until the frog can be flushed out of the area being shocked and/or until the frog or tadpole is held in a dip net while shocking proceeds. However, as stated above, in fall or winter, when this project is proposed to occur, frogs and tadpoles are much more difficult to survey for and detect. Therefore, it is likely that many or most frogs and tadpoles present would not be detected and moved out of harm's way during electroshocking surveys.

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 biological opinion. 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 Act.

Because Las Animas Creek is predominately in a wilderness area, and the Ladder Ranch portion is managed as naturally as possible, there are no future actions that are reasonably certain to occur in the action area that will contribute cumulatively to the proposed action. Therefore, no cumulative effects are known or anticipated.

VI. Conclusion

After reviewing the current status of the frog, the environmental baseline of the action area, the anticipated effects of the proposed antimycin treatment and electroshocking actions, 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. No critical habitat has been designated, thus none would be affected. We make these findings for the following reasons:

1. The frog occurs over a large area of southeastern Arizona and southwestern New Mexico. The proposed action affects a very small percentage of the species' range.

2. Very few frogs and tadpoles are likely to be adversely affected by being collected and held during antimycin treatment and electroshocking.

3. The antimycin treatment is not likely to directly affect a large number of tadpoles and frogs, because only four individuals were detected in the action area during surveys in 2001. In addition, some individuals may be detected in the fall or winter months and maintained in a safe location until antimycin treatment is complete.

4. Electroshocking is not likely to directly affect a large number of frogs, tadpoles and/or eggs, because only four individuals were detected in the action area during surveys in 2001. In addition, some individuals may be detected and moved out of the immediate area in advance of electroshocking activities.

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 Forest and their applicants/cooperators (NMDGF and the Ladder Ranch), so that they become binding conditions of any grant or permit issued to applicants, as appropriate, in order for the exemption

in section 7(o)(2) to apply. The Forest has a continuing duty to regulate the activity covered by this incidental take statement. If the Forest or their cooperators, (1) fail to require an applicant 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 (2) fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

1. Amount and Extent of Take Anticipated

The frog is known to have recently inhabited part of Cave Creek, because four individuals were detected in the action area during surveys in 2001. Therefore, some incidental take of frogs and tadpoles due to harm and/or harassment from antimycin treatment and electroshocking is anticipated to occur. In addition, because the status of the species could change over time through immigration, emigration, and loss or creation of habitats, the exact level of take resulting from this action cannot be precisely quantified, but should be limited to five or fewer individuals. We anticipate take could occur in the following ways:

1. A few frogs and tadpoles would be captured and held until the antimycin treatment and electroshocking are completed. There is a low probability that handling frogs or tadpoles will lead to their death, but injury is possible.

2. A small number of frogs and tadpoles may be missed in the pretreatment surveys and be harmed or harassed by antimycin treatment and/or electroshocking.

3. The antimycin treatment may directly adversely affect a few frogs and tadpoles and temporarily reduce the aquatic invertebrate community upon which the frog feeds.

4. Electroshocking may temporarily stun, injure or kill a few frogs and/or tadpoles.

5. Diseases may be transported to other frog populations, if disinfection of equipment is inadequate.

II. Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the frog:

1. The Forest shall take measures to minimize impacts to frogs, tadpoles, and egg masses in the action area by removing and holding as many individuals as can be detected by qualified surveyors until stream conditions have returned to normal.

2. The Forest shall take measures to minimize impacts to frogs in the action area by killing non-native frog predators and competitors.

Terms and Conditions

To implement reasonable and prudent measure 1, the Forest shall:

1.1 Survey all streams containing potential frog habitat for the presence of frogs, tadpoles, and/or egg masses immediately before antimycin treatment and/or electroshocking. The Forest shall conduct surveys for frogs in the action area of the proposed project using the Service's Survey Protocol for Project Evaluation 2003, which accompanies each frog permit. As stated in the protocol, in order to survey when frogs are most active and most likely to be detected, surveys shall be conducted from April through September, and when water temperatures are at least 14 °C at elevations below 5,500 feet and at least 12 °C at 5,500 feet and above.

1.2 Collect and hold frogs, tadpoles and/or eggs during antimycin treatment and electroshocking activities prior to treating any occupied streams. Only qualified ranid experts shall move and maintain frogs in clean buckets, holding tanks or areas immediately upstream of the treated area. These individuals may include Charles Painter (NMDGF), Bruce Christman (Ladder Ranch), Randy Jennings (Western New Mexico University), or other species experts approved in advance by NMESFO to assist with this project. The selected individual(s), in conjunction with NMESFO, shall review the terms and conditions below and discuss any concerns or questions with NMESFO to determine the best location, conditions, protocol and duration to hold frogs, tadpoles and/or eggs during treatment, at least 1 month prior to implementation of the project.

1.3 In areas where electroshocking is used to determine the presence of non-native trout, the Forest shall not return frogs, tadpoles and/or eggs to their previous habitats until electroshocking in the immediate area has been completed.

1.4 Notify the NMESFO within 24 hours if more than a total of 5 individuals have been killed or injured during the project. Should any unexpected problems occur, immediately contact NMESFO.

1.5 If a frog or tadpole dies, it is to be preserved in 10 percent formalin and accessioned to the University of New Mexico Museum of Southwestern Biology or to the Department of Natural Sciences, Western New Mexico University. If a frog or tadpole is injured, it

is to be collected and housed in a 5-gallon bucket, and not released until the situation can be discussed with NMESFO.

1.6 To prevent inadvertent movement of disease or parasitic organisms among sites, research and management activities shall conform to the Declining Amphibians Population Task Force Fieldwork Code of Practice available at the Internet site, www.npwrc.usgs.gov/narcam/techinfo/daptf.htm, with the exception that 10 percent bleach solution, or a solution of quaternary ammonia (Quat 128) mixed according to label instructions, shall be used to clean equipment, rather than 70 percent ethanol. Before and after working in the action area, the Forest shall follow all disinfection procedures as outlined in the survey protocol. To further reduce the possible spread of frog diseases, the Forest shall not transport buckets of water, frogs or tadpoles from one site to another.

1.7 The Forest shall not intentionally kill frogs or tadpoles for chytrid fungus analysis or any other purpose.

1.8 If egg masses are present, care shall be taken to minimize impacts to the eggs. Water temperature will be measured in the stream or pool prior to handling eggs. A new, 1-gallon, self-closing bag will be used to transport the egg masses. To transfer the egg mass into the bag, submerge the bag and fill with water. Next, carefully cut away any vegetation or sticks attached to the egg mass without dividing the egg mass. With cupped hands, remove the egg mass and place in the plastic bag. Do not place more than one egg mass in a plastic bag at a time. Do not reuse plastic bags to transport egg masses because of the risk of spreading disease. Seal the bag with approximately 1 inch of air space. Before releasing the egg masses into the holding tank, the water temperature shall be checked to ensure that it is not more than a few degrees different from the water in the plastic bag.

1.9 Tadpoles will be collected using dip nets and/or seines. When tadpoles are collected, up to 10 individuals may be held in a 5-gallon bucket containing local stream water and aerated with battery-powered air pumps. Before placing the tadpoles into the holding tank, the water temperature of the holding water should be measured to ensure that it is not more than a few degrees different from the stream temperature. The bucket shall be disinfected according to Condition 1.6 to prevent the spread of disease. When tadpoles are collected, the water temperature in the holding container should be maintained within a few degrees of the stream water temperature from which the frogs were collected. Before returning tadpoles to the stream, the water temperature of the holding water shall be measured to ensure that it is not more than a few degrees different from the stream water temperature.

1.10 When collecting adult frogs, capture the individuals and hold only one adult frog per 5-gallon bucket containing shallow stream or pool water. Place a lid with perforations on top to prevent the escape of the frog and provide air. The temperature of the holding

water should be measured prior to use to ensure that it is not more than a few degrees different from the stream or pool water temperature. The bucket shall be disinfected after each use according to Condition 1.6 to prevent the spread of disease.

1.11 Provide a report on the results of surveying for and holding frogs, tadpoles, and/or eggs to NMESFO by December 1 of the year in which the project was conducted.

1.12 Evaluate the aquatic and shoreline invertebrate communities before and after antimycin treatment in occupied frog habitat to determine if the frog's diet will remain adequate for survival. If results indicate that the resulting community may not be adequate, the Forest shall contact NMESFO for further consultation. Sampling protocols will be designed by biologists from the Forest and NMESFO. The number of years of sampling will be determined by the magnitude of the effect observed after treatment. The Forest will report results to the NMESFO annually.

To implement reasonable and prudent measure 2, the Forest shall:

2.1 Capture and kill non-native bullfrogs and crayfish in a humane manner when they are encountered during the course of normal activites that implement this project.

The Service believes that no more than five frogs, tadpoles, and/or eggs will be incidentally taken in the forms of either harm or harassment as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Forest must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

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. Regularly inventory and survey all potential habitats on the Forest for frogs.

2. Take actions to improve aquatic habitats for the frog on the Forest.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the proposed action to establish a pure population of Rio Grande cutthroat trout in the Las Animas Creek watershed using antimycin. 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 Rio Grande cutthroat trout and protection of the frog. In future communications regarding this consultation, please refer to consultation #2-22-03-F-553. If you have any comments or questions about this opinion, please contact Patricia Zenone at the letterhead address or at (505) 761-4718.

Sincerely,

Susan MacMullin

Susan MacMullin
Acting Field Supervisor

cc:
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LITERATURE CITED

Anderson, N. H. and J. B. Wallace. 1984. Habitat, Life history, and behavioral adapatations of aquatic insects. Pages 38-58 *in* R/. W. Merritt and K. W. Cummins, editors, Aquatic Insects of North America. Kendall Hunt Publishing Company, Dubuque, Iowa.

Berger, L., R. Speare, P. Daszak, D. E. Green, A. A. Cunningham, C. L. Goggins, R. Slocombe, M. A. Ragan, A. D. Hyatt, K. R. McDonald, H. B. Hines, K. R. Lips, G. Marantelli, and H. Parkes. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. Proceedings of the National Academy of Science 95:9031-9036.

Boulton, A. J., C. G. Peterson, N. B. Grimm, and S.G. Fisher. 1992. Stability of an aquatic macroinvertebrate community in a multiyear hydrologic disturbance regime. Ecology 73: 2192-2207.

Calamusso, B. 1998. Ladder Ranch Native Fishes and Amphibian Inventory. Unpublished Report.

Clarkson, R. W., and J. C. Rorabaugh. 1989. Status of leopard frogs (*Rana pipiens* Complex) in Arizona and southeastern California. Southwestern Naturalist 34(4):531-538.

Christman, B. L. 2002. Investigations of the status and distribution of amphibians on the Ladder Ranch with special emphasis on the Chiricahua leopard frog (*Rana chiricahuensis*). Unpublished report.

Daszak, P. 2000. Frog decline and epidemic disease. International Society for Infectious Diseases. Http://www.promedmail.org.

Davidson, C. 1996. Frog and toad calls of the Rocky Mountains. Library of Natural Sounds, Cornell Laboratory of Ornithology, Ithaca, New York.

Declining Amphibian Populations Task Force. 1993. Post-metamorphic death syndrome. Froglog 7:1-2.

Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico.

Dwyer, W.P., W. Fredenber, and D.A. Erdahl. 2002. Influence of electroshock and mechanical shock on survival of trout eggs. North American Journal of Fisheries Management 13:839-843.

Fernandez, P. J., and J. T. Bagnara. 1995. Recent changes in leopard frog distribution in the White Mountains of east central Arizona. Page 4 *in* abstracts of the First Annual Meeting of the Southwestern Working Group of the Declining Amphibian Populations Task Force, Phoenix, Arizona.

Fernandez, P. J., and P. C. Rosen. 1996. Effects of the introduced crayfish *Oronectes virilis* on the native aquatic herpetofauna in Arizona. Arizona Game and Fish Department, Heritage Program, IIPAM Project No. I94054.

Gresswell, R. E. 1991. Use of antimycin for the removal of brook trout from a tributary of Yellowstone Lake. North American Journal of Fisheries Management. 11:83-90.

Halliday, T. R. 1998. A declining amphibian conundrum. Nature 394:418-419.

Herr, F., E. Greslin and C. Chappel. 1967. Toxicology studies of antimycin, a fish eradicant. Transactions of the American Fisheries Society. 96:320-326.

Houf, L. J. and R. S. Campbell. 1977. Effects of antimycin A and rotenone on macrobenthos in ponds. Investigations in Fish Control, USDI Fish and Wildlife Service, Washington, D.C.

Hillis, D. M. 1988. Systematics of the *Rana pipiens* complex: Puzzle and paradigm. Annual Review of Ecological Systematics 19:39-63.

Jacobi, G.Z. and D.J. Degan. 1977. Aquatic macroinvertebrates in a small Wisconsin trout stream before, during, and two years after treatment with the fish toxicant antimycin. Investigations in Fish Control, USDI Fish and Wildlife Service, Washington D.C.

Jennings, R. D. 1988. Ecological studies of the Chiricahua leopard frog, *Rana chiricahuensis* in New Mexico. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 29 pp.

Jennings, R. D. 1990. Activity and reproductive phenologies and their ecological correlates among populations of the Chiricahua leopard frog, *Rana chiricahuensis*. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 46pp.

Jennings, R. D. 1995. Investigations of recently viable leopard frog populations in New Mexico *Rana chiricahuensis* and *Rana yavapaiensis.* Gila Center, New Mexico University, Silver City, New Mexico.

Johnson, S. L. and C.C. Vaughn. 1995. A hierarchical study of macroinvertebrate recolonization of disturbed patches along a longitudinal gradient in a prairie river. Freshwater Biology 34:531-540.

Kocovsky, P. M., Gowan, C. K. D. Fausch, and S. C. Riley. 1997. Spinal injury rates in three wild trout populations in Colorado after eight years of backpack electrofishing. North American Journal of Fisheries Management. 17:308-313.

Lesser, B.R. 1972. The acute toxicities of antimycin A and juglone to selected aquatic organisms. M.S. Thesis, University of Wisconsin-La Crosse.

Longcore, J.E., A.P. Pessier, and D.K. Nichols. 1999. *Batracytrium dendrobatidis* gen. Et sp., a chytrid pathogenic to amphibians. Mycologia 91(2):219-227.

Mangum, F. A. 1985. Aquatic ecosystem inventory – macroinvertebrate analysis, Gila National Forest. Annual progress report, U.S. Department of Agriculture, Forest Service, Intermountain Region Aquatic Ecosystem Analysis Laboratory, Provo, Utah.

Marking, L.L. and T.D. Bills. 1975. Toxicity of potassium permanganate to fish and its effectiveness for detoxifying antimycin. Transactions of the American Fisheries Society. 104:579-583.

Matthaei, C.D., U. Uehlinger, E. Meyer, and A. Frutiger. 1996. Recolonization by benthic invertebrates after experimental disturbance in a Swiss prealpine river. Freshwater Biology. 35:233-248.

McGuire, D. L. 1998. Aquatic macroinvertebrate survey of Animas, Seco, and South Palomas Creeks, Sierra County, New Mexico. Unpublished report.

Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 293 pp.

Minckley, W. L. and P. Milhalick. 1981. Effects of chemical treatment for fish eradication on stream dwelling invertebrates. Journal of the Arizona-Nevada Academy of Sciences 16:79-82.

Morell, V. 1999. Are pathogens felling frogs? Science 284:728-731.

Nelson, S. M. and R.A. Roline. 1996. Recovery of a stream macroinvertebrate community from mine drainage discharge. Hydrobiologia 339:73-84.

Painter, C. W. 2000. Status of listed and category herpetofauna. U. S. Fish and Wildlife Service, Albuquerque, New Mexico. Completion report No. E-31/1-5.

Pennack, R. W. 1989. Fresh-water invertebrates of the United States. John Wiley and Sons, Inc. New York.

Platz, J. E., and J. S. Mecham. 1979. *Rana chiricahuensis*, a new species of leopard frog (*Rana pipiens* Complex) from Arizona. Copeia 1979(3):383-390.

Platz, J. E., and A. L. Platz. 1973. *Rana pipiens* complex: Hemoglobin phenotypes of sympatric and allopatric populations in Arizona. Science 179:1334-1336.

Rosen, P. C., C. R. Schwalbe, D. A. Parizek, P. A. Holm, and C. H. Lowe. 1994. Introduced aquatic vertebrates in the Chiricahua region: Effects on declining native ranid frogs. Pages 251-261 *in* L.F. DeBano, G.J. Gottfried, R.H. Hamre, C.B. Edminster, P.F. Ffolliott, and A. Ortega-Rubio, Biodiversity and management of the Madrean Archipelago. USDA Forest Service, General Technical Report RM-GTR-264.

Rosen, P. C., C. R. Schwalbe, and S. S. Sartorius. 1996. Decline of the Chiricahua leopard frog in Arizona mediated by introduced species. Report to Heritage program, Arizona Game and Fish Department, Phoenix, AZ. IIPAM Project No. I92052.

Schnick, R. A. 1974. A review of the literature on the use of antimycin in fisheries. U. S. Department of Interior, Fish and Wildlife Service, Fish Control Laboratory, La Crosse, Wisconsin.

Snyder, J., T. Maret, and J. P. Collins. 1996. Exotic species and the distribution of native amphibians in the San Rafael Valley, AZ. Page 6 *in* abstracts of the Second Annual Meeting of the Southwestern United States Working Group of the Declining Amphibian Populations Task Force. Tucson, Arizona.

Speare, R., and L. Berger. 2000. Global distribution of chytridiomycosis in amphibians. Http://www.jcu.edu.au/school/phtm/PHTM/frogs/chyglob.htm.11 November 2000.

Sredl, M. J., and D. Caldwell. 2000. Wintertime populations surveys - call for volunteers. Sonoran Herpetologist 13:1.

Sredl, M. J., and J. M. Howland. 1994. Conservation and management of madrean populations of the Chiricahua leopard frog, *Rana chiricahuensis*. Arizona Game and Fish Department, Non-game Branch, Phoenix, Arizona.

Sredl, M. J., J. M. Howland, J. E. Wallace, and L.S. Saylor. 1997. Status and distribution of Arizona's native ranid frogs. Pages 45-101 *in* M. J. Sredl (ed). Ranid frog conservation and management. Arizona Game and Fish Department, Non-game and Endangered Wildlife Program, Technical Report 121, Phoenix, Arizona.

Sredl, M. J. and R.. D. Jennings. In press. Chiricahua Leopard Frogs. In Lannoo, M. J. (Ed.), Status and Conservation of U. S. Amphibians. Volume 2: Species Accounts, University of California Press, Berkeley, California.

Stefferud, A.A., D.L. Propst, and G.L. Burton. 1992. Use of antimycin to remove rainbow trout from White Creek, New Mexico. Pages 55-66. *In* D. A. Hendrickson (ed.). Proceedings of the Desert Fishes Council Vol. xxii-xxiii. Desert fishes Council, Bishop, California.

The Nature Conservancy. 1995. The biodiversity of riparian ecosystems of the Ladder Ranch. Unpublished report.

Tiffan, K. F. and E.P.Bergerson. 1996. Performance of antimycin in high-gradient streams. North American Journal of Fisheries Management. 16:465-468.

U. S. Fish and Wildlife Service. 1995. Recovery plan for the Mexican spotted owl (*Strix occidentalis lucida*). Albuquerque, New Mexico. 85pp.

U. S. Fish and Wildlife Service. 2002. Endangered and Threatened Wildlife and Plants; Listing of the Chiricahua Leopard Frog (*Rana chiricahuensis*). *Federal Register:* 67(114):40790-40811.

Van Eimeren, P. A. 1988. Comparative food habits of Gila trout and speckled dace in a southwestern headwater stream. M.S. Thesis, New Mexico State University, Las Cruces, New Mexico.

Walker, C.R., R.E. Lennon, and B.L. Berger. 1964. Preliminary observations on the toxicity of antimycin A to fish and other aquatic animals. Bureau of Sport Fisheries and Wildlife, Investigations in Fish Control No. 2 and Circular 186:1-18.