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In reply refer to:

In Reply Refer To:
R2/ES-TE

Cons. #2012-F-0005

April 30, 2012

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Regional Forester
U.S. Forest Service, Southwestern Region
333 Broadway SE
Albuquerque, New Mexico 87102

Jim Upchurch, Forest Supervisor
Federal Building
300 W. Congress
Tucson, Arizona 85701

Dear Mr. Newman:

The enclosed biological opinion (BO) responds to your request for reinitiation of formal consultation under section 7(a) of the Endangered Species Act of 1973 (Act), as amended. We received your letter requesting reinitiation and a Biological Assessment (BA) titled *Biological Assessment for the Reinitiation of Consultation on the Forest Service's Continued Implementation of the Land and Resource Management Plans for the 11 Southwestern Region National Forests and National Grasslands* on April 9, 2011.

Described within your BA is the programmatic nature of the LRMPs. It analyzes the affects of LRMP implementation; specifically the implementation of the Standards and Guidelines (S&Gs) to species and their critical habitat within each National Forest. Each National Forest has a separate chapter within the BA that discusses the potential effects to each species resulting from the implementation of the S&Gs for that particular National Forest. This BO addresses the Forest Service's continued implementation of the Land and Resource Management Plan (LRMP) for the Coronado National Forest of the Southwestern Region. This BO will be in place until the Coronado National Forest revises its LRMP.

Throughout this process, we have been working closely with your staff. We appreciate your willingness to cooperate and assist the Service during the completion of this consultation.

If you have questions or comments, please contact me at the Arizona Ecological Services Office (AESO), at 602-242-0210.

Sincerely,

Steven L. Spangle
Field Supervisor

Enclosure

cc: Regional Consultation Coordinator, Threatened and Endangered Species, Ecological Services, Region 2
Chief, Threatened and Endangered Species, Ecological Services Region 2
Supervisor, Ecological Services Office, Phoenix, AZ

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BIOLOGICAL OPINION

The Continued Implementation of the Land and Resource Management Plan
for
The Coronado National Forest of the
Southwestern Region U.S.D.A. Forest Service

Regional Office, Region 2
U.S. Fish and Wildlife Service

Cons. #2012-F-0005

April 30, 2012

Executive Summary

The accompanying document transmits the biological opinion (BO) of the U.S. Fish and Wildlife Service (FWS) in response to the U.S. Forest Service's (USFS) request for re-initiation of consultation in accordance with the Endangered Species Act of 1973 (ESA or Act), as amended. This opinion addresses the USFS's continued implementation of the Land and Resource Management Plan (LRMP) for the Coronado National Forest (NF) of the Southwestern Region (proposed action), and its effects to 22 federally-listed species and 11 designated critical habitats (CHs). The consultation approach used to complete this consultation was the same used in the 2004/2005 consultation (Please refer to the executive summary in the 2005 BO/CO). We are hereby incorporating the 2004/2005 Biological Assessment (BA) and BO/CO by reference into this document.

This approach provided the information necessary to determine whether or not a jeopardy determination could be concluded. For those species with designated or proposed CH, our effects' analysis approach identified how the primary constituent elements (PCEs) or physical and biological features (PBFs) essential to the conservation of the species were likely to be affected; thus, how the proposed action affected the function and conservation value of the associated critical habitat units (CHUs).

A consultation agreement (CA) between the FWS and the USFS was signed on December 7, 2010. The CA addressed issues such as timeframes, staffing, and included a dispute resolution process. In addition, as part of the CA, the agencies have agreed to organize the BA and BO/CO differently than in the 2005 consultation. This consultation is considered to be a programmatic batched consultation that will be organized by NF. Therefore, while the BA describes the programmatic nature of the LRMPs, it specifically analyzes the effects of LRMP implementation to species and their CHs within the action area of each NF. As a result, each NF has a separate chapter within the BA which discusses the effects to the species that occur on that particular NF that are predicted to result from the implementation of the Standards and Guidelines (S&Gs) of that individual NFs LRMP. The resulting BO/COs issued by the FWS will assign incidental take, reasonable and prudent measures, and terms and conditions for each individual NF LRMP. The BO/CO will then be in place until the Coronado NF revises its LRMP.

Using the approach described above, along with careful consideration of the species' status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects; we found that the proposed action would not jeopardize the continued existence of the 22 species identified within the action area of the Coronado NF. Similarly, we determined that the proposed action was not likely to destroy or adversely modify CH for the 11 species with designated CH.

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INTRODUCTION

This Biological Opinion (BO) responds to the U.S. Forest Service's (USFS) request for re-initiation of consultation with the U.S. Fish and Wildlife Service (FWS) in accordance with the requirements of the Endangered Species Act of 1973 (ESA or Act), as amended (16 U.S.C. 1531 *et seq.*). We, the FWS, prepared this opinion which addresses the USFS's continued implementation of the Land and Resource Management Plan for the Coronado National Forest (NF) of the Southwestern Region, and its effects to 22 federally-listed species and 11 designated or proposed CHs (see below). On April 17, 2009, the USFS requested re-initiation of the 2005 LRMP BO/CO due to the belief that the incidental take threshold for the Mexican spotted owl (MSO) could soon be approached and/or exceeded and due to issues related to term and condition 3.1 in the 2005 LRMP BO/CO for several species. Again, on May 18, 2010, the USFS requested re-initiation for all species addressed in the 2005 LRMP BO/CO, as well as requesting consultation for the ocelot, a species now considered present in small numbers in Arizona. The FWS acknowledged the requests for re-initiation for the MSO on June 22, 2010, and followed up with a clarification letter acknowledging the USFS request to reinitiate consultation for all other species, including the ocelot, on August 9, 2010. On October 18, 2010 the USFS submitted a species list for this reinitiation effort to the FWS for concurrence. On December 7, 2010 a consultation agreement was signed by the two agencies. On January 18, 2011 the USFS received a species list concurrence letter from the FWS. A final BA from the USFS was received by the FWS on April 6, 2011.

The 2005 BO/CO was considered a plan-level or programmatic consultation, using a tiered approach. The tiered approach is a two-stage consultation process: the first stage is a programmatic BO/CO, which evaluates the program level effects of continued implementation of the USFS's LRMPs that guide how site-specific projects are designed and managed. The second stage consists of the future consultations on site-specific projects proposed by the USFS. USFS site-specific activities affecting listed species have tiered to the 2005 programmatic BO/CO.

A distinct change from the 2004/2005 consultation is that this consultation will be a programmatic batched consultation that will be organized by NF. Therefore, while the USFS's BA describes the programmatic nature of the LRMPs, it specifically analyzes the effects of LRMP implementation to species and their CH within the action area of each NF. As a result, each NF has a separate chapter within the BA discussing specifically the effects to the species that occur on that particular NF predicted to result from the implementation of the S&Gs of that individual NFs LRMP. Therefore, the FWS's resulting BO/COs will issue an incidental take statement, reasonable and prudent measures, and terms and conditions for each individual NF LRMP. This BO will then be in place until the Coronado NF revises its LRMP.

<u>Coronado National Forest</u>

This programmatic consultation examines the effects on 22 federally listed species and 11 designated CHs from the direction and guidance provided within the Coronado NF LRMP. The following species may be affected by the proposed action and are included within this BO.

Mammals

Jaguar (*Panthera onca*) Endangered
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*) Endangered
Mexican long-nosed bat (*Leptonycteris nivalis*) Endangered
Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) Endangered with designated CH
Ocelot (*Leopardus pardalis*) Endangered

Birds
Mexican Spotted Owl (*Strix occidentalis lucida*) Threatened with designated CH
Northern Aplomado Falcon (*Falco femoralis septentrionalis*) Non-essential experimental 10(j) population

Reptiles/Amphibians
Chiricahua leopard frog (*Rana chiricahuensis*) Threatened with designated CH
New Mexico ridge-nosed rattlesnake (*Crotalus willardi obscurus*) Threatened
Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) Endangered

Fish
Desert pupfish (*Cyprinodan macularius macularius)* Endangered with designated CH
Gila chub (*Gila intermedia*) Endangered with designated CH
Gila topminnow (*Poeciliopsis occidentalis*) Endangered
Gila trout (*Oncorhynchus gilae*) Threatened
Loach minnow (*Tiaroga cobitis*) Endangered with designated CH
Sonora chub (*Gila ditaenia*) Threatened with designated CH
Spikedace (*Meda fulgida*) Endangered with designated CH
Yaqui catfish (*Ictalurus pricei*) Threatened with designated CH
Yaqui chub (*Gila purpurea*) Endangered with designated CH

Plants
Canelo Hills ladies'-tresses (*Spiranthes delitescens*) Endangered
Huachuca water-umbel (*Lilaeopsis schaffneriana* var. *recurva*) Endangered with designated CH
Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*) Endangered

This BO is based on information provided in the USFS's April 6, 2011 BA, subsequent information provided by the USFS to the FWS throughout the consultation, the 11 NF LRMPs, 1996 Regional Amendment and the 2004/2005 BA and BO/CO which are hereby incorporated by reference. In order to obtain current information concerning the above species, we reviewed final listing rules, candidate assessment forms, recovery plans, published literature, unpublished reports and data, species and CH location maps, and other sources of information. In addition, we consulted species experts (e.g., research scientists conducting field surveys, monitoring, or research studies on any of the above species) from state conservation agencies, USFS research stations, and FWS biologists. A complete administrative record of this consultation is on file at the FWS Regional Office, Albuquerque, New Mexico.

CONSULTATION HISTORY

The history of this consultation is complex. A chronology of past consultations associated with the proposed action, agreed-upon time extensions, and important meetings associated with this biological and conference opinion is provided below.

- From 1985 to 1988, each of the 11 NFs in the Southwestern Region developed and approved LRMPs pursuant to the National Forest Management Act (NFMA). The FWS issued a non-jeopardy/no adverse CH modification opinion on each of the USFS LRMPs for all federally listed species.

- On April 15, 1993, the MSO was listed as threatened. On September 6, 1995, the USFS requested initiation of formal consultation on the 11 NF Plans for effects on the MSO.

- On May 14, 1996, the FWS issued a BO on the 11 LRMPs, which concluded jeopardy to the MSO and adverse modification for its designated CH tat (U.S. Fish and Wildlife Service 1996a). The FWS's Reasonable and Prudent Alternative to the existing LRMPs advised the USFS to implement the 1995 Recovery Plan for the MSO. This opinion was litigated in US District Court because it did not quantify incidental take for the MSO. On November 25, 1996, the FWS issued another final jeopardy BO that included incidental take for the MSO pursuant to a September 17, 1996 Court Order. Also on November 25, 1996, the FWS issued a BO on the USFS's June 1996 Regional Amendment to the LRMPs for the MSO. The 1996 Regional Amendment directs the implementation of the Recovery Plan for the MSO, as well as guidelines for the northern goshawk and old-growth management. The FWS concluded non-jeopardy for the MSO and no adverse modification of its designated CH (U.S. Fish and Wildlife Service 1996b).

- On May 15, 1996, the USFS requested formal consultation on the effects to federally-listed species on NFs as a result of the continued implementation of the 11 NF LRMPs.

- On December 19, 1997, the FWS issued a BO/CO on the USFS's 1996 Regional Amendment to the LRMPs for all federally listed species other than the MSO (U.S. Fish and Wildlife Service 1997). This BO concluded non-jeopardy for all federally listed or proposed species, and no adverse modification for designated or proposed CHs. This opinion contained conservation measures (CMs) for seven listed species including the southwestern willow flycatcher, cactus ferruginous pygmy-owl, Sonora chub, Little Colorado spinedace, loach minnow, spikedace, and Pima pineapple cactus. The CMs were a product of a collaborative effort by FWS and USFS and became known as the "seven species direction." The CMs implemented by the USFS are discussed in the effects of the action sections for these species.

- On December 24, 2002, Forest Guardians (et al.) sent the USFS a 60-day Notice of Intent to sue for failing to reinitiate formal consultation on the 11 NF LRMPs for all federally listed species.

- On January 13, 2003, the FWS finalized a BO on the proposed rate of implementation of the grazing S&Gs in the 1996 Regional Amendment and its effect on the MSO. This opinion concluded no jeopardy for the MSO.

- In February of 2003, the USFS and FWS began discussions on the relevance of the 1996 and 1997 LRMP and 1996 Regional Amendment consultations. In early April 2003, the agencies agreed that for the USFS would reinitiate consultation with the FWS on the USFS's 11 LRMPs and the 1996 Regional Amendment. On June 2, 2003, the USFS and FWS signed a consultation agreement that outlined timelines, responsibilities, and dispute resolution for the 11 NF LRMP consultation.

- In November 2003, the USFS provided the FWS with a draft BA for the consultation.

- On April 5, 2004, the USFS requested reinitiation of formal consultation under section 7 of the ESA on the 1996 MSO opinion and the 1997 opinion for all other federally listed species on the 11 NFs. The USFS provided the FWS with the final BA for the Continued Implementation of the LRMPs for the Eleven NFs and National Grasslands (NG) of the Southwestern Region (USFS2004).

- On May 26, 2004, the FWS responded to the USFS, acknowledging formal consultation had been initiated.

- On September 14, 2004, the FWS requested a 90-day extension. The USFS responded on November 10, 2004, and extended the timeline further for a draft to be available for USFS review on January 15, 2005.

- On February 2, 2005, the USFS provided the FWS with supplemental information to their April 8, 2004 BA. The supplemental information included the following four documents: (1) CMs for the spikedace, Little Colorado spinedace, Chiricahua leopard frog, and Sacramento prickly poppy; (2) replacement of pages 54-66 of the BA regarding the Rangeland Management Program; (3) clarification of grazing management level definitions; and (4) proposed amendment for noxious or invasive plant management for the Coconino, Kaibab, and Prescott, and Coconino NFs, November 2004 Forest Plan Amendment #20. Post- BA submissions were also provided to the FWS informally throughout the consultation and are part of the administrative record.

- On April 22, 2005, the FWS provided the USFS with a draft programmatic BO/CO.

- On June 10, 2005 the FWS provided the USFS with a final programmatic LRMP BO/CO.

- On April 17, 2009, the USFS requested re-initiation of the 2005 LRMP BO/CO because the threshold set for incidental take for the MSO could soon be approached and/or exceeded and due to issues related to term and condition 3.1 in the 2005 LRMP BO/CO for several species. Again, on May 18, 2010, the USFS requested re-initiation for all species addressed in the 2005 LRMP BO/CO, including the ocelot, a species now considered present in small numbers in Arizona.

- On June 22, 2010 FWS acknowledged the USFS request for reinitiation on the MSO and followed up with a clarification letter acknowledging FSs request to reinitiate the consultation for all other species, including the ocelot on August 9, 2010.

- A CA between the FWS and USFS was signed on December 7, 2010, that addressed timeframes, staffing, and a dispute resolution process. As part of the CA, the agencies agreed to organize the BA and BO/CO differently than in the 2004 BA and 2005 BO/CO. This consultation is considered to be a programmatic batched consultation that will be organized by NF. Therefore, while the BA describes the programmatic nature of the LRMPs, it specifically analyzes the effects of LRMP implementation to species and their CHs within the action area of each NF. The resulting BO/COs will issue an incidental take statement, reasonable and prudent measures, and terms and conditions for each NF LRMP.

DESCRIPTION OF THE PROPOSED ACTION

The proposed action being analyzed in this BO is the Coronado NF LRMP in the USFS Southwestern Region (including the 1996 Region-wide Amendment). Also included in this BA is an analysis of those S&Gs that have been added through any amendments to the individual NF LRMPs since the 2004 LRMP BA (See Appendix 4 for a complete list of S&Gs analyzed in the 2011 BA).

The LRMPs direct how current and future activities will be carried out in the following Programs: Engineering; Fire Management; Forestry/Forest Health; Lands and Minerals; Rangeland Management; Recreation, Heritage and Wilderness; Watershed Management; and Wildlife, Fish, and Rare Plants (WFRP). The S&Gs related to these Programs are discussed in the **Effects of the Action** section of this BO.

The LRMPs and the 1996 Regional LRMP Amendment described long-range management strategies for the NFs and NGs in the USFS Southwestern Region. They provide a programmatic framework for future activities and emphasize the application of certain S&Gs in the undertaking of those activities on the land. The LRMPs do not, however, make site-specific decisions about exactly how, when, and where these activities will be carried out. However, all site-specific activities must conform to the programmatic framework set up in the LRMPs (S&Gs) and they must meet site-specific National Environmental Policy Act (NEPA) and ESA requirements. Implementation of ongoing projects and the issuance of incidental take associated with those projects is covered under this programmatic opinion since it supersedes the 2005 LRMP BO/CO.

This consultation on the LRMPs does not eliminate the requirement for site-specific biological analyses and the need for site-specific informal or formal ESA § 7 consultation with the FWS for individual projects implemented under the LRMPs. Furthermore, it should be noted that an amendment (e.g., deleting/changing S&Gs) of a particular NF LRMP for a site specific project is allowed and can and does occur, although rarely. In this situation, the action would be considered outside of the scope of this consultation and would require its own site specific ESA § 7(a) (2) consultation to address the effects of that particular proposed action which is being implemented under a project specific amendment to the NF LRMP. Furthermore, wildfire and wildland fire use are not discussed in this BO as they will be covered under separate emergency ESA § 7(a) (2) consultations.

As described above, the LRMP does not make site specific decisions, but it provides direction to each NF regarding how current and future activities will be carried out. Incidental take anticipated in this BO would occur during implementation of site-specific projects. In addition, monitoring to determine overall compliance with the incidental take limits set forth in this BO will be required in all future project level BOs. Project specific monitoring will be designed and implemented to determine if and/or when the incidental take limits set forth in this BO have been exceeded.

DESCRIPTION OF THE ACTION AREA

The Action Area for this BO is defined as all lands that the Coronado NF encompass in the Southwestern Region of the USFS, plus adjacent lands that the proposed action may directly or indirectly affect. The Coronado NF is located in southeastern Arizona and southwestern New Mexico and is composed of approximately 1,780,000 ac ranging in elevation from 3,000 to 10,720 ft. in twelve widely scattered mountain ranges referred to as "sky islands." Vegetative communities on the Forest range from Sonoran desert to spruce-fir forest. Within the NF there are eight wilderness areas: Chiricahua, Pajarita, Mt. Wrightson, Pusch Ridge, Rincon Mountain, Galiuro, Santa Teresa, and Miller Peak. The Forest is divided into five districts: Douglas, Nogales, Santa Catalina, Safford, and Sierra Vista.

Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC 2007) "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1300 years (IPCC 2007). It is very likely that over the past 50 years cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007). Data suggest that heat waves are occurring more often over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007).

The IPCC (2007) predicts that changes in the global climate system during the 21st century will very likely be larger than those observed during the 20th century. For the next two decades a warming of about 0.2°C (0.4°F) per decade is projected (IPCC 2007). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007). Various emissions

scenarios suggest that by the end of the 21st century, average global temperatures are expected to increase 0.6°C to 4.0°C (1.1°F to 7.2°F) with the greatest warming expected over land (IPCC 2007).

Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007), with warming in southwestern states greatest in the summer (IPCC 2007b). The IPCC also predicts hot extremes, heat waves, and heavy precipitation will increase in frequency (IPCC 2007). There is also high confidence that many semi-arid areas like the western United States (U.S.) will suffer a decrease in water resources due to climate change (IPCC 2007), as a result of less annual mean precipitation and reduced length of snow season and snow depth (IPCC 2007b). Milly et al. (2005) project a 10–30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models.

The increase in global temperature is already putting pressure on ecosystems and the plants and animals that co-exist in those systems. Warmer temperatures during the second half of the 20th century have begun to shift the growing season in many parts of North America by increasing it as much as two weeks (Regonda et al. 2005). In addition, spring is coming earlier. This change in the growing season affects the broader ecosystem. Migrating animals have to start seeking food sources earlier. The shift in seasons may already be causing the lifecycles of pollinators, like bees, to be out of synch with flowering plants and trees. This mismatch can limit the ability of both pollinators and plants to survive and reproduce, which would reduce food availability throughout the food chain.

An extended growing season also means that plants need more water to keep growing throughout the season or they will dry out, increasing the risk of wildfire. Once the growing season ends, the shorter, milder winters fail to kill dormant insects, increasing the risk of large-scale insect infestations in subsequent seasons (Seager et al. 2007).

In some ecosystems, maximum daily temperatures might climb beyond the tolerance of indigenous plant or animal. To survive the extreme temperatures, both marine and land-based plants and animals have started to migrate towards the poles. Those species, and in some cases, entire ecosystems, that cannot quickly migrate or adapt, may ultimately face extinction.

CONSULTATION APPROACH

The purpose of this section is to articulate the FWS's approach to this consultation in order to clearly present the chain-of-logic supporting our determinations. During the initial consultation in 2005, the FWS came up with an analytical approach to completing the consultation. At that time, there was a large number of species to be considered, an extensive number of USFS S&Gs analyzed, as well as eight complex Forest programs. The approach is described in the 2005 BO/CO and is hereby incorporated by reference. It included deconstructing of the proposed action, diagnosing the species' status, establishing the species' condition within the action area, analyzing the effects, and finally, putting it back together to make our conclusions.

In this consultation, both agencies relied on the extensive analysis conducted in the 2005 opinion and incorporated all of the information that has remained unchanged since then. We also considered the species status and any changes that have occurred since 2005. Our analysis focuses on the changes in forest management and species status since the 2005 BO/CO. This approach is consistent with the 1998 Consultation Handbook and the implementing regulations at 50 CFR § 402.

As reflected in the 2005 BO/CO, in order to make determinations of effects to listed species, proposed, or candidate species, and proposed or designated CHs, the USFS made two primary assumptions about the implementation of the 11 LRMPs. These assumptions are as follows:

1. The NFs will implement site-specific management actions to move toward land management goals and desired future conditions for various resources, with the caveat that available funding and other LRMP direction will control the actual extent and intensity of these site-specific management actions;

2. The S&Gs in the LRMPs will be followed when selecting, planning, and executing site-specific management actions. In addition, should a site-specific action not follow the S&Gs, the action must be modified or the LRMP must be amended before the action can be allowed. In the situation where a site specific action requires LRMP amendment, the action would be considered outside the scope of this consultation and would require separate site specific ESA § 7(a) (2) consultation to address the effects of that particular proposed action.

The FWS concurred with the two assumptions stated above. However, based on the large amount of uncertainty surrounding how the S&Gs are implemented and exactly which ones are used during project development, it was necessary for the FWS to make additional assumptions regarding this consultation. Our assumptions are as follows:

3. Site-specific projects will conform to the S&Gs, as well as the programmatic framework established in the LRMPs. If not, the action would be considered outside the scope of this consultation and would require separate site specific ESA § 7(a) (2) consultation to address the effects of that particular proposed action.

4. Land managers use and/or implement the S&Gs at every level of planning (i.e., forest-wide, management areas (MAs), and project level).

5. Due to their broad scope, the S&Gs may be interpreted and applied differently depending upon the forest planner and interdisciplinary teams.

6. Implementation of the S&Gs will have varying degrees of effects on the species analyzed.

Please refer to the exposure/response analysis in the 2005 BO/CO (pages 38-41) for an explanation of how the S&Gs were considered in the consultation.

For listed species with proposed or designated CH, the FWS analyzed the direct and indirect effects of the proposed action, and those actions interrelated and interdependent of the proposed action on proposed or designated CH. The CH analysis identified how the PCEs or biological features essential to the conservation of the species are likely to be affected, and in turn, how that will impact the function and conservation value of the associated CHUs.

The following contains the jeopardy analysis for each of the 22 listed species arranged in the following order: mammals, birds, fish, amphibians, reptiles, invertebrates and plants. The status of the species, environmental baseline, effects of the action (which includes cumulative effects), conclusion, and incidental take statements are provided for each species henceforth. In the effects of the action section, we evaluated all eight of the USFS programs within the Coronado NF LRMP for each species. The discussions within the effects of the action section address the pertinent S&Gs that had effects (both adverse and beneficial) to species as well as which S&Gs that could cause take of listed species. Finally, standard language for the disposition of dead, injured, or sick federally listed species as well as a reintiation statement and literature cited section is contained at the end of this BO.

The following section describes the effects to species of the continued implementation of the Coronado NF LRMP. No Effect calls were made for the Apache trout, and desert pupfish designated CH, and therefore, these species/critical habitats will not be addressed below. The FWS has concurred with the USFS on "may affect, but is not likely to adversely affect" determinations for the following species: jaguar, lesser long-nosed bat, Mexican long-nosed bat, Ocelot, and Canelo Hills ladies-tresses. In addition, we also concur with your determination of "not likely to adversely affect" Yaqui chub CH, Yaqui catfish CH, and "not likely to jeopardize" the Northern aplomado falcon. These concurrences can be found in appendix A of this document.

MOUNT GRAHAM RED SQUIRREL

STATUS OF THE SPECIES

Description

Mount Graham red squirrels (MGRS, squirrel, or red squirrel) are small, grayish-brown arboreal rodents with a rusty to yellowish tinge along the back (Spicer *et al.* 1985). Their tails are fluffy and the ears are slightly tufted in winter (Spicer *et al.* 1985). In summer, a thin, black lateral line separates the upper parts from the whitish underparts. The cheek teeth number 16 (P1/1, M3/3), are low-crowned and tuberculate (with small knob-like processes), and the skull is rounded with the postorbital process present (Hoffmeister 1986). The species ranges from 10.8 – 15.4 (mean=13.3) inches in total length and from 3.7 – 6.3 (mean=5.4) inches in tail length (Hoffmeister 1986, Gurnell 1987). Average adult weight from nine specimens was 236.4 grams (Froehlich 1990). Hoffmeister (1986) found no sexual dimorphism in measurements of adult MGRS.

First described in 1894 by J. A. Allen, the MGRS type specimen is from the Pinaleño Mountains. Allen (1894) designated it as a separate subspecies based on pelage (fur) differences and its isolation for at least 10,000 years from other red squirrel populations. The MGRS is slightly smaller than the Mogollon red squirrel (*T. h. mogollonensis*) of northern Arizona in body measurements including total body, hind foot, and skull length (Hoffmeister 1986). The skull is also narrower postorbitally than that of *T. h. mogollonensis.*

Although Hoffmeister (1986) thought the subspecies was not strongly differentiated from the Mogollon red squirrel, he (1986) and Hall (1981) retained the subspecies designation. Research with protein electrophoresis (Sullivan and Yates 1995), mitochondrial DNA (Riddle *et al.* 1992), and microsatellite loci (Fitak and Culver 2009) have provided data that, in conjunction with morphological and ecological considerations, demonstrate that the MGRS is a distinct population. Sullivan and Yates (1995) and Riddle *et al*. (1992) state it deserves subspecific status. Fitak and Culver (2009) state it is highly differentiated from other red squirrels found in the neighboring White Mountains.

Legal Status: In 1987, we listed the MGRS as endangered (52 FR 20994) (U.S. Fish and Wildlife Service 1987). The final rule concluded that the MGRS was endangered because its range and habitat were reduced, and its habitat was threatened by a number of factors, including the (then) proposed construction of an astrophysical observatory, occurrences of high-severity wildland fires, proposed road construction and improvements, and recreational developments at high elevations on the mountain. The rule noted that red squirrels might also suffer due to resource competition with the introduced Abert's squirrel. In 1990, we designated CH for the MGRS (55 FR 425) (U.S. Fish and Wildlife Service 1990). We finalized the first MGRS Recovery Plan in 1993 (U.S. Fish and Wildlife Service 1993a); it is currently undergoing revision.

Distribution and Abundance

Most of the distribution and abundance Information has not changed since the 2005 BO/CO so we hereby incorporate that information by reference. The red squirrel inhabits only specific areas of the Pinaleño Mountains in Graham County in southeastern Arizona, with its entire range situated within the Safford Ranger District of the Coronado NF. As recently as the 1960s, the species ranged as far east as Turkey Flat and as far west as West Peak, but is currently found only as far west as Clark Peak (U.S. Fish and Wildlife Service 1993).

Since 1986, semi-annual and, beginning in 2009, annual midden surveys have been conducted jointly by the AGFD and the USFS. Midden surveys in 1986 suggested that 22,436 acres (9,083 hectares) of potential red squirrel habitat existed in the Pinaleño Mountains. In 1988, the amount of potential red squirrel habitat was revised to exclude pure ponderosa pine stands (no middens were located in this forest type), and suitable habitat was then estimated to be closer to 11,733 acres (7,750 hectares) (U.S. Fish and Wildlife 1993).

In 2005, trees near all 1,251 documented red squirrel territories showed signs of insect damage. In a recent habitat analysis conducted by James Hatten (U.S. Geological Survey) using satellite imagery from June 2008, it appears that only 6,427 acres of MGRS habitat currently exist in the Pinaleño Mountains, compared to 13,257 acres in 1993 (unpub. data; see Hatten 2009 for a

description of the methodology used in this analysis). This represents a temporary loss of habitat of over 50 percent in the past 18 years. With the loss of most of the higher-elevation habitat in the spruce-fir due to wildland fire and insect damage, red squirrels now occur primarily in the mixed-conifer forest on the mountain but also in remaining patches of spruce-fir.

Habitat

The following information is taken from the 2005 BO/CO. The red squirrel inhabits the spruce-fir (*Picea engelmannii*), corkbark fir (*Abies lasiocarpa* var. *arizonaica*), and mixed conifer forest types at high elevations of 8,500 ft (2,590 m) or higher. Red squirrels and middens (i.e., cone debris piles used for winter food caching) have also been documented in drainage bottoms where the mixed conifer association reaches lower elevations. Historically, the species was common above 8,500 ft (2,590 m), but is currently seldom found below 9,200 ft (2,804 m) (Spicer et al. 1985). Old growth mixed conifer stands dominated by Douglas-fir (*Psudotsuga menziesii*) and white fir (*Abies concolor*) also provide habitat; however, specific needs for the selection of midden placement may limit the red squirrels use of mixed conifer stands (Froehlich 1990).

Overall habitat suitability for the species depends on the ability of the forest to produce reliable and adequate conifer cone crops for food and suitable microclimate conditions for storage of closed cones (U.S. Fish and Wildlife Service 2000).

Critical Habitat: Critical habitat (CH) is defined in section 3 of the ESA as (i) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the ESA, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management consideration or protection and; (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon determination that such areas are essential for the conservation of the species. ‘‘Conservation’’ means the use of all methods and procedures that are necessary to bring an endangered species or a threatened species to the point at which listing under the ESA is no longer necessary.

On January 5, 1990, we designated approximately 1,900 acres as Mount Graham Red Squirrel CH (55 FR 425-429) (U.S. Fish and Wildlife Service 1990). Critical Habitat includes three areas:

1) The area above 10,000 feet in elevation surrounding Hawk and Plain View peaks and a portion of the area above 9,800 feet;

2) the north-facing slopes of Heliograph Peak above 9,200 feet; and

3) the east-facing slope of Webb Peak above 9,700 feet.

The main attribute of these areas at that time was the existing dense stands of mature (about 300 years old) spruce-fir forest. The MGRS Refugium established by the Arizona-Idaho Conservation Act (P.L. 100-696) (AICA) has the same boundary as the designated CH boundary surrounding Hawk and Plain View peaks (about 1,700 acres), but does not include CH on Heliograph or Webb Peaks. Unfortunately, most of the habitat in the Refugium and in CH has

been devastated by wildland fire and insect damage. There remains a small, unknown amount of habitat in the Refugium (A. Casey, U.S. Forest Service, pers. comm. 2008).

Life History

For a detailed discussion of Mount Graham red squirrel life history, please refer to the 2005 BO/CO.

Reasons for Listing

Due to the red squirrel's geographic restrictions and inherent vulnerability to extinction, the subspecies was listed as endangered in 1987 under the ESA (U.S. Fish and Wildlife Service 1987), with CH designated on February 5, 1990 (U.S. Fish and Wildlife Service 1990).

Threats: Threats facing MGRS include loss of habitat due to native and exotic insect infestations (Koprowski *et al.* 2005); direct mortality and loss of habitat and middens due to large-scale wildland fires (Koprowski *et al.* 2006); loss of habitat due to human factors (e.g., disturbance, conversion to roads, trails, and/or recreation sites, permitted special uses, etc.; U.S. Fish and Wildlife Service 1993); loss or reduction of food sources due to drought; predation; and apparent dietary and territory competition with Abert's squirrel, which was introduced in the 1940s by the Arizona Game and Fish Department (AGFD) (Edelman *et al.* 2005). Additionally, current climate change models suggest that a 10 to 20 year (or longer) drought is anticipated in the Southwest (Swetnam and Betancourt 1998, Woodhouse and Overpeck 1998, McCabe *et al.* 2004, Seager *et al*. 2007). While this drought is apparently within natural historical variation (Swetnam and Betancourt 1998), mean annual temperatures are forecasted to rise 5-8 ^{0}F in the 21st century (Intergovernmental Panel on Climate Change 2007), which in turn are predicted to be accompanied by a more arid climate (Seager *et al.* 2007), increasing insect outbreaks in Southwestern forests, and increasing wildland fires (Betancourt 2004). Increasing levels of drought, insect outbreaks, and wildland fires will likely directly impact MGRS's already limited habitat and food resources, decreasing our ability to recover this subspecies.

Climate Change

Refer to the 2011 MGRS BA section on climate change. The potential effects of climate change to the MGRS could include long-term drought and hotter average temperatures, which could result in a higher risk of stand-replacing fires, heat and water stress on conifer trees, and increase in exotic pest episodes, all of which would be major threats to MGRS habitat. However, there are no expectations of measurable changes in climate within the temporal bounds of the proposed action.

Recovery Actions

The following information is taken from the 2005 BO/CO. The Safford Ranger District of the Coronado NF has completed, and continues to implement, the following conservation activities, meeting recovery actions as outlined in the1993 recovery plan:

1) employing best management practices (BMPs) to conduct projects while protecting and restoring habitat; 2) conducting vegetation monitoring; 3) employing BMPs for recreational activities (a recreation plan is being implemented to protect the red squirrel); 4) coordinating

with AGFD for red squirrel population monitoring; and, 5) conducting fire suppression and wildfire risk abatement activities.

Critical Habitat designated by the FWS on February 15, 1990, is recognized as the MGRS Refugium (Refugium), as well as the north-facing slopes of Heliograph Peak above 9,200 feet and the east-facing slope of Webb Peak above 9,700 feet. These areas were determined to contain the largest contiguous stand of good to excellent habitat and densest concentration of red squirrel middens, providing the best existing habitat components for the survival of the species (U.S. Fish and Wildlife Service 1988). The Coronado NF does not conduct any activities that would diminish habitat quality, midden concentrations, or red squirrel survival within the Refugium or CH.

Population monitoring continues to be conducted cooperatively between the USFS, AGFD, FWS, and the University of Arizona. Surveys had been conducted semi-annually (spring and fall of each year) from 1988 through 2008; beginning in 2009, surveys are being conducted only in the fall of each year. Analysis found that data acquired during spring surveys were inconsistent due to the difficulty of detecting squirrels during this time of year (they are foraging far and wide and not yet caching cones), especially when compared to data collected during fall surveys (when squirrels are actively caching cones, thereby making it much easier to determine if a midden is occupied). Future surveys are planned at West Peak to determine if re-colonization has occurred in this area (USFS 2004:141).

The University of Arizona also conducts studies on MGRS demographics, middens, and competition effects between the red squirrel and the introduced Abert's squirrel. A Population Viability Analysis has been completed for the squirrel (USFS 2004:142).

Established with new members in 2000, the MGRS Recovery Team continues to revise the 1993 plan, a draft version of which was completed in May 2011 (U.S. Fish and Wildlife Service 2011). An array of options is being discussed, including the possibility of habitat restoration in the West Peak area, once supporting MGRS habitat, and a captive breeding pilot program.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, the anticipated impacts of all proposed federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

The action area means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). For purposes of the MGRS analysis, we have determined the action area encompasses the entire MGRS range and CH located in the Pinaleño Mountains. The mixed-conifer forest within the action area mainly consists of Douglas-fir, southwestern white pine, ponderosa pine, corkbark fir, white fir, quaking aspen, and Engelmann spruce, and occurs at differing aspects and elevations from above 7,750

feet to approximately 10,000 feet. Much of the spruce-fir within the action area was damaged or destroyed by insect outbreaks and wildland fire.

Status of the Species within the Action Area

Based on survey information from fall 2010, there are 1,288 known midden locations within the action area, of which 909 (71 percent) have been "removed." "Removed" middens are those that, over the course of formal population surveys, have been visited multiple times, the last three of which have documented the midden as having "disappeared" (there is no longer any visible evidence that a midden was present, and the midden is only identified by the presence of a tag and the flagging used to locate the site). "Removed" middens appear to occur in areas that at one time provided habitat for MGRS, but currently do not. Many of them are within areas that have been heavily impacted by insect outbreaks and/or wildland fire.

There are 379 known midden locations within the action area that have not been "removed," meaning there is still some evidence that the midden is there, whether or not it is currently occupied. Activity at these middens appears to typically cycle between active and inactive states, as indicated by midden surveys formally conducted since 1986. However, for purposes of our analysis, we consider all middens that have not been "removed" as active and occupied. Other middens that have not yet been found may be present within the action area.

As discussed in the Status of the Species, it appears that only 6,427 acres of MGRS habitat currently exist in the Pinaleño Mountains, compared to 13,257 acres in 1993 (Hatten, unpub. data; see Hatten 2009 for a description of the methodology used in this analysis). This represents a temporary loss of habitat of over 50 percent in the past 18 years, primarily due to insect outbreaks and wildfires. Most of the active MGRS middens (76 percent) fall within areas defined as habitat through this analysis.

Factors Affecting the Species within the Action Area

Table 1. Formal consultations involving MGRS on the Coronado NF since 2005.

Consultation #	**Date of Final BO**	**Project**	**Approximate # of MGRS Anticipated Taken**	**Form of Take**
02-21-86-F-075	7/14/1988	Mt. Graham Astrophysical Area Plan*	1 squirrel per year	Harm
02-21-04-M-0299	*6/8/2007*	*Nuttall-Gibson Complex Wildfire Suppression actions*	*1 active midden; Unknown number of squirrels*	*Harm & Harass*
22410-2007-F-0163	8/18/2008	Mount Graham Summerhome Special Use Permit Residence Renewals	2 squirrels	Harm (1) & Harass (1)
22410-2005-F-0651	8/5/2011	Pinaleño Ecosystem Restoration Project	15 percent decline in abundance of	Harm & Harass

			MGRS within treated areas during project implementation (through year 15)	
22410-2011-IE-0250	*5/8/2011*	*Horseshoe 2 Fire Suppression actions*	*Ongoing consultation*	
22410-2011-IE-0295	*6/12/2011*	*Monument Fire Suppression actions*	*Ongoing consultation*	
22410-2008-F-0149-R001	*12/6/2011*	*Effects to Listed Species from U.S. USFS Aerial Application of Fire Retardants on NFS Lands*	*Incidental take will be tracked as it occurs per the BO*	*Harm & Harass*

*The 1988 BO originally included both the Forest Plan and the Astrophysical Area Plan. The 2005 LRMP BO/CO superseded the Forest Plan portion of this formal consultation, but the consultation is included here because the Astrophysical Area Plan portion authorized ongoing incidental take.
**Projects in italics are fire suppression activities that are not included in the proposed action for this consultation.

Eight formal consultations on the MGRS have been conducted on the Coronado NF, and two are in process (See Table 1). The incidental take associated with the nonemergency projects was from traffic mortality, habitat alteration, and human disturbance. However, restoration projects such as the Pinaleño Ecosystem Restoration Project (PERP) on Mount Graham will have long-term beneficial effects to the MGRS despite the project's potential to result in a 15 percent decline in abundance of MGRS in treated areas during project implementation (through year 15). Since the 2005 LRMP BO/CO was issued, only two formal consultations (PERP and the Mount Graham Summerhome Special Use Permit Residence Renewals) have been completed for the MGRS. Aside from the incidental take associated with PERP, incidental take in the form of harm or harassment was anticipated for 2 individual squirrels as a result of the Mount Graham Summerhome Special Use Permit Residence Renewals. Incidental take of MGRSs associated with wildland fire suppression activities is not part of the action under consultation in this BO, but is part of the environmental baseline. The Coronado NF provided CMs that would minimize the impacts to MGRSs in all formal consultations. All BOs for projects conducted on the Coronado NF were determined not to jeopardize the species or result in adverse modification or destruction of CH.

Most of the action area has supported significant recreational use by researchers, hikers, campers, birders, wildlife and plant collectors, fuel wood collectors, and hunters. Past and present research and monitoring activities (permitted under section 10(a) (1) (A) enhancement of survival permits) include pre-baiting, trapping, handling, marking, and using radio-telemetry to track MGRS. Additionally, an annual mountain-wide survey is conducted each fall, during which a sample of middens is visited to determine MGRS occupancy. Summerhome owners and sometimes their pets inhabit the action area near Old Columbine and Turkey Flat, and use the forest lands surrounding their cabins for a variety of activities. The forested lands surrounding Old Columbine and Turkey Flat are very steep and rough, and recent information indicates that most residents remain close to their respective summerhome area (S. Wallace, U.S. Forest

Service, pers. comm. 2007). Some residents (and likely a few of their visitors) may hike a short distance uphill on designated trails, but the elevation, the steep and rugged terrain, and the general age and abilities of the resident population make it unlikely these people use the trails very much or leave the trail for the forest (A. Casey, U.S. Forest Service, pers. comm. 2007). Because no new summerhomes or additions will be permitted, the number of people using these portions of the action area is expected to remain at current levels (S. Wallace, U.S. Forest Service, pers. comm. 2007). On August 18, 2008, we issued a BO on the renewal of the Mt. Graham Summerhome Special Use Permits, in which we anticipated incidental take of up to two red squirrel middens (consultation #22410-2007-F-0163).

Other portions of the action area, as defined in the Environmental Baseline section above, are posted for speed limits on the roads and types of permitted activities at the sites. Bear-proof garbage containers are provided at public sites (especially picnic areas, camp sites, and Riggs Lake) and are serviced regularly by USFS personnel. Surveys for MGRS middens have documented active and inactive middens in the surrounding forest that supports denser, interlocking canopy and a cooler, moister climatic regime deeper into the forest than that found on the edge of roads and trails mountain-wide. A few middens are known to be visible from some portions of some hiking trails, and some are very close to the edges of Forest roads, but we believe they remain relatively inconspicuous to the typical forest user. While roads and trails have a drying effect on the immediate forest edge, middens tend to be far enough away from these edges to remain active over time. No formal study has been conducted on edge effects of trails and roads on midden persistence.

In 2001, the Pinaleño Ecosystem Management Demonstration Project (PEM) was initiated to reduce heavy fuel loads on up to 1,100 acres roughly between Jesus Goudy Trailhead and Shannon Campground. For this project, we anticipated incidental take of three squirrels due to harm from potential burning or damaging a midden or harassment due to smoke and work-related noise (consultation #2-21-98-F-282). Both PEM and the special uses area hazardous fuel treatments (consultation #02-21-05-I-0818), which we concurred was not likely to adversely affect squirrels, were designed and coordinated with other resource protection agencies, including the FWS and AGFD, to reduce fuel loading, increase forest health, and encourage return of the natural fire cycle. Treatments completed under PEM provided firefighters safer areas to combat wildland fire during the Nuttall-Gibson Complex Fire in 2004 (see below). MGRS have persisted in and continue to inhabit areas treated through PEM, which includes removing trees up to nine-inches diameter at breast height (dbh); retaining large (16-inches dbh at the midpoint) logs, or, if few large logs exist, then leaving all 12-inch dbh logs, averaging between two to six per acre; retaining large snags, averaging between two to six per acre; and reducing the fuel load to between five and 25 tons per acre.

Two large wildland fire events – the Clark Peak Fire and the Nuttall-Gibson Complex Fire – have dramatically affected the extent and quality of MGRS habitat in recent years. The Clark Peak fire was a human-caused fire that started on April 24, 1996 in the Riggs Lake area at the northwestern end of the mountain range. The fire was contained at about 6,700 acres on May 9. On June 9, 1999, we issued a BO on the effects of suppression activities during the fire (consultation #2-21-96-F-286). The opinion concluded that suppression was not likely to have jeopardized the continued existence of the MGRS, nor did it result in destruction or adverse

modification of CH. However, 15 MGRS were thought to have been taken incidentally. The Nuttall-Gibson Complex Fire began as two small, separate fires: the Gibson Fire, which started on June 22, 2004, and the Nuttall Fire, which started June 26, 2004. Both fires were caused by lightning strikes. This fire burned approximately 29,900 acres in areas of oak woodland, ponderosa pine, mixed-conifer, and spruce-fir forest. On June 8, 2007, we issued a BO on the effect of suppression activities during the fire (consultation #02-21-04-M-0299). The opinion concluded that suppression was not likely to have jeopardized the continued existence of the MGRS, nor did it result in destruction or adverse modification of CH, although one squirrel was thought to have been incidentally taken due to suppression activities.

On June 10, 2005, we issued a programmatic BO/CO on the Continued Implementation of the LRMPs for the Eleven NFs and National Grasslands of the Southwestern Region (#2-22-03-F-366), including the Coronado NF LRMP. The opinion concluded that implementation of the Coronado NF portion of the LRMP did not rise to the level of jeopardy for the species, nor did it destroy or adversely modify designated CH, although up to 10 percent of the middens outside CH (called refugia in the opinion) could be incidentally taken, as measured through abandonment and/or physical alteration of middens.

In a May 22, 2006 letter from the MGRS Recovery Team (Recovery Team) to Dr. Benjamin Tuggle (then Acting Regional Director), the Recovery Team recommended capturing up to 16 MGRS from the wild to establish a captive breeding pilot program. Dr. Tuggle provided written approval to investigate a captive propagation program in a letter to Dr. William Matter (Recovery Team Leader) dated June 14, 2006. The project would involve trapping and transporting squirrels, holding them in captivity, and releasing progeny back into the wild. This project is currently under consultation.

During the last two weeks of June, 2011, the FWS Arizona Ecological Services Field Office initiated an emergency action to trap and remove four MGRS from the Pinaleño Mountains as an emergency measure to guard against the loss of the entire subspecies due to the potential threat of destruction of its remaining habitat by wildfire. When this emergency action was being considered, conditions in the Pinaleños were drier and more fire prone than they were prior to the Nuttall Complex and Clark Peak Fires that burned squirrel habitat in 2004 and 1996 (above). Meteorologists had predicted at least four dry lightning events could hit the Pinaleños before the monsoon season brought rain, and, if a fire were to have begun, the one road leading in and out of the mountains -- Swift Trail -- would have been closed to all but fire crews, rendering it too late to rescue any squirrels. In cooperation with the Coronado NF and AGFD, two male and two female squirrels were trapped and brought to the Phoenix Zoo, where they are currently being cared for. This emergency action is currently under consultation.

EFFECTS OF THE ACTION

The following information has not changed since the 2005 BO/CO and is hereby incorporated by reference. The MGRS only occurs on the Coronado NF. Under the direction of the Coronado NF LRMP, adverse effects to the red squirrel and its CH may occur as a result of implementation of the Engineering, Fire Management, Forestry and Forest Health, Lands and Minerals, and Recreation programs.

This BO includes projects that were covered by prior opinions but have yet to be implemented or are ongoing. These projects that were determined to have adverse effects to the MGRS include the 1988 BO for the Coronado NF Plan and Mt. Graham Astrophysical Area Plan and the 2011 BO for the Pinaleno Ecosystem Restoration Project (PERP).

The MGRS only occurs on the Coronado NF. Most of the red squirrel habitat is located within MAs 2 and 2A as defined in the Coronado NF LRMP, and all known MGRS middens are located within these two MAs. As shown in the Draft Recovery Plan for the MGRS, smaller areas of habitat have been identified (by Hatten 2009) in MAs 7, 8, 8A, and 9, but these areas comprise approximately 10 to 15 percent of all MGRS habitat on the Coronado NF and no middens have been documented within any of these MAs.

In general, most of the S&Gs analyzed have a positive effect in that they prohibit or restrict activities which could adversely affect the red squirrel. There were 81 applicable S&Gs that, when implemented, maintain habitat or provide recovery to the species. Most of the beneficial S&Gs are found in the Wildlife program. Other Coronado NF programs are either positive or neutral with respect to the squirrel. Effects of applicable S&Gs within each LRMP resource program are discussed below. Twelve S&Gs were found to be to open to interpretation and difficult to analyze. Additionally, two Coronado NF LRMP S&Gs were found in the 2005 BO/CO to have sub-lethal and lethal effects to the squirrel. These S&Gs with the potential to result in lethal and sub-lethal effects to MGRS are within the Forestry and Forest Health Program and the Rangeland Management Program. Based on additional information provided by the USFS since the 2011 BA, the FWS no longer ranks either of the two S&Gs as having lethal or sub-lethal effects.

Engineering Program

There are only two applicable forest-wide S&Gs (693, 694) within this program. Both S&Gs provide general resource protection from road construction and maintenance, and are beneficial for overall ecosystem heath. There are several applicable MA S&Gs. Management Area S&Gs 729, 730, 754, and 818 are more specific to the red squirrel. Standard and Guideline 729 (MA 2) would enforce road closures in MGRS habitat overlapping breeding season. Standard and Guideline 730 (MA 2A), 754 (MA 2A), and 818 (MA 8) provide for road closures in specific areas so as to reduce disturbance to the squirrel. Overall, the S&Gs within this program limit access and reduce road densities in MGRS habitat. In addition, the mere presence of vehicular traffic within MGRS is anticipated to result in adverse effects to the MGRS. The expected vehicular traffic within the occupied habitat is likely associated with a variety of activities, such as ingress/egress to the observatory, recreational use, administrative purposes, and special uses. Eight road-killed squirrels have been reported, with two being the most reported in any one year (both 1989 and 2004). The S&Gs outlined within the Engineering Program may minimize impacts to the MGRS and its habitat, but adverse effects are still likely to occur.

Fire Management Program

Catastrophic wildfire is an imminent threat to MGRS because of its restricted distribution (USFS 2004:144). Coronado NF fire management activities directly address this threat. Fire activities can be both interrelated/interdependent or direct actions (e.g., prescribed fire, fire risk

abatement). Standards and Guidelines for this program are difficult to assess at the programmatic level, since the application of these standards can have positive long-term effects, but initial negative effects, and are dependent upon site specific prescriptions. However, after close analysis, all applicable S&Gs within this program are noted for their beneficial long-term effects, but are also noted for initial short-term take. Management area S&Gs 713 and 731 provide overall ecosystem health, with respect to fuel reduction. Management Area S&G 755 specifically places emphasis on squirrel habitat for utilizing prescribed fire.

Forest-wide trends on the Coronado NF show prescribed fires to average 2,800 ac (1,133 ha) per year, and remain fairly constant from year to year (USFS 2004:144). Prescribed fires in ponderosa pine and mixed conifer types can have a positive effect on the red squirrel if the fire is not too severe; ladder fuels and fuel loads can be reduced through prescribed fire and thus reduce the risk of catastrophic wildfire (U.S. Fish and Wildlife Service 2000). However, harm could occur to middens (active or inactive) during prescribed fire activities. Harassment through noise disturbance is also likely to occur during prescribed fire activities. Piling and burning debris could also create new, relatively small openings in the canopy covered areas of red squirrel habitat. Midden placement appears to depend upon high levels of canopy closure and foliage volume around the top and side of the midden (U.S. Fish and Wildlife Service 2000). Currently, direct reduction of fuel loads in Wildland Urban Interface (WUI) areas has occurred at about 1,000 acres (404 hectares) per year and has been fairly constant (USFS 2004:144). However, midden placement occurs in stands with high canopy cover, foliage volume, and large amounts of dead or downed wood; therefore prescribed fire and fuel reduction activities, although essential to protect forest resources from catastrophic fires, could prove to have a negative effect to the species.

<u>Forestry and Forest Health Program</u>
Forest-wide and MA S&Gs within this program are mixed in their potential effects to the red squirrel. Forest-wide S&G 697 allows for pesticide use in recreation areas and administrative sites. Typically, these chemical treatments are conducted through ground-based spot treatments. Because this type of activity is authorized under the Coronado NF LRMP, and MGRS have been documented in and near such sites, it may result in negative effects if pesticides are ingested by red squirrels. However, S&Gs 723 and 739-745 will help to offset some of the potential impacts associated with S&G 697 because MA 2A is managed under S&G 723 stating *Red squirrel habitat needs will supersede the needs of all other species.* At this time, pesticide use is not occurring in MGRS habitat on the Coronado NF (USFS 2004:144). Although S&G 697 was found to have lethal effects to the MGRS during the 2005 consultation, the FWS believes that adverse effects to the MGRS are extremely unlikely to occur as a result of this S&G and are, therefore, discountable. FWS bases this on the history of pesticide use in recreation areas and administrative sites, which has not resulted in squirrel deaths.

Another high level threat to the species is habitat destruction through widespread defoliation and subsequent mortality of spruce and fir trees by the four-insect epidemics currently progressing on the mountain. Several MA S&Gs discuss ways to control outbreaks of insects by using integrated pest management concepts or lack thereof. Standards and Guidelines 819, 824, and 830 (MA 8, 8A, 9; cumulatively comprise approximately 10 percent of MGRS habitat) state that insect outbreaks will not be controlled, except when there is clear and imminent danger to timber

or other resources. These particular S&Gs are open to interpretation because their further application and subsequent effects are indeterminate at the time of our analysis. This same rationale can be used for S&Gs 671 and 725, with respect to timber management. Although 671 and 725 are somewhat ambiguous because they could allow for timber harvest to potentially occur within the range of the squirrel, most (if not all) of the lands within the range of the squirrel are considered unsuitable for timber harvest. Forest-wide trends for the Coronado NF show significant quantities of timber are not harvested; volume sold since 1986 has been less than 1 million board feet per year, and actual harvest has been much less than 1 million board feet . Fuelwood harvest has also been less than 1 million board feet per year since 1986. Additionally, no pesticide use for mistletoe control occurs on the Coronado NF (USFS 2004:144).

However, there are several positive S&Gs within this program (704, 723, 726, 727, 728, 748, and 756), with S&Gs 704 and 756 more specific towards habitat protection for MGRS.

Lands and Minerals Program

The Lands and Minerals Program contains two components relevant to MGRS – special uses and minerals. Special use permits affect, both positively and negatively, the development of facilities and their associated infrastructures. Mineral permits affect the actions associated with precious and common variety mineral extraction. These program components can remove, degrade, and fragment existing squirrel habitat (USFS 2004:145). Several applicable forest-wide S&Gs pertain to special use permits within the range of the squirrel. Overall, these forest-wide S&Gs (685, 686, 687, 688) intend to limit electronic site development, expansion of facilities and associated infrastructure, and use of existing facilities, with respect to the Mount Graham International Observatory, a special use permitted development. Standards and Guidelines 683 and 691 permit utility lines to be buried rather than strung from poles and would eliminate right-of-way corridors for utility lines, in turn reducing squirrel habitat loss and fragmentation and thus, maintaining and/or protecting MGRS habitat. Overall, the S&Gs mentioned above seek to improve or maintain squirrel habitat by consolidating existing facilities to capacity before the construction of additional facilities. However, new facility construction is not prohibited. The AICA directs the USFS to consider applications for up to four additional telescopes at the Mount Graham International Observatory. This expansion, if proposed, would have to comply with the Coronado NF LRMP, because any expansion would have an effect on the species (USFS 2004:145). Construction of any new telescopes would require additional consultation under section 7(a) (2) of the Endangered Species Act.

The remaining MA S&Gs (752, 816, 817, 823) address mineral extraction from specific MAs. Management Area 8 and 8A (both within the range of MGRS) have been withdrawn from mineral entry (S&Gs 816 and 817). Management Area 2A is *recommended* for withdrawal from mineral entry (823). The remaining MAs have not been withdrawn, including MA 2, which contains the largest amount of spruce-fir forest. According to the Land Management Program Trends and Description section (USFS 2004:46), the Coronado NF has averaged over 100 locatable plans of operation per year since 1996, with less than two acres as the average size of each operation. However, most of these activities include mining of semi-precious stones, which have minimal impacts to surfaces and forested environments. Additionally, no oil or gas development occurs on the Coronado NF, but common variety materials use is fairly constant.

Rangeland Management Program

All S&Gs within the Rangeland Management Program apply to specific MAs. Management Area 7 coincides with the range of the MGRS, and allow for livestock grazing within MA 7 under S&G 792. However, the habitat type (mixed conifer and spruce-fir forest) utilized by MGRS is considered unsuitable for grazing activities, and there is no grazing in red squirrel habitat. Standard and guideline 792 was found to have sub-lethal affects to the MGRS during the 2005 consultation because it allows for livestock grazing within MA 7, but the FWS has determined that adverse effects associated with this particular S&G are extremely unlikely to occur within MGRS habitat because of the area's unsuitable grazing conditions. Therefore, the FWS no longer believes that sub-lethal effects are expected to result from S&G 792. Management Area S&Gs (710, 747, 815, 822) seek to manage MAs 1, 2A, 8, and 8A at level A, or no assigned permitted use for livestock.

Recreation, Heritage, and Wilderness Program

Overall, forest-wide S&Gs within this program (612, 613, 626) provide baseline protection for all forest resources, whereas MA S&Gs within this program specifically address recreation effects to the squirrel. Management Area S&Gs 717 and 718 restrict snow play activities in MA 2. Management Area S&G 732 closes trail and trailhead use within the red squirrel Refugium (MA 2A). Management Area S&G 733 is similar in that it restricts hiking within this area. Management Area S&Gs 734 and 735 restrict motorized vehicles within MA 2A. Management Area S&G 736 prohibits snow play in MA 2A. Additionally, Management Area S&Gs 737 and 738 limit the amount of human-induced disturbance to the squirrel in MA 2A.

Watershed Management Program

In general, watershed activities are targeted at maintaining or improving watershed condition on the Forest. Most applicable S&Gs (672, 673, 674, 711, 749, 782) within this program provide overall watershed maintenance or improvement. No specific activities from the Coronado LRMP are identified within this program, although general direction is given for site-specific rehabilitation.

Wildlife, Fish, and Rare Plants Program

The Coronado NF Forest Plan, in particular, is very specific to the red squirrel and its habitat. This program directs various activities to maintain or improve fish and wildlife habitat. All applicable forest-wide and MA S&Gs were noted for their positive effects to the red squirrel, signifying that this program places an emphasis on endangered species and their requirements. There are several S&Gs (both forest-wide and MA specific) in this program that provide baseline habitat protection. However, there are several S&Gs with positive effects for the red squirrel. Many of these S&Gs (632, 722, 723, 742) work towards the implementation of specific recovery plan objectives. Additionally, there are two S&Gs (744, 745) that specifically implement the MGRS recovery plan.

In summary, the species effects analysis shows adverse effects to MGRS could potentially occur from implementation of the LRMP, and some of these adverse effects may rise to the level of incidental take (as described below).

1996 Regional Amendment
The management direction provided by the S&Gs in the 1996 Regional Amendment relates to the conservation of MSOs and Northern Goshawks. S&G 1478 for the 1996 Regional Amendment states "Management activities necessary to implement the Mt. Graham red squirrel recovery plan, which may conflict with S&Gs for MSO, will take precedence and will be exempt from the conflicting MSO S&Gs." The remainder of the applicable S&Gs from the 1996 Regional Amendment promotes healthy forest ecosystems; functioning watersheds; and riparian and aquatic systems (USFS 2004). The range of the MGRS coincides with the MSO restricted and protected areas, as well as the nesting and post-fledgling family areas of Northern Goshawks. Thus, the S&Gs associated with the 1996 Regional Amendment are applicable to the MGRS and its CH. However, we found that the guidelines used by the USFS for the Northern Goshawk do not appreciably affect this species.

Management activities necessary to implement the Mt. Graham red squirrel recovery plan, which may conflict with S&Gs for MSO, will take precedence and will be exempt from the conflicting MSO S&Gs.

EFFECTS OF THE ACTION (Critical Habitat)

The following information has not changed since the 2005 BO/CO and is hereby incorporated by reference. A complete list of the S&Gs from the Coronado NF LRMP and 1996 Regional Amendment that were analyzed to determine effects on CH for the Mount Graham red squirrel can be found in the 2005 BO/CO. Many S&Gs considered for MGRS CH consist of general guidance or program direction. In general, most of the applicable S&Gs have a positive effect in that they prohibit or restrict activities that could destroy or adversely modify CH designated for MGRS.

Critical Habitat for MGRS consists of three blocks of spruce-fir forests on the Safford Ranger District of the Coronado NF, specifically located in MAs 2, 2A, and some in MA 9. The PCE of CH for the red squirrel is dense spruce-fir forest. Activities which may adversely modify CH are any that destroy or substantially reduce forest density. Such activities include timber harvest and recreational development that proceed without adequate consideration of the welfare of the squirrel (U.S. Fish and Wildlife Service 1990). However, S&Gs 723 and 739 specify that red squirrel habitat needs will supersede the needs of all other species in MAs 2 and 2A.

<u>Engineering Program</u>
Roads occur within the boundaries of designated MGRS CH, and therefore maintenance activities occur. Use of many of these roads is restricted to authorized vehicles (especially in MA 2 and 2A). New road construction would be dependent on need for access from other resource areas, but the S&Gs for this program also require closure of unneeded roads in MAs 2 and 2A. The S&Gs limit access and are generally intended to reduce road densities in MGRS CH.

<u>Fire Management Program</u>
Catastrophic wildfire is an imminent and high-level threat to MGRS CH. Prescribed fires in ponderosa pine and mixed conifer types may have a positive effect on the red squirrel if the fire

is not too severe. Ladder fuels and fuel loads can be reduced through prescribed fire and thus reduce the risk of catastrophic wildfire. Direct reduction of fuel loads in WUI areas has occurred at about 1,000 ac (405 ha) per year, and has been fairly constant. Again, these activities can have a positive effect on MGRS CH for the same reasons as prescribed fire. Overall, applicable S&Gs within this program provide maintenance for MGRS CH.

Forestry and Forest Health Program

The Forestry and Forest Health Program affect MGRS CH through direct removal of large (greater than 12 inches diameter) trees and canopy cover, degradation and fragmentation of existing habitat (including construction of access roads), and fuelwood harvest. Although timber harvest could potentially occur within MGRS CH (S&G 725), most (if not all) of the lands within the designated CH of the red squirrel are considered unsuitable for timber harvest. Standards and Guidelines (704, 727, 728, 748) exist which restrict the type and extent of both commercial harvest and fuelwood harvest, providing some protection for red squirrel CH PCEs.

Lands and Minerals Program

Activities associated with this program, such as special uses and minerals, have the potential to remove, degrade, or fragment existing MGRS CH. Special uses in the range of the red squirrel have a large number of applicable S&Gs (683, 684, 685, 686, 687, 688, 691), most of which limit electronic site development, expansion of facilities and associated infrastructure, and use of existing facilities. The overall intent is to use and consolidate existing facilities to capacity before considering new facilities. As mentioned in the species Effects Analysis section, new facility construction is not prohibited and any additional expansions would lie within red squirrel CH. If proposed, any expansion would have to comply with the Coronado NF LRMP and would likely have an effect on MGRS CH. Standard and Guideline 752 recommends MA 2A for withdrawal from mineral entry. Standard and Guidelines 816, 817, and 823 would not allow mineral withdrawals from MAs 8 and 8A. However, the remaining MAs have not been withdrawn, including MA 2, which contains the majority of spruce-fir forest and lies within designated CH.

Rangeland Management Program

All MAs that fall within designated red squirrel CH are managed at Grazing Management Level A; no grazing (USFS 2004:150). Therefore, S&Gs within the Rangeland Management Program are not likely to adversely affect MGRS CH.

Recreation, Heritage, and Wilderness Program

Recreation can cause habitat degradation from human activity, and potentially habitat removal if new facilities are developed. Visitor use within some areas of MGRS CH is restricted (716, 717, 718) with road closures to unauthorized vehicles in MA 2A (733, 734, 735). Snow play activities are prohibited in MA 2A as well (736). However, other areas are open to recreation uses.

Watershed Management Program

Overall, activities within this program are targeted at maintaining or improving watershed condition; thus, we believe all applicable S&Gs within this program will not negatively affect the PCEs of MGRS CH.

Wildlife, Fish, and Rare Plants Program
The S&Gs within this program mostly restrict activities within CH of MGRS, but the majority of S&Gs apply only to the red squirrel and not necessarily to its CH.

1996 Regional Amendment
Standards and Guidelines from the 1996 Regional Amendment were predominately adopted for the MSO and Northern Goshawk; therefore, most of the applicable S&Gs provide habitat protection for the Mount Graham red squirrel and direction for overall ecosystem health. More than 50 percent of the S&Gs assessed would promote beneficial effects because they prohibit or restrict activities with potential to destroy or adversely modify CH designated for MGRS.

Cumulative Effects
The following information is taken from the 2005 BO/CO. 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 Act.

The USFS manages almost all lands within the action area and administers projects and permits on those lands; thus, almost all activities that could potentially affect MGRS are Federal activities and subject to additional section 7 consultations under the Act. The exceptions are road improvements proposed by the Arizona Department of Transportation that could occur along Swift Trail. These could include paving the remaining portion of the road up to Riggs Lake, which could increase both the speed and number of vehicles through this part of the action area. Greater speeds and numbers of vehicles could impact MGRS by injuring or killing individuals crossing the road, as well as potentially further disrupting dispersal patterns due to an increase in traffic.

CONCLUSION

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical Habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the CH to satisfy

essential requirements of the species" (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998:4-34).

After reviewing the current status of the MGRS and its CH, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, we conclude that continued implementation of the LRMP for the Coronado NF will not likely jeopardize the continued existence of MGRS and is not likely to destroy or adversely modify designated CH. Effects analyses and conclusions in BOs from 2005 through 2010 for the Coronado NF also determined that projects implemented under the current LRMP were not likely jeopardize the continued existence of MGRS or destroy/adversely modify designated CH. Projects implemented under the current Forest LRMP since 2005 in which the FWS determined adverse effects were caused and associated incidental take of squirrels were primarily due to fuels reduction and restoration projects (i.e., the Pinaleño Ecosystem Restoration Project) which are consistent with recommendations pursuant to the draft revised Recovery Plan (U.S. Fish and Wildlife Service 2010). Further, summary of our reasoning for determining that the continued implementation of the LRMP for the Coronado NF will not jeopardize MGRS and will not destroy or adversely modify designated CH for the species is based on the following:

- The Coronado NF's LRMP allows actions related to management of the MGRS to supersede other species (chapter 2, p. 44).
- Standards and Guidelines within the Coronado NF's LRMP have only had minor changes since 2005, including allowing Christmas tree removal and public firewood gathering in the Pinaleño Mountains, as well as establishing less restrictive visual quality objective in the mountain range. These amendments were necessary to implement the Pinaleño Ecosystem Restoration Plan, which is a recovery action benefitting MGRS as described in the draft revised Recovery Plan (U.S. Fish and Wildlife Service 2010).
- Large-scale projects implemented under the Coronado NF's LRMP in the Pinaleño Mountains have not lead to a jeopardy determination or adverse modification of MGRS CH, but instead will have beneficial effects to MGRS survival and recovery through fuels reduction and restoration.
- The implementation of the proposed action is not expected to impede the survival or recovery of MGRS within its range, but should aid in the maintenance and sustainability of MGRS and its CH through implementation of recovery actions (e.g., the Pinaleño Ecosystem Restoration Plan) as recommended in the draft Recovery Plan (U.S. Fish and Wildlife Service 2010).

Population estimates for MGRS since 2001 have fluctuated between approximately 200-300 individuals (using the fall conservative estimate), and, specifically since 2005, between 214-276 individuals. Our records do not indicate a decline in the MGRS population over the past 10 years.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) 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 which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE

We anticipate that incidental take of MGRS may occur under the current Coronado NF LRMP in addition to any previously authorized incidental take, as identified in the 2011 PERP BO. The BO for PERP, including all authorized incidental take, reasonable and prudent measures, and terms and conditions, is incorporated by reference. Additional incidental take is expected to occur in the form of harm as a result of ongoing vehicle traffic within MGRS habitat. We anticipate that two squirrels per year could be taken over the life of this BO. A total of eight road-killed squirrels have been reported on the Coronado NF, with two being the most reported in any one year (both 1989 and 2004). This level of take is not expected to result in jeopardy to the MGRS or cause destruction or adverse modification of MGRS CH.

Effect of the Take

In this BO, the FWS determines that this level of anticipated take is not likely to result in jeopardy to MGRS or destruction or adverse modification of MGRS CH. While the proposed action may result in incidental take of MGRS due to vehicle traffic, the LRMP contains multiple S&Gs that serve to protect MGRS and its habitat.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Coronado NF must comply with the following terms and conditions, which implement the reasonable and prudent measures described below and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary

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The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of MGRS.

1. Minimize or eliminate road related take of MGRS on the Coronado NF.

2. Monitor the impacts of the proposed action on the MGRS.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the Coronado NF must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1.1 The Coronado NF shall take steps to reduce the risk of road kills along all roads within MGRS habitat in the Pinaleños under their jurisdiction.

The following terms and conditions will implement reasonable and prudent measure 2:

2.1 The Coronado NF shall document any known incidental take resulting from vehicle traffic and report their findings to the FWS.

2.2 Annual reports, which will include this species, shall be sent to the appropriate local FWS Ecological Services field office by March 1st of each year.

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. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement Recovery Plans, or to develop information.

1. We recommend that the Forest continues to assist the Recovery Team in the implementation of the MGRS Recovery Plan and its revisions, including providing funding for carrying out key recovery actions under your authorities.

MEXICAN SPOTTED OWL

STATUS OF THE SPECIES

In 1993, the FWS listed the MSO (*Strix occidentalis lucida*) (MSO) as threatened under the Endangered Species Act. The FWS appointed the MSO Recovery Team in 1993, which produced the Recovery Plan for the MSO (Recovery Plan) in 1995 (USDI Fish and Wildlife Service 1995). The FWS released a Draft Revised Recovery Plan for public review during the summer of 2011 (U.S. Fish and Wildlife Service 2011) and intends to finalize the revised

recovery plan in 2012. In addition to referencing the 1995 Recovery Plan, we are also using additional information from the Draft Revised Recovery Plan (U.S. Fish and Wildlife Service 2011) in this BO. Additional information included from the Draft Revised Recovery Plan in this BO includes updated science about the biology of the MSO, updated threats information, and updated management recommendations (such as a revised population modeling framework). Critical habitat was designated for the MSO in 2004 (USDI Fish and Wildlife Service 2004).

A detailed account of the taxonomy, biology, and reproductive characteristics of the MSO is found in the Final Rule listing the MSO as a threatened species (USDI 1993), in the Recovery Plan (USDI Fish and Wildlife Service 1995), and in the Draft Revised Recovery Plan (U.S. Fish and Wildlife Service 2011). The information provided in those documents is included herein by reference. The MSO occurs in forested mountains and canyonlands throughout the southwestern U.S. and Mexico (Gutiérrez et al. 1995). It ranges from Utah, Colorado, Arizona, New Mexico, and the western portions of Texas south into several States of Mexico. Although the MSO's entire range covers a broad area of the southwestern U.S. and Mexico, it does not occur uniformly throughout its range. Instead, the MSO occurs in disjunct localities that correspond to isolated forested mountain systems, canyons, and in some cases steep, rocky canyon lands. Known MSO locations indicate that the species has an affinity for older, uneven-aged forest, and the species is known to inhabit a physically diverse landscape in the southwestern U.S. and Mexico.

The MSO occupies many habitat types scattered across a diverse landscape. In addition to this natural variability in habitat influencing MSO distribution, human activities also vary across the MSO's range. The combination of natural variability, human influences on MSOs, international boundaries, and logistics of implementation of the Recovery Plan necessitates subdivision of the MSO range into smaller MAs. The 1995 Recovery Plan subdivided the MSO's range into 11 "Recovery Units" (RUs): six in the U.S. and five in Mexico. In this revision of the Recovery Plan, we renamed RUs as "Ecological Management Units" (EMUs) to be in accord with current FWS guidelines (USDC NMFS and USDI FWS 2010). We divide the MSO range within the U.S. into five EMUs: Colorado Plateau (CP), Southern Rocky Mountains (SRM), Upper Gila Mountains (UGM), Basin and Range-West (BRW), and Basin and Range-East (BRE) (Figure 1).

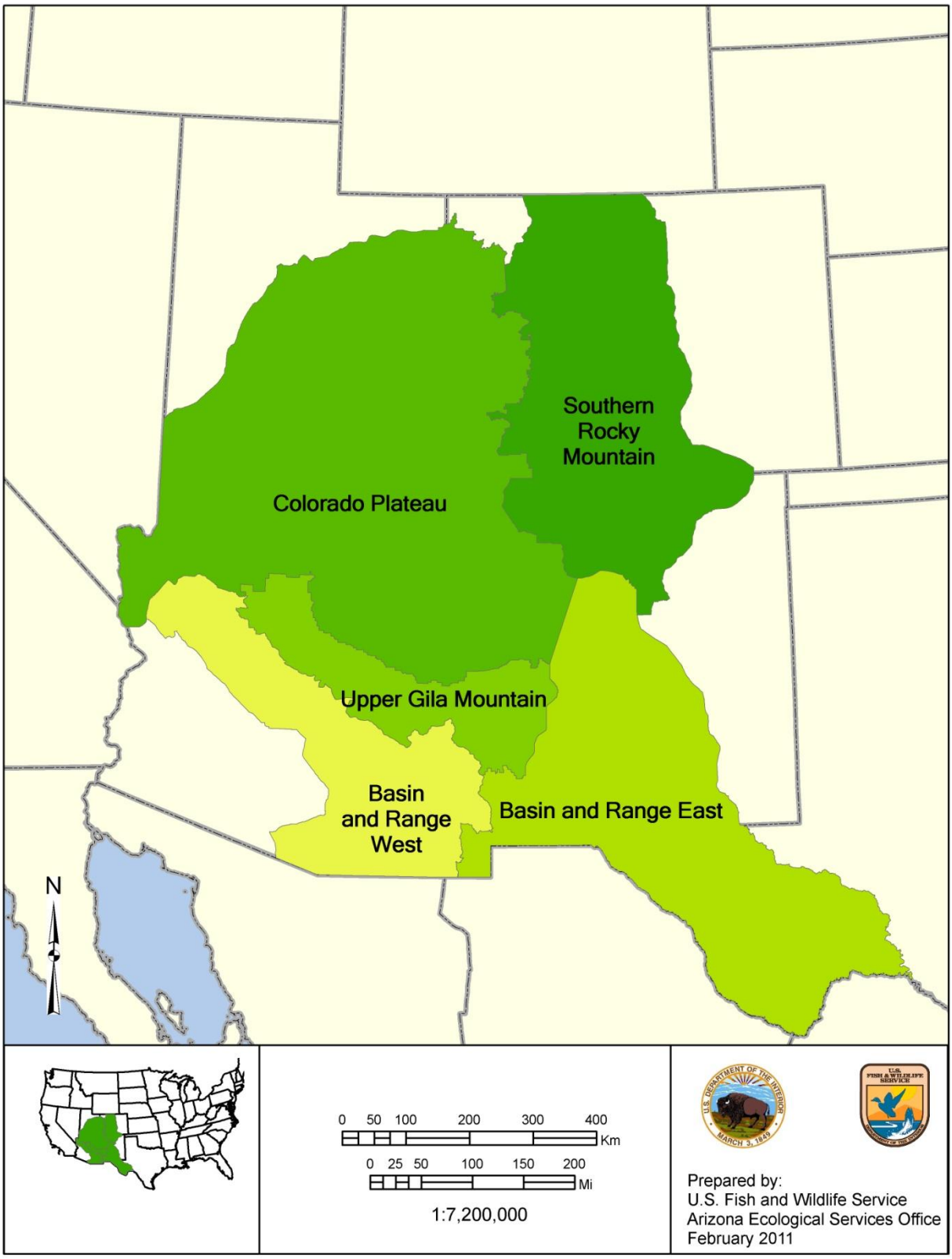

Figure 1. Ecological Management Units in the U.S.

There are two types of monitoring that can be conducted for the MSO. The first type of monitoring is a site-specific inventory of MSO habitat conducted using the MSO survey protocol. This method can provide information regarding the presence or absence of MSOs in a specific area (and is used to establish PACs, etc.), but does not provide population level indicators of the species general population trend. We will refer to this type of monitoring as "MSO surveys." The second type of monitoring is population monitoring. Population monitoring is conducted a large enough scale (typically range-wide) to provide information regarding population trend (i.e., is the species increasing, decreasing, or stable). Methodologies to conduct this type of monitoring include demographic studies or range-wide occupancy monitoring as described in the 2011 Draft Revised Recovery Plan (USDI Fish and Wildlife Service 1995, U.S. Fish and Wildlife Service 2011).

MSO surveys since the 1995 Recovery Plan and issuance of the 2005 LRMP BO/CO have increased our knowledge of MSO distribution, but not necessarily of MSO abundance. Population estimates, based upon MSO surveys, recorded 758 MSO sites from 1990 to 1993, and 1,222 MSO sites from 1990 to 2004 in the U.S. The Draft Recovery Plan for the MSO (FWS 2011) states that there were 1,301 MSO sites as of June 2011. An MSO site is an area used by a single or a pair of adult or subadult MSOs for nesting, roosting, or foraging. The increase in number of known MSO sites is mainly a product of new MSO surveys being completed within previously unsurveyed areas (e.g., several National Parks within southern Utah, Grand Canyon National Park in Arizona, Guadalupe National Park in West Texas, Guadalupe Mountains in southeastern New Mexico and West Texas, Dinosaur National Monument in Colorado, Cibola NF in New Mexico, and Gila NF in New Mexico). Thus, an increase in abundance in the species range-wide cannot be inferred from these data (U.S. Fish and Wildlife Service 2011). However, we do assume that an increase in the number of areas considered to be occupied to be a positive indicator regarding MSO numbers.

Two primary reasons were cited for the original listing of the MSO in 1993: (1) historic alteration of its habitat as the result of timber-management practices; and, (2) the threat of these practices continuing as evidenced in existing LRMPs. The danger of stand-replacing fire was also cited as a current and future threat at that time. Since publication of the Recovery Plan (USDI Fish and Wildlife Service 1995), we have acquired new information on the biology, threats, and habitat needs of the MSO. Threats to its population in the U.S. (but likely not in Mexico) have transitioned from commercial-based timber harvest to stand-replacing wildland fire. Recent forest management has moved from a commodity focus and now emphasizes sustainable ecological function and a return toward pre-settlement fire regimes, both of which have potential to benefit the MSO. Southwestern forests have experienced larger and more severe wildland fires from 1995 to the present than prior to 1995. Climate variability combined with dense forest conditions may also synergistically result in increased negative effects to habitat from fire. The intensification of natural drought cycles and the ensuing stress placed upon overstocked forested habitats could result in even larger and more severe fires in MSO habitat. Several factors have been identified as particularly detrimental to the MSO, including predation, starvation, accidents, disease, and parasites.

Historical and current anthropogenic uses of MSO habitat include both domestic and wild ungulate grazing, recreation, fuels reduction treatments, resource extraction (e.g., timber, oil,

gas), and development. These activities have the potential to reduce the quality of Mexican spotted MSO nesting, roosting, and foraging habitat, and may cause disturbance during the breeding season. Livestock and wild ungulate grazing is prevalent throughout Region 3 NF lands and is thought to have a negative effect on the availability of grass cover for prey species. Recreation impacts are increasing on all forests, especially in meadow and riparian areas. Fuels reduction treatments, though critical to reducing the risk of severe wildland fire, can have short-term adverse effects to MSOs through habitat modification and disturbance. As the human population grows in the southwestern U.S., small communities within and adjacent to National Forest System (NFS) lands are being developed. This trend may have detrimental effects to MSOs by further fragmenting habitat and increasing disturbance during the breeding season.

West Nile Virus also has the potential to adversely impact the MSO. The virus has been documented in Arizona, New Mexico, and Colorado, and preliminary information suggests that MSOs may be highly vulnerable to this disease (Courtney et al. 2004). Unfortunately, due to the secretive nature of MSOs and the lack of intensive monitoring of banded birds, we will most likely not know when MSOs contract the disease or the extent of its impact to the MSO range-wide.

Currently, high-intensity, stand-replacing fires are influencing ponderosa pine and mixed conifer forest types in Arizona and New Mexico. Uncharacteristic, high-severity, stand-replacing wildland fire is probably the greatest threat to the MSO within the action area. As throughout the West, fire severity and size have been increasing within this geographic area. Landscape level wildland fires, such as the Rodeo-Chediski Fire (2002) and the Wallow Fire (2011), have resulted in the loss of tens of thousands of acres of occupied and potential MSO habitat across significant portions of its range.

Global climate variability may also be a threat to the MSO and synergistically result in increased effects to habitat from fire, management actions across the MSO's range that result in adverse impacts, and other factors discussed above. Studies have shown that since 1950, the snowmelt season in some watersheds of the western U.S. has advanced by about 10 days (Dettinger and Cayan 1995, Dettinger and Diaz 2000, Stewart et al. 2004). Such changes in the timing and amount of snowmelt are thought to be signals of climate-related change in high elevations (Smith et al. 2000, Reiners et al. 2003). The impact of climate change is the intensification of natural drought cycles and the ensuing stress placed upon high-elevation montane habitats (IPCC 2007, Cook et al. 2004, Breshears et al. 2005, Mueller et al. 2005). The increased stress put on these habitats is likely to result in long-term changes to vegetation, invertebrate, and vertebrate populations within coniferous forests and canyon habitats that affect ecosystem function and processes.

Critical Habitat

The FWS designated CH for the MSO in 2004, on approximately 8.6 million acres (3.5 million hectares) of Federal lands in Arizona, Colorado, New Mexico, and Utah (U.S. Fish and Wildlife Service 2004). Within the designated boundaries, CH includes only those areas defined as protected habitats (defined as PACs and unoccupied slopes >40 percent in the mixed conifer and pine-oak forest types that have not had timber harvest in the last 20 years) and restricted habitats

(defined as unoccupied mixed conifer and pine-oak on slopes <40% or have been harvested for timber in the past 20 years and riparian forests) as defined in the 1995 Recovery Plan (USDI Fish and Wildlife Service 1995). The PCEs (PCEs) for MSO CH were determined from studies of their habitat requirements and information provided in the Recovery Plan (USDI Fish and Wildlife Service 1995). Since MSO habitat can include both canyon and forested areas, PCEs were identified in both areas. The PCEs identified for the MSO within mixed-conifer, pine-oak, and riparian forest types that provide for one or more of the MSO's habitat needs for nesting, roosting, foraging, and dispersing are:

- A range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees, 30 to 45 percent of which are large trees with diameter at breast height ((dbh) 4.5 ft above ground)) of 12 inches or more;
- A shade canopy created by the tree branches covering 40 percent or more of the ground and;
- Large, dead trees (snags) with a dbh of at least 12 inches.
- High volumes of fallen trees and other woody debris;
- A wide range of tree and plant species, including hardwoods; and
- Adequate levels of residual plant cover to maintain fruits and seeds, and allow plant regeneration.

The PCEs listed above usually are present with increasing forest age, but their occurrence may vary by location, past forest management practices or natural disturbance events, forest-type productivity, and plant succession. These PCEs may also be observed in younger stands, especially when the stands contain remnant large trees or patches of large trees. Certain forest management practices may also enhance tree growth and mature stand characteristics where the older, larger trees are allowed to persist.

<u>Summary of Rangewide Status of the Mexican spotted owl and critical habitat</u>
Overall, the distribution of the MSO and its designated CH has not changed significantly range-wide in the U.S. (which includes Utah, Colorado, Arizona, New Mexico, and extreme southwestern Texas) based upon the information we have since issuance of the 2005 LRMP BO/CO. What we mean by this is that MSOs continue to occur in the same areas and CH is continuing to provide for the life history needs of the MSO throughout all of the EMUs located in the U.S. We do not have detailed information regarding the status of the MSO in Mexico, so we cannot make inferences regarding its overall status.

However, this is not to say that significant changes have not occurred within the action area described below. Wildland fire has resulted in the most significant effects to PACs and CH relative to actions implemented under the LRMP (e.g., forest management, livestock grazing, recreation, etc.) throughout the U.S. range of the MSO. These wildland fire impacts have most impacted MSOs within the Upper Gila Mountains EMU (e.g., Rodeo-Chediski and Wallow Fires on the Apache-Sitgreaves NF) and Basin and Range West EMU (e.g., Horseshoe 2 Fire on the Coronado NF); but other EMUs have been impacted as well (Southern Rocky Mountains EMU, the Santa Fe NF by the Las Conchas Fire). However, we do not know the extent of the effects of these wildland fires on actual MSO numbers.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions within the action area. All proposed federal actions within the action area that have undergone formal or early section 7 consultation are included in the environmental baseline discussion. The environmental baseline discussion defines the current status of the MSO, its habitat, and designated CH within the Coronado NF. This discussion serves as a platform to assess the effects of the action to the MSO now under consultation.

Status of the Mexican Spotted Owl and Critical Habitat within the Action Area

The Coronado NF is located within the Basin and Range West (BRW) Ecological Management Unit (EMU). The Coronado NF is representative of basin and range topography often characterized as "sky islands." The Coronado NF is organized as five Ranger Districts; each Ranger District administers several sky island mountain ranges. The sky islands form distinct mountain ranges located in southeastern Arizona and southwestern New Mexico, twelve of which make up the Coronado NF. The mountain ranges offer a range of vegetative types and climates with tree-covered mountains rising from grassy savannas and the Sonoran and Chihuahuan Desert lowlands.

Mexican spotted owls are widely distributed on the Coronado NF. Mexican spotted owls are most common in mixed-conifer forests dominated by Douglas-fir and/or white fir as well as Madrean encinal woodlands, ponderosa pine-Gambel oak, and canyons with varying degrees of forest cover including riparian. As of 2011, 107 MSO PACs were delineated within the boundaries of the Coronado NF. Future surveys by the USFS as part of their regular management within currently unoccupied MSO habitat on the Coronado may detect additional MSOs.

Since our issuance of the 2005 LRMP BO/CO, the status of the MSO within the action area has likely been most impacted by the 2011 wildfires (see discussion below). However, because the fires occurred during the 2011 MSO breeding season, we will not have survey results until mid-to-late 2012 that may assist us in determining how MSO may have been affected by the fire.

The Horseshoe 2 Fire started in the Chiricahua Mountains on May 8, 2011 and was declared contained on June 25, 2011. The fire burned a total of 222,954 acres of which included 192,647 acres of the Coronado NF System. Fourteen PACs (7,993 acres) were affected by wildland fire, fire suppression, and/or emergency rehabilitation and stabilization actions, either directly or indirectly. An estimated seven MSO PACs were affected by suppression actions such as burn-out operations or line construction. Approximately 4,556 acres within MSO PACs were subjected to low-moderate burn severity or did not burn. These areas experienced a mosaic burn pattern and resulted in suitable MSO habitat remaining. Canopy closure, tree density, understory vegetation, and snag availability are relatively unchanged compared to pre-fire conditions within these areas. Approximately 2,346 acres within MSOs PACs burned at a moderate severity. Pockets of live, unburned trees remain scattered throughout these moderate-severity burn areas.

Approximately 1,091 acres within MSO PACs had high burn severity.

Two other fires also impacted MSO PACs in 2011. The Monument Fire started on June 12, 2011, and burned a total of 30,526 acres. Eight PACs were affected by the fire, of which seven were affected by suppression actions. According to the USFS, all but one of the MSO PACs experienced low to moderate burning. The Murphy Fire started on May 30, 2011 on the Nogales Ranger District and was contained on June 14, 2011. A relatively small percentage (i.e., less than 3 percent) of the fire area burned at high severity according to USFS reports. Four MSO PACs occurred within the fire perimeter but were not subjected to high severity fire. Altogether, the three wildfires burned approximately 26 MSOs PACs which represents roughly 24% of the total MSO PACs on the Coronado NF.

Fire has always been a major disturbance agent in southwestern forests (Swetnam 1990), and MSOs co-evolved with this disturbance. However, the structure of southwestern forests, the frequency with which they experience fire, and the types of fires experienced have changed greatly following increased human settlement of these lands (Covington and Moore 1994).

The Draft Revised Recovery Plan (U.S. Fish and Wildlife Service 2011) provides a detailed review of the literature regarding the effects of high-severity fire on MSOs. Based upon what we know, in many cases (but probably not all) adult MSOs are able to fly to relative safety during fire and may survive the initial fire effects (Bond et al. 2002). However, it is unlikely that eggs or nestlings in a nest would survive moderate-to-high severity fire effects due to direct effects from burning or smoke inhalation (for nestlings). Fledgling MSOs (juvenile owls that have left the nest but are still dependent upon their parents for care), are not likely to survive high-severity fire as they are not skilled at flying and may fly into the fire or become easy prey due to their weak flying skills.

Many of the key habitat components of MSO habitat are typically destroyed in high-severity fires. In addition to the direct loss of MSO nesting and roosting habitat, effects to MSOs may also result from the actions taken to suppress the fire.

Research indicates that spotted owls studied continued to occupy burned areas, even following relatively high-severity fires, except in the territory that experienced the highest burn severity (Bond et al. 2002). Results further suggest that survival rates and mate and site fidelity in these MSOs were relatively high in the year following fire. Bond et al. (2009) monitored movements and habitat use of radio-marked California spotted owls from four territories in the southern Sierra Nevada, California for four years following a large wildfire. MSOs nested in all four territories: two nests were located in moderate-severity burned mixed-conifer forest, one in low-severity burned mixed-conifer forest, and one in unburned mixed-conifer-hardwood forest. One nesting pair in a moderate-severity burned area successfully fledged a single owl. The others were not successful. MSOs roosted selectively in low-severity burned forest, avoided moderate-severity and high-severity burned forest, and used unburned forest in proportion to availability. Within 1 km of their nest, MSOs foraged selectively in all severities of burned forests and avoided unburned forests. These results collectively suggest that the post-fire landscapes studied contained enough suitable habitat to support pair occupancy and at least attempted nesting. They further suggest that burned areas may provide benefits to foraging MSOs. Bond et al. (2009)

concluded that assessments of fire impacts should not assume that all fires have negative impacts on spotted owls and recommended that burned forests within 1.5 km of MSO roosts or nests not be salvage-logged.

In addition to the above studies, there are numerous anecdotal observations of MSOs occupying territories following wildfires and prescribed burns (Paul Boucher, Gila National Forest retired, pers. comm.; Shaula Hedwall, FWS, pers. comm.), as well as evidence of radio-marked MSOs moving into and foraging in burned areas during winter (J. P. Ward, Jr. and J. L. Ganey, unpublished data). Most wildland fires burn in a patchy nature and leave pockets of useable habitat for MSOs, and MSOs appear able to locate and use these patches for nesting and roosting. Thus, MSOs appear to be somewhat resilient to wildfire, at least in the short term. However, we have no data on long-term effects of these fires on occupancy patterns or on components of MSO fitness such as survival and reproduction. Therefore, it is unclear at this time how MSOs will respond to habitat modification resulting from the three wildfires discussed above and the associated suppression activities.

Critical Habitat

Eleven CHUs occur within the boundaries of the Coronado NF and include the following: BRW-7 (18,126 acres of the Santa Teresa Wilderness), BRW-8 (44,587 acres within the Pinaleno Mountains, Mount Graham Wilderness), BRW-9 (63,419 acres of the Galiuro Wilderness), BRW-10 (13,427 acres of the Winchester Mountains), BRW-11 (241,851 acres of the Santa Catalina and Rincon Mountains), BRW-12 (55,157 acres of the Mount Wrightson Wilderness, Santa Rita Mountains), BRW-13 (54,881 acres of the Atascosa and Pajarito Mountains), BRW-14 (56,756 acres of the Patagonia Mountains), BRW-15 (53,844 acres of the Miller Peak Wilderness, Huachuca Mountains), BRW-16 (21,150 acres of the Whetstone Mountains), and BRW-18 (75,609 acres of the Chiricahua Mountains). Only areas identified as protected and restricted pursuant to the Recovery Plan (USDI Fish and Wildlife Service 1995) within the CHUs are considered CH.

Factors Affecting the Mexican Spotted Owl and its Critical Habitat within the Action Area

The factors (i.e., Federal, State, tribal, local, and private actions) already affecting the MSO and its designated CH within the action area are discussed in this section. Since the action area consists of NFS lands, there are likely very few, if any, State, tribal, or private actions impacting the MSO or its CH in the action area. Formal consultations that have occurred from 2005 (the year of the original LRMP BO) to the present are summarized in Table 2.

Table 2. Formal consultations on the Coronado National Forest from 2005 to 2011.*

Consultation #	**Date of Final BO**	**Project**	**Approximate # of MSOs Anticipated Taken**	**# of PACs Anticipated Taken**	**Form of Take**
02-21-04-M-0287	*11/3/2005*	*Sunnyside Fire Suppression actions*	*0*	*0*	*n/a*
02-21-04-M-0299	*6/8/2007*	*Nuttall-Gibson Complex Wildfire*	*4 adults and associated*	*2 PACs*	*Harassment*

		Suppression actions	*young*		
02-21-98-F-0650	9/7/2007	Johnson Peak Fire Management Plan	0	0	n/a
22410-2008-F-0451	4/2/2009	Huachuca FireScape Project	0	0	n/a
22410-2005-F-0651	8/5/2011	Pinaleño Ecosystem Restoration Project	12 adult pairs and associated juveniles	6 PACs	Harm (4 pairs); Harassment (2 pairs)
22410-2008-F-0149-R001	*12/6/2011*	*Effects to Listed Species from U.S. USFS Aerial Application of Fire Retardants on NFS Lands*	*Incidental take will be tracked as it occurs per the BO*	*Incidental take will be tracked as it occurs per the BO*	*Harm & Harass*
		TOTAL		8 PACs	

*Projects in italics are fire suppression activities that are not included in the proposed action for this consultation.

Since 2005, six BOs have been issued and two are in process for the Coronado NF (see Table 2). The majority of the projects that involved harm and/or harassment of MSOs include fuel reduction, forest restoration, and wildland fire suppression activities on the Coronado NF. The incidental take associated with the nonemergency projects was from chronic disturbance and habitat alteration. However, restoration projects such as the Pinaleño Ecosystem Project on Mount Graham will have long-term beneficial effects to the MSO as well. Overall, from 2005 to present, incidental take in the form of harm or harassment was anticipated for MSOs associated with 8 PACs on the Coronado NF. Incidental take of MSOs associated with wildland fire suppression activities is not part of the action under consultation in this BO, but is part of the environmental baseline. The Coronado NF provided CMs that would minimize the impacts to MSOs in all formal consultations. All BOs for projects conducted on the Coronado NF were determined not to jeopardize the species or result in adverse modification or destruction of CH.

According to the USFS's 2009 Annual Report, the Coronado NF monitors MSO PACs each year as funding allows with priority given to PACs affected by project activities. Our information from BOs since 2005 state that actions implemented under the LRMP have resulted in the incidental take of MSOs occurring within eight MSO PACs on the Coronado NF. Eight MSO PACs represent seven percent of the total 107 MSO PACs on the Coronado NF. Though the actions analyzed above did result in adverse effects and incidental take of MSOs, stand-replacing fire was likely the most important factor affecting the MSO on this forest since the 2005 LRMP BO/CO was finalized.

Critical Habitat

Since our issuance of the 2005 LRMP BO/CO, the status of CH has been most impacted by the 2011 wildfires (see discussion below). A significant portion of CHU BRW-18 was affected by the Horseshoe 2 fire although an approximate percentage has not been reported by the USFS. The Monument Fire burned within CHU BRW-15 and the Murphy Fire burned areas within

MSO CHU BRW-14. Loss of important structural elements such as downed woody debris, snags, and canopy cover may impact MSOs in the short term by reducing important habitat features for nesting, roosting, and foraging. The areas that burned at low severity will continue to provide breeding and foraging habitat. The majority of drainage bottoms burned at low or moderate severity and may continue to provide adequate breeding and foraging habitat. The CH has likely significantly reduced PCEs related to forest structure, including a range of tree species composed of different sizes and a shade canopy created by tree branches covering 40 percent or more of the ground. The fire did create numerous beneficial snags (dead trees) through fire kill, but many of these fire-killed trees will fall within a few years (Chambers and Mast 2005). As snags fall, the PCE of high volumes of fallen trees and other woody debris (related to prey abundance) will continue to increase, which may make for good foraging habitat. However, the limiting habitat feature post-fire for MSOs may be nesting-roosting habitat (forested habitat with a range of trees species and high canopy cover).

EFFECTS OF THE ACTION

Effects of the action refer to the direct and indirect effects of an action on the species or CH, 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.

Background Information regarding the Proposed Action

The proposed action being analyzed in this BO is implementation of the Coronado NF LRMP and its amendments. The most important amendment in regards to MSO management is the June 5, 1996, Amendment of Forest Plans in Arizona and New Mexico for the Management of the MSO and northern goshawk. This amendment was developed in collaboration with the FWS and incorporated many of the management recommendations from the Recovery Plan for the MSO (USDI Fish and Wildlife Service 1995) into all 11 NF LRMPs.

An LRMP provides guidance and direction in the context of a broad management framework. The LRMP defines the direction for managing the NF. Direction in the LRMP is provided in the form of the S&Gs. Because it was unclear what the operational difference is between a "standard" and "guideline," neither the USFS nor FWS differentiated between the two for the analyses in the BA or the BO. The FWS recognizes that some differences in interpretation may exist on the part of forest managers at the project level in the implementation of LRMPs through the S&Gs. These differences in interpretation also add to the complexity of this consultation.

The S&Gs are written to apply Forest-wide or to a specific MA. The Coronado NF has designated "MAs" based on such criteria as vegetation type, principal land use, and special management designations such as wilderness areas. During the development of a project, each management program reviews Forest-wide and MA-specific S&Gs that either give direction to, guide, or place constraints upon management activities (e.g., logging, grazing, recreation,

mining, etc.). The S&Gs that provide direction state what will be accomplished to achieve specific resource goals. In many cases, the S&Gs were developed to target management of a specific species (e.g., the 1996 Forest-wide amendment to include S&Gs for the threatened MSO).

This BO is now covering the projects that were covered by prior BOs that have yet to be fully implemented. For example, this BO covers Johnson Peak Fire Management Plan, Huachuca FireScape Project, and Pinaleño Ecosystem Restoration Project on the Coronado NF.

The LRMPs direct how current and future activities will be carried out in the following management programs: (1) Engineering, (2) Fire Management, (3) Forestry and Forest Health, (4) Lands and Minerals, (5) Rangeland Management, (6) Recreation, Heritage and Wilderness, (7) Watershed Management, and (8) Wildlife, Fish, and Rare Plants. Each of the USFS's eight resource programs were discussed in depth within the April 8, 2004, BA, the June 10, 2005, LRMP BO, and the April 6, 2011, BA.

Effects to the MSO were evaluated in the 2005 BO/CO, and are included herein by reference (see U.S. Fish and Wildlife Service 2005). The majority of the S&Gs within the Coronado NF's LRMP were considered positive in the sense that management would maintain habitat for the MSO or provide for its recovery. Several S&Gs moved towards recovery or implemented recovery plans for listed species. However, potential adverse effects were found in Fire Management Program; Forestry and Forest Health; and Rangeland Management programs. The Fire Management Program combines elements of fire prevention, prescribed fire, wildland fire, and fire suppression. However, wildland fire, including fire suppression and wildland fire use, are not included in the proposed action and consultation on these actions will continue to be handled under emergency Section 7 consultation procedures. As stated in the 2005 BO/CO, the overall assessment of the Coronado NF's LRMP was positive for the MSO. Therefore, our conclusion was that the continued implementation of the Coronado NF's LRMP would not jeopardize the continued existence of the MSO or destroy or adversely modify designated CH for the species.

Effects of the Action on the Mexican spotted owl

Since 2005, three BOs have been issued to the Coronado NF addressing adverse effects to MSO from projects implemented under the Forest's LRMP. These projects included two fuels reduction projects and one large forest restoration project. Six MSO PACs were determined to have incidental take in the form of both harm and harassment associated with the Pinaleño Ecosystem Restoration Project. This large restoration project will have benefits to the MSO in the long-term through fire abatement. All BOs for projects conducted on the Coronado NF were determined to be non-jeopardy for the species and non-adverse modification or destruction for CH.

Fire Management Program

Standard and Guideline 713 stated that prescribed fire will be used to reduce fuel hazards, enhance wildlife values, and enhance visual resources. Fuels reduction and light burning are recommended in the Recovery Plan for the MSO to reduce the threat of large-scale, stand-

replacing fires (U.S. Fish and Wildlife Service 1995). However, short-term behavioral responses such as flushing or nest/roost abandonment could occur (Swarthout and Steidl 2001, 2003; Delaney et al. 1999). The USFS typically implements measures to minimize effects to these key habitat components (e.g., burning during periods of increased fuel moisture, etc.).

Forestry and Forest Health Program

Standard and Guideline 697 states that chemicals may be used within guidelines approved by other agencies; insecticides and rodenticides will be used in recreation areas and administrative sites. Using chemical agents such as rodenticides in areas occupied by MSOs could have negative effects by killing their primary prey item (i.e., small mammals). Standard and guideline 726 provides the Forest standards on timber removal based on rotation age and basal area. Management direction provided by this S&Gs does not appear to be compatible with maintaining nesting and/or roosting habitat for MSOs; however, it is unlikely that timber harvest will occur in occupied nesting and/or roosting habitat.

Rangeland Management Program

Several S&Gs in the Rangeland Management Program were ranked as possibly causing a sublethal response (e.g., reduced reproduction). For instance, S&G 792 calls for managing suitable rangeland at level D (i.e., highest grazing intensity) and if level D is not achievable then to manage at level A (no livestock). According to the Coronado's definition, level D grazing includes intensive livestock management and will obtain relatively uniform distribution at 35-55 percent use level over 100 percent of the full capacity range. In addition, S&G 805 also manages for level D and projects that approximately 1,700 acres will be in unsatisfactory condition with 15,000 being in satisfactory condition. As stated above, inappropriate grazing practices are primarily manifested through two indirect effects, (1) adverse alteration of food and cover resources needed by the MSO's prey species and (2) adverse alteration or elimination of vegetation (e.g., riparian and oak communities) that may ultimately develop into MSOs roosting or nesting cover.

Recreation, Heritage, and Wilderness Program

No negative S&Gs were identified in the Recreation Program. However, the LRMP for the Coronado NF allows for certain levels of recreation. There may be disturbance from hikers, campers, and bird watchers on the various Ranger Districts on the Coronado NF. Because of its proximity to urban areas, this Forest experiences a large number of birdwatchers, with the MSO being one of the more popular species sought by birders in the region (U.S. Fish and Wildlife Service 1995:101). However, activities such as these may result in disturbance but do not cause habitat alteration.

Wildlife, Fish, and Rare Plants Program

Standard and Guideline 724 allows the Forest to maintain and improve occupied habitat for the several species including the MSO. In addition, this S&G specifically states to delist threatened and endangered (T&E) species following guidelines of approved recovery plans. These S&Gs may be beneficial to the MSO.

In summary, the overall assessment of the Coronado NF's LRMP is that it is beneficial for the MSO. Eight S&Gs moved toward recovery and 11 stated specifically to implement recovery plans.

Effects of the Action on Mexican spotted owl Critical Habitat

Since 2005, MSO designated CH has been affected by the proposed action. Project impacts documented in BOs since 2005 to the PCEs related to forest structure and maintenance of adequate prey species are summarized below. Below the PCEs related to forest structure and maintenance of adequate prey species and the effects from implementation of the LRMP are described.

Primary Constituent Elements related to forest structure:

PCE: A range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees, 30 percent to 45 percent of which are large trees with diameter-at-breast height (dbh) of 12 inches or more.

Effect: Actions implemented under the LRMP are expected to retain the range of tree species (i.e., conifers and hardwoods associated with MSO habitat) and will not reduce the range of tree sizes needed to create the diverse forest and multi-layered forest canopy preferred by MSOs. Some loss of trees, of all types and dbh size classes, will occur from actions such as hazard tree removal, prescribed fire, forest restoration, and forest thinning (as implemented under the Fire Management and Forest and Forest Health Programs). However, actions implemented under the LRMP are expected to maintain a range of tree species and sizes needed to maintain this PCE in PACs and restricted habitat across the NF because the USFS is implementing the Recovery Plan guidelines that strive to retain large trees, canopy cover appropriate for MSO habitat, and a diverse range of tree species (such as Gambel oak in pine-oak forests and several conifer species in mixed conifer forest. Removal of trees and various trees species may also occur as part of the Recreation (development of recreation sites) and Engineering Programs (creation, maintenance of roads); but these effects should be small in extent. The function and conservation role of this PCE would not be compromised by the proposed action.

PCE: A shade canopy created by the tree branches covering 40 percent or more of the ground. Previous treatments were not expected to reduce the shaded canopy below 40 percent.

Effect: We expect that tree shade canopy will be reduced following hazard tree removal, thinning, and burning treatments implemented under the LRMP in the Fire Management and Forest and Forest Health Programs. However, we do not expect reduction of canopy cover in MSO forested habitat to be reduced below 40 percent because the USFS has adopted the Recovery Plan recommendations which include managing for higher basal area and denser canopy cover in MSO habitat versus pure ponderosa pine or other forest and woodland habitats. We would expect that some small reduction in existing canopy cover (5 to 10 percent) may actually aid in increasing understory herbaceous vegetation and forb production, which will benefit MSO prey species. The function and conservation role of this PCE would not be compromised by the proposed action.

PCE: Large, dead trees (snags) with a dbh of at least 12 inches.

Effect: Large snags would most likely be reduced following proposed prescribed burning and hazard tree removal actions conducted under the Fire Management and Forest and Forest Health Programs. Currently, any loss of this habitat component may be significant in terms of maintaining MSO and prey habitat. Some snags will be created through prescribed burning, which could benefit the MSO. However, snags currently used by MSOs for nesting are typically very old, large dbh, highly decayed snags with cavities. In individual burning projects, the USFS would attempt to minimize loss of these large snags through CMs (such as lining or using lighting techniques to avoid snags). However, it is likely that following burning treatments, upwards of 30 percent of this existing snags may be lost within treated (i.e., burned) MSO habitat, resulting in short-term adverse effects to this PCE (Randall Parker and Miller 2000). This is why CMs that the USFS implements to protect the largest and oldest snags (particularly those with nest cavities) are so important. As such, the function and conservation role of this PCE would not be compromised by the proposed action.

Primary Constituent Elements related to maintenance of adequate prey species:

PCE: High volumes of fallen trees and other woody debris.

Effect: Fallen trees and woody debris would likely be reduced by the proposed burning treatments (broadcast, piling, and maintenance burning) as part of the Fire Management Program. Logs are expected to be reduced by approximately 50 percent following prescribed burning in forested habitat (Randall Parker and Miller 2000). This loss of large logs would result in short-term adverse effects to this PCE and could result in localized impacts to prey species habitat. However, across the Coronado NF, it is likely that hazard tree removal and prescribed burning will also create fallen trees and woody debris as trees are felled (i.e., cut) and left on the ground or die post-burn and fall. The function and conservation role of this PCE would not be compromised by the proposed action.

PCE: A wide range of tree and plant species, including hardwoods.

Effect: This PCE will likely be positively affected by the actions taken under the Fire Management and Forest and Forest Health Programs. Plant species richness would likely increase following thinning and/or burning treatments that result in small, localized canopy gaps. Individual projects conducted under the LRMP typically propose CMs that focus on retaining Gambel oaks and other hardwoods, but some level of short-term loss could occur at the individual project level. However, the function and conservation role of this PCE would not be compromised by the proposed action.

PCE: Adequate levels of residual plant cover to maintain fruits and seeds, and allow plant regeneration.

Effect: Short-term decrease in plant cover will result from prescribed burning conducted under the Fire Management Program. We expect long-term increases in residual plant cover because treatments would provide conditions suitable for increased herbaceous plant growth by removing a thick layer of dead plant debris within treated areas. The mosaic effect created by burned and unburned areas and by opening up small patches of forest within protected habitat is also expected to increase herbaceous plant species diversity and, in turn, assist in the production and maintenance of the MSO prey base. The function and conservation role of this PCE would not be compromised by the proposed action. The combination of low-intensity prescribed burns during restoration projects most likely resulted in short-term adverse effects to the MSO with regard to modifying prey habitat within treatment areas. There is the potential for the Rangeland Program to have adverse effects on the production of plant cover post-burning. However, typically the USFS includes measures in its allotment (livestock) management plans to maintain healthy levels of forage and the Fire Program recommends removing livestock temporarily following prescribed and wildland fire.

Effects of the Action on the Role of Critical Habitat in Recovery

In our analysis of the effects of the action on CH, we must determine if the proposed action impacts CH PCEs to the point that they diminish the value of that CH for the recovery of listed species. To determine if an action results in destruction or adverse modification of CH, we must also evaluate the current condition of all designated CHUs and their PCEs, to determine the overall ability of all designated CH to support recovery.

The proposed action includes actions that are recommended in the 1995 Recovery Plan and the Draft Revised Recovery Plan for the MSO. These actions were identified by the Recovery Team as being necessary to recover the MSO and the Coronado NF is implementing these actions in designated CH. Designated CH includes all protected (PACs and steep-slope (>40%) habitat in mixed conifer and pine-oak that have not been harvested for timber in the past 20 years) and restricted (all other unoccupied mixed conifer and pine-oak vegetation types as well as riparian areas) within CHUs. These actions include the following:

- The Coronado NF incorporated most of the management recommendations from the 1995 Recovery Plan for the MSO.

- The Coronado NF has and continues to designate 600 acres surrounding known MSO nesting and roosting sites. PACs are established around MSO sites and are intended to protect and maintain occupied MSO nest/roost habitat. Nesting and roosting habitat is rare across the range of the MSO and by identifying these areas for increased protection, the USFS is aiding in recovery.

- The Coronado NF has identified and is managing pine-oak, mixed-conifer, and riparian forests that have potential for becoming replacement MSO nest-roost habitat, or is currently providing habitat for MSO foraging, dispersal, or wintering habitats. As stated above, nesting and roosting habitat is a limiting factor for the MSO throughout its range. By managing CH for future nest/roost habitat, the USFS is aiding in recovery.

- Projects implemented on the Coronado since the species was listed have not resulted in jeopardy, and projects implemented since the designation of CH have not resulted in adverse modification or destruction of CH.

These actions should increase the sustainability and resiliency of MSO habitat (particularly through fuels management and forest restoration actions). Therefore, continued implementation of the Coronado NF LRMP is not expected to further diminish the conservation contribution of CH to the recovery of the MSO.

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 Act. Since the land within the action area is almost exclusively managed by the USFS, most activities that could potentially affect listed species are Federal activities and subject to additional section 7 consultations.

CONCLUSION

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the CH to satisfy essential requirements of the species" (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998:4-34).

After reviewing the current status of the MSO and its CH, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, we conclude that continued implementation of the LRMP for the Coronado NF will not likely jeopardize the continued existence of the MSO and is not likely to destroy or adversely modify designated CH. Effects analyses and conclusions in BOs from 2005 through 2010 for the Coronado NF also determined that projects implemented under the current LRMP were not likely to jeopardize the continued existence of the MSO or destroy/adversely modify designated CH. Projects implemented under the current Forest LRMP since 2005 in which the FWS determined caused adverse effects and associated incidental take of MSOs were primarily due to fuels reduction and

restoration projects which are consistent with management recommendation pursuant to the Recovery Plan (USDI Fish and Wildlife Service 1995). Further, summary of our reasoning for determining that the continued implementation of the LRMP for the Coronado NF will not jeopardize the MSO and will not destroy or adversely modify designated CH for the species is based on the following:

- In 1996, the USFS amended the Coronado NF LRMP to incorporate recommendations from the 1995 Recovery Plan (USDI Fish and Wildlife Service 1995) through an EIS pursuant to NEPA. Since then, the USFS has incorporated 1995 Recovery Plan recommendations into individual projects consulted on under the 2005 LRMP BO/CO and provided project implementation monitoring information to the FWS indicating that these projects were implemented as proposed.

- Standards and Guidelines within the Coronado NF's LRMP have not changed since 2005, the majority of which were found to be beneficial to the MSO. Although the MSO's environmental baseline may have changed on the Coronado NF as a result of wildland fires, the USFS continues to implement many of the 1995 Recovery Plan recommendations to protect the MSO (e.g., minimize noise disturbance and habitat altering actions within PACs during the breeding season) and its CH (e.g., manage for PCEs such as large trees, high canopy cover, snags, and logs in designated CH).

- Projects implemented under the Coronado NF's LRMP have not lead to a jeopardy determination or adverse modification of MSO CH since 2005. Implementation of fuels reduction and forest restoration projects that follow 1995 Recovery Plan recommendations will have long-term beneficial effects to MSO's survival and ultimately recovery (U.S. Fish and Wildlife Service 2011).

- The population monitoring scheme within the 1995 Recovery Plan was proven to be not feasible due to logistics and expense. A new population monitoring protocol was developed within the Draft Revised Recovery Plan based on MSO occupancy. The USFS has agreed to meet with the FWS to discuss their future participation in population monitoring with us and other land management agencies.

Across the range of the MSO, the population monitoring described within the 1995 Recovery Plan was never implemented because it was not economically or operationally feasible. A revised population monitoring procedure has been outlined in the Draft Revised Recovery Plan (USFWS 2011) which aims at assessing MSO population trends. Although population trend monitoring has not occurred for the MSO, our records indicate no decline in the MSO population based upon an increase in known PAC numbers since the MSO was listed (see the Status of the Species section). However, some level of range-wide MSO population monitoring is needed in order for us to assess the status of the MSO. In the 2005 LRMP BO, we included a reasonable and prudent measure for occupancy monitoring that was not feasible, clearly defined, or constrained, nor could be used to effectively measure incidental take associated with the proposed action. Our revised incidental take statement provides for a level of project-specific implementation monitoring at the individual BO level by assessing incidental take associated with the site-specific actions implemented under the LRMP.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) 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 which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

For the purpose of evaluating incidental take of MSO from the action under consultation, incidental take can be anticipated as either the direct mortality of individual birds, or the alteration of habitat that affects behavior (i.e., breeding or foraging) of birds to such a degree that the birds are considered lost as viable members of the population and thus "taken." Birds experiencing only temporary or short-term effects may fail to breed, fail to successfully rear young, or raise less fit young; longer-term disturbance may result in MSOs deserting the area because of chronic disturbance or because habitat no longer meets the MSO's needs.

We anticipate that the proposed action is reasonably certain to result in incidental take of MSOs. However, it is difficult to quantify the number of individual MSOs taken because: (1) dead or impaired individuals are difficult to find and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species could change over time through immigration, emigration, and loss or creation of habitat; and (3) the species is secretive and we rarely have information regarding the number of MSOs occupying a PAC and/or their reproductive status. For these reasons, we will attribute incidental take at the PAC level. This fits well with our current section 7 consultation policy which provides for incidental take if an activity compromises the integrity of an occupied PAC to an extent that we are reasonably certain that incidental take occurred (FWS Memorandum, February 3, 1997). Actions outside PACs will generally not result in incidental take because we are not reasonably certain the MSOs are nesting and roosting in areas outside of PACs. We may modify this determination in cases when areas that may support MSOs have not been adequately surveyed and we are reasonably certain MSOs may be present.

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

Amount of Take

Based upon analyses of the effects of USFS projects within previous BOs, we anticipate the majority of incidental take for future projects implemented under the Coronado NF LRMP will be in form of short-term harassment. MSOs experiencing short-term harassment may fail to successfully rear young in one or more breeding seasons, but not likely desert the area because of a short-term disturbance (Delaney et al. 1999). Incidental take in the form of harm is also anticipated albeit at a lesser amount (i.e., the number of MSOs) than take from harassment. Harm would be defined as either the direct mortality of individual birds, or the alteration of habitat that affects behavior (e.g. breeding or foraging) of birds to such a degree that the birds desert the area and would be considered lost as viable members of the population.

The number of MSO PACs on the Coronado NF is currently 107. Currently, because of impacts associated with the Horseshoe 2, Monument, and Murphy Fires, we are unclear as to the long-term status of 26 (24 %) of these PACs. Although the long-term status of these PACs is unknown, until we receive site specific occupancy information, we will assume that all of the 107 currently designated PACs are occupied and may continue to be occupied over the life of this project. Therefore, using the best available information and based upon the potential for incidental take to occur as part of implementation of the LRMP, we anticipate the following incidental take for the proposed action, which is in addition to previously authorized take resulting from ongoing projects or projects that have yet to be implemented as identified in the "Background Information regarding the Proposed Action" section above.

- Harassment of MSOs associated with up to six PACs per year (approximately 5.6 percent) of the 107 PACs that still are functioning as MSO nesting/roosting habitat due to a single or short-term (1 to 3 years) disturbance. Mexican spotted owls associated with an individual PAC may not be harassed over the course of more than three breeding seasons.

- Harm of MSOs associated with two MSO PACs due to long-term or chronic disturbance (> three consecutive years of harassment during the breeding season), or habitat degradation or loss over the life of the project. We expect that actions that could result in harm would be very rare under the existing LRMP due to the protective S&Gs included in the LRMP for the MSO.

This amount of incidental take is different from that anticipated in the 2005 LRMP BO/CO as it is based upon site-specific information from the Coronado NF and not a compilation of all Region 3 NFs in the BRW EMU.

Effect of the Take

In this BO, the FWS determines that this level of anticipated take is not likely to result in jeopardy to MSOs. While the proposed action may adversely affect the MSO in the short-term through noise disturbance and habitat modification, the long-term ramifications of the proposed action are expected to be beneficial to MSOs, MSO habitat, and their designated CH by reducing the potential for high-severity, stand replacing fire. Yearly reports will allow the FWS to evaluate whether projects under the LRMP were implemented as proposed and that the effects were equal to or less than we analyzed in our BO.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Coronado NF must comply with the following terms and conditions, which implement the reasonable and prudent measures described below and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary
.
The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of MSOs.

1. Minimize or eliminate adverse effects to MSOs on the Coronado NF.
2. Minimize or eliminate adverse effects to MSO habitat on the Coronado NF.
3. Monitor the impacts to MSO from the proposed actions.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the Coronado NF must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1.1 Where feasible, the Coronado NF shall avoid activities within 0.25 mile of PACs during the MSO breeding season (March 1 to August 31) that could result in disturbance to MSOs.

1.2 On site-specific projects, the USFS will work with FWS staff to identify and implement additional reasonable measures, specific to the project, to minimize effects to owls.

The following terms and conditions will implement reasonable and prudent measure 2:

2.1 Where feasible, vegetation management treatments (which could include activities such as fuels reduction, utility line maintenance, etc.) will maintain adequate amounts of important habitat features for MSOs (such as large trees, large snags, and large logs).

2.2 On site-specific projects, the USFS will work with FWS staff to identify and implement additional reasonable measures, specific to the project, to minimize effects to MSO habitat.

The following terms and conditions will implement reasonable and prudent measure 3:

3.1 The Coronado NF shall monitor incidental take resulting from the proposed action and report their findings to the FWS. Incidental take (implementation) monitoring shall include information such as when or if the project was implemented, whether the project was implemented as analyzed in the site-specific BO (including CMs, and BMPs), breeding season(s) over which the project occurred, relevant MSO survey information, and any other pertinent information about the project's effects on the species.

3.2 Annual reports, which will include this species, shall be sent to the appropriate local FWS Ecological Services field office by March 1st of each year. If the Coronado NF conducts MSO surveys within the perimeter of the Horseshoe 2, Monument, and Murphy wildfires (see Conservation Recommendation 3 below), these survey results shall be included in the annual reports.

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. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information.

1. We recommend that the USFS work with the FWS to design forest restoration treatments across the Coronado NF that protects existing nest/roost habitat from high-severity, stand-replacing fire, and enhances existing or potential habitat to aid in sustaining MSO habitat across the landscape. PACs can be afforded substantial protection from wildland fire by emphasizing fuels reduction and forest restoration in surrounding areas outside of PACs and nest/roost habitat.

2. We recommend that the Coronado NF implement forest restoration projects that will reduce fire risk across the landscape. Most forest treatments will be outside PACs, but some may need to occur within or close to PACs in order to protect and sustain MSO habitat on the landscape.

3. We recommend that MSO surveys occur within the perimeter of the Horseshoe 2, Monument, and Murphy wildfires to determine the status and distribution of MSOs impacted by the fire. (Note: As we have stated earlier in this document, there is uncertainty in regards to the status of the MSO within the fire perimeters and we do not know how many MSOs will be able to use a portion of the fire area for activities other

than foraging into the future.) There is currently no science that allows us to say exactly how many MSOs may be able to continue to conduct roosting and/or nesting behaviors within the fire perimeters. However, we are using our knowledge of MSO behavior following other large, high-severity fires and the existing status of the species within the BRW EMU to estimate the number of PACs we believe may still be present before reinitiation of this consultation should occur.

Surveys shall be conducted according to protocol unless other factors (e.g., human health and safety) result in needed modifications. Surveys should be coordinated with the FWS prior to beginning work in spring 2012. Surveys should focus on potential habitat within the fire perimeter.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

DESERT PUPFISH

STATUS OF THE SPECIES

The desert pupfish was listed as an endangered species with critical habitat in 1986 (51 FR 10842). Historical collections occurred in Baja California and Sonora, Mexico and in the U.S. in California and Arizona. Historical distribution of desert pupfish in Arizona included the Gila, San Pedro, Salt, and Santa Cruz rivers, and likely the Hassayampa, Verde, and Aqua Fria rivers, although collections are lacking for the latter three. The desert pupfish is also found in the Lower Colorado River, Rio Sonoyta basin, Salton Sink basin, and Laguna Salada basin (Eigenmann and Eigenmann 1888, Garman 1895, Gilbert and Scofield 1898, Evermann 1916, Miller 1943, Minckley 1980, Black 1980, Turner 1983, Miller and Fuiman 1987).

The habitat and distribution of the desert pupfish is very similar to that described for the Gila topminnow. They occupy similar habitats, although the pupfish was not nearly as widespread. The desert pupfish also went through cycles of expansion and contraction of populations because of natural climatological variation (Weedman and Young 1997). Such a scenario would have led to panmixia among populations over a very large geographic area (FWS 1993).

Naturally occurring populations of desert pupfish (*Cyprinodon m. macularius* or *C. macularius*) are now restricted in the U.S. to two streams tributary to, and in shoreline pools and irrigation drains of, the Salton Sea in California (Lau and Boehm 1991). This species is found in Mexico at scattered localities along the Colorado River Delta and in the Laguna Salada basin (Hendrickson and Varela-Romero 1989, Minckley 2000). The Rio Sonoyta pupfish (*Cyprinodon m. eremus* or *C. eremus*), recently considered a separate species, persists in only two populations: one near the U.S. – Mexico border at Quitobaquito Springs in Organ Pipe Cactus National Monument in Arizona, in the U.S., and the other at Rio Sonoyta in Sonora, Mexico.

The Recovery Plan incorporates a 3-tier plan for protection, re-establishment, and recovery of the species. All extant natural populations are designated as "tier 1 populations" in the Recovery Plan and are recognized as the most valuable resource due to their representation of the original genotypes; therefore, these tier 1 populations demand the highest level of protection. Collectively, there are 11 extant (tier 1) populations of desert pupfish known in the wild in the U.S. and Mexico (California = 5, Arizona = 1, and Mexico = 5). Populations designated tier 2 are replicates of remaining, naturally occurring stocks, typically composed of re-established populations in the most natural identifiable habitat within probable historic range. Although many reintroductions have been attempted, approximately 16 transplanted tier 2 populations of the desert pupfish exist in the wild at present, all in Arizona. Tier 3 re-established populations are those in the most-natural habitats remaining after fulfillment of tier 2 requirements. There are a total of 46 captive or refuge desert pupfish populations (that do not qualify for the Tiers 1, 2, or 3 category), comprised of 27 in Arizona, 15 in California, and 4 in Sonora, Mexico. The range-wide status of desert pupfish is poor but stable. The fate of the species depends heavily upon future developments in water management of the Salton Sea and Santa de Clara Cienega in Mexico.

One or more threats imperil most natural and transplanted populations. Since the 19th century, desert pupfish habitat has been destroyed by stream bank erosion, the construction of water impoundments that dewatered downstream habitat, excessive groundwater pumping, the application of pesticides to nearby agricultural areas, and the introduction of non-native fish species. Non-native bullfrogs may also prove problematic in the management of desert pupfish. The bullfrog is an opportunistic omnivore with a diet throughout its range that includes fish (Cohen and Howard 1958, Clarkson and deVos 1986). There is also a concern that introduced salt cedar (*Tamarix* spp.) next to pupfish habitat may cause a lack of water at critical times (Bolster 1990; R. Bransfield, FWS, pers. comm., 1999). The remaining populations continue to face these threats, and the Salton Sea area populations, in particular, are severely threatened.

Recovery Actions

A number of potentially viable sites have been identified by federal and state agencies that could support desert pupfish. These sites have not been stocked, but many have been evaluated.

The Arizona Department of Transportation has completed a Safe Harbor Agreement for the Gila topminnow and the desert pupfish (Arizona Department of Transportation 2000). This agreement covers all properties managed by Arizona Department of Transportation. The AGFD also has a Safe Harbor Agreement, which allows Gila topminnow and desert pupfish populations to be established on non-federal lands. Implementation of this Safe Harbor Agreement has allowed for the establishment of eight new populations and maintenance of genetic stocks and refuge populations in natural, semi-natural, or manmade habitats, which will aid in recovery efforts for the two species.

One site occurs on NFS lands. There are many reasons for failure of many of the stocked populations, but flooding, desiccation, water development, livestock, and non-native species have been identified as the major reasons (Brooks 1985, Weedman and Young 1997, Voeltz and

Bettaso 2003). Additional efforts have identified suitable sites for stocking the topminnow on NFS lands.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, 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 which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

Currently, the desert pupfish does not occur on the Coronado NF or within the action area. However, desert pupfish were once widely distributed in desert springs, marshes, backwaters, and tributaries through much of the lower Colorado and Gila Rivers, from southern Arizona to southeastern California, and northern Sonora, Mexico (Minkley and Marsh 2009; USFWS 2010). Several efforts have been made to translocate populations of desert pupfish to locations on NFS lands, but none of these efforts have yet been successful. Desert pupfish have been considered for reestablishment on the Coronado NF, and FWS is completing this analysis in anticipation that future reintroductions of this fish may occur.

Factors Affecting the Species within the Action Area

Because desert pupfish do not currently occur on the Coronado NF, no consultations involving affects to the species on this NF have been conducted.

The only NF that currently has desert pupfish occupied sites is the Tonto NF. We are discussing the occupied sites on the Tonto NF to provide some insight as to which types of management activities would affect the desert pupfish if introduced on the Coronado NF. The most-recent consultation regarding a NF's effects on the desert pupfish was our January 5, 2010 BO on forest uses and management of springs on desert pupfish (22410-2009-F-0462). The action included measures to reduce the adverse effects of livestock grazing on Walnut Spring and Creek, Cottonwood Artesian, and Mud Spring (Tonto Basin) and recreation, vegetation management and pond maintenance, and crayfish removal. The proposed action may establish new populations of desert pupfish, which would contribute to recovery. The FWS anticipates that incidental take would be exceeded if desert pupfish are extirpated from all three ponds at the same time and it is due to the implementation of USFS proposed land management actions. Terms and conditions were prescribed to ensure maintenance and monitoring of the sites, monitoring, and removing cattle quickly when they access exclosures. No fish have been released at these sites.

The desert pupfish's status within the Tonto NF is not necessarily secure; the currently-occupied site has not demonstrated occupancy over a sufficiently long time, and may lack the ability to survive the current, chronic drought. The reestablishment history of desert pupfish illustrates that even sites that were thought to be secure may fail for various reasons. Desert pupfish on

federal lands are widely dispersed and in some cases vulnerable to events beyond the respective land management agencies' control. Such actions would include invasions or unauthorized introductions of non-native fishes and stochastic events such as floods. The risk associated with maintaining desert pupfish for the long-term across such a diversity of sites renders the species' status within the action area as tenuous as it is rangewide.

EFFECTS OF THE ACTION

Although the desert pupfish does not occur on the Coronado NF, the USFS requested formal consultation due to its presence downstream and the potential for future releases. Pupfish have been considered for reestablishment on the Coronado, Tonto, and Prescott NFs. The S&Gs listed in these NF LRMPs and the 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs within these LRMPs are applicable to the desert pupfish and its habitat. These S&Gs may result in both indirect and direct effects to the species. The 2005 BO/CO included a complete analysis of the S&Gs that included tables showing which S&Gs are applicable to the desert pupfish and ranking tables displaying the types of effects these S&Gs could have on the species. Because there have been no changes in Forest policy or programs since the 2005 BO/CO and no new significant scientific information on the desert pupfish has become available, we hereby incorporate by reference the 2005 effects analysis and provide a narrative summary below.

There were two S&Gs within the Coronado NF that resulted in adverse effects to the desert pupfish. Although the majority of S&Gs are positive and provide for some level of recovery of the species, there were several that were beneficial in the long-term but had some short-term adverse effects.

<u>Fire Management Program</u>
Overall, there is a lack of direction within the Coronado NF LRMP to address conflicts between fire management and its effects to the desert pupfish. Fire is often used to meet management objectives, such as improving wildlife habitat and livestock forage, reducing fuel hazards, and improving watershed condition. The Fire Management Program within the Coronado NF LRMP seeks to improve forest health, watershed condition, and wildlife habitat. Although fire management may result in beneficial effects to the desert pupfish, prescribed burning may result in direct and indirect short-term effects.

Standard and Guideline 695 seeks to conduct fire suppression activities to protect both watershed and visual resource values. Although this S&G exists, fire suppression is not part of the proposed action for this project and therefore will not be analyzed in this consultation. The effects of fire suppression are addressed during emergency consultations.

<u>Forestry and Forest Health Program</u>
Standards and Guidelines within the Forestry and Forest Health program are aimed at addressing land management practices, such as vegetation manipulation for disease control or insect outbreaks, removing slash and dead and down material to prevent catastrophic wildfires, or using pesticides to control outbreaks.

Standard and Guideline 697 allows for the use of pesticides in recreation and administrative sites, and it does not offer alternative land management practices to that of pesticide use. Pesticides are selected for their biocidal properties and are applied to kill or control organisms. Pesticides may be introduced into natural aquatic systems by various means: incidentally during their application (i.e., through aerial spray drift), and through surface water runoff after application.

Rangeland Management Program

The Coronado NF LRMP seeks to provide sustainable livestock grazing and to maintain or improve riparian and watershed conditions (USFS 2004). Within this Forest, guidance for rangeland management is directed at the MA level rather than Forest-wide. Standard and Guidelines allow for various levels of grazing within suitable rangelands of Management Area 3. This S&G was noted for possible sublethal effects to desert pupfish. Additionally, other S&Gs seek to manage suitable rangeland at either Level A (no grazing) or Level D (intensive livestock management with higher density of water developments and interior fencing). Livestock management activities on the Coronado NF can have indirect effects, through upland or watershed effects on riparian and aquatic habitats.

Activities related to grazing could result in some limited direct effects to all listed aquatic species. Maintenance of viable populations of desert pupfish is compatible with well-managed livestock grazing. However, adverse effects to aquatic species from grazing may occur under certain circumstances. Potential effects include trampling of eggs, juvenile fish, egg masses, tadpoles, and frogs; deterioration of watersheds; erosion or siltation of stream courses; elimination of undercut banks that provide cover; loss of wetland and riparian vegetation and backwater pools; and spread of disease (Hendrickson and Minckley 1984, Ohmart 1995, Jancovich et al. 1997, Belsky et al. 1999, U.S. Fish and Wildlife Service 2000). Livestock grazing and trampling can indirectly affect fish by altering the shape and form of the aquatic habitat, riparian soils and vegetation composition, density, and structure; water quality, quantity, and flow patterns (Kauffman and Krueger 1984, Fleischner 1994, and Belsky et al. 1999).

Livestock can injure or kill young fish by stepping on them (Roberts and White 1992), or through ingestion, however, most livestock effects are related to changes in habitat. Increased erosion in the watershed caused by grazing can accelerate sedimentation that can negatively affect aquatic habitat (Gunderson 1968). Sediment can alter primary productivity, fill interstitial spaces in streambed materials with fine particulates that impede water flow, completely fill habitat, reduce oxygen levels, and restrict waste removal (Chapman 1988). Many fish can probably avoid trampling when they are active.

Livestock watering could result in the loss of fish from trampling and ingestion through consumption of water. Livestock watering there could result in the reduction of fish growth and reduced survival from increased turbidity levels leading to decreased primary productivity, or water quality degradation from heavy accumulation of livestock waste. Adult fish are more likely to avoid direct injury from livestock than newly hatched fish.

Watershed Management Program

The Watershed Management Program seeks to maintain or improve watershed conditions and maintain water quality. This program in particular provides beneficial guidance for the desert pupfish within the Coronado LRMP.

Standard &Guideline 678 provides guidance for management of the aquatic-riparian resources, and seeks to meet the following objectives: (1) maintain at least 80 percent of natural shade over water in fish bearing streams; (2) maintain at least 80 percent of natural bank protection; and (3) maintain the composition of sand, silt, and clay within 20 percent of natural levels in fish bearing streams. This S&G allows a certain amount of riparian habitat to be maintained at less than optimal conditions. For example, if 80 percent of the streambank linear distance is maintained in stable condition, then the assumption is that 20 percent of the streambank is at less than stable conditions. This could result in increased sedimentation into the stream channel, thus lowering water quality and channel integrity. As a result, potential effects to the species include a reduction of invertebrate food supplies, interference with reproduction, and direct mortality.

Standard and Guideline 677 intends to classify all riparian areas within a certain time period, while completing plans to improve all unsatisfactory areas. This S&G is beneficial because it is moving toward satisfactory riparian conditions; however, there may be some short-term adverse effects that may continue to occur until the riparian habitat reaches satisfactory conditions.

Several S&Gs deal with improving watershed conditions, but apply to different MAs. They allow for short-term, temporary impacts to water quality and watershed condition in exchange for longer-term improvement in watershed condition, sediment reduction, and riparian status.

Wildlife, Fish and Rare Plants Program

Standards and Guidelines 667 & 668 are likely to cause short-term adverse effects to achieve long-term beneficial goals. Standard and Guideline 667 allows for prescribed burning. While it is advantageous to reduce the risk of catastrophic wildfire, the prescribed fire itself may have short-term impacts on water quality in adjacent streams inhabited by desert pupfish. Standard and Guideline 668 also allows for short-term, temporary impacts from the construction of habitat improvements and fencing. These impacts may include direct mortality of fish as well as indirect impacts to the habitat such as temporary alterations of stream flow, or short-term isolated increases in sediment entering the stream.

1996 Regional Amendment

As stated in the 2005 BO/CO, no adverse effects to the desert pupfish from the implementation of the S&Gs for the 1996 Regional Amendment. All applicable S&Gs were determined to maintain habitat for the desert pupfish. Also, we found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

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.

Residential and commercial development on lands within watersheds containing T&E native fishes, are cumulative effects and can adversely affect the species through a variety of avenues.

Additional cumulative effects to desert pupfish may include ongoing activities in watersheds such as livestock grazing and associated activities outside of federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization without a federal nexus, and recreation. Some of these activities, such as irrigated agriculture are declining and are not expected to contribute substantially to cumulative long-term adverse effects to native fishes.

Other activities, such as recreation, are increasing. Increasing recreational, residential, or commercial use of the non-federal lands near the riparian areas would likely result in increased cumulative adverse effects to occupied, as well as potentially-occupied native fish habitat through increased water use, increased pollution, and increased alteration of the streambanks through riparian vegetation suppression, bank trampling, and erosion.

Additional cumulative impacts to the species may occur from cross-border Department of Homeland Security activities along the U.S. and Mexico border. The following cross-border activities include, but may not be limited to the following: human traffic, deposition of trash, new trails from human traffic, soil compaction and erosion, increased fire risk from human traffic, water depletion and contamination, introduction and spread of disease, and interference of survey, monitoring and research.

CONCLUSION

After reviewing the current status of the desert pupfish, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the FWS's opinion that the proposed action is not likely to jeopardize the continued existence of the desert pupfish. Pursuant to 50 CRF 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. No critical habitat has been designated for the species on or near NFS lands in Arizona; therefore, none will be affected.

The FWS anticipates adverse effects to the desert pupfish from the implementation of the Coronado NF LRMP, as well as the 1996 Regional Amendment. However, the FWS does not believe the impacts of the proposed action will rise to the level of jeopardy for the species. The FWS bases this conclusion on the following reasons:

- Continuing efforts to stock desert pupfish in various wild sites and within NFS lands have allowed the status of pupfish populations to remain stable.

- The Coronado NF LRMP specifically states that habitat for desert pupfish will be maintained at current levels of occupied habitat.

Therefore, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of the desert pupfish.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Per the Act, "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) 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 which include, but are not limited to, breeding, feeding, or sheltering. "Incidental take" is defined (50 CFR 402.02) as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

Amount or Extent of Take Anticipated

No take is anticipated to occur as a result of the proposed action because the species is currently not found on the NFS lands and the potential adverse indirect effects that were analyzed in the opinion, do not rise to the level of take. If the species becomes established on the NFS within the life of the current LRMP, reinitiation will be necessary.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. Assist with the development of a desert pupfish monitoring plan that addresses all actions occurring within pertinent watersheds on the Coronado NF.
2. In cooperation with the AGFD and academia, assess habitat dynamics and fish- habitat relationships of the desert pupfish.
3. Cooperate with state conservation agencies to eliminate the introduction and presence of non-native fish species within desert pupfish habitat.

In order for the FWS to be kept informed of action minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

GILA CHUB

STATUS OF THE SPECIES (rangewide)

Description

The Gila chub is small-finned, deep-bodied, chubby, and darkly colored (sometimes lighter on belly; diffuse lateral band(s) are rarely present). Adult males average about 6 in (150 mm) in total length; females can exceed 10 in (250 mm) (Rinne and Minckley 1991). Scales are coarse, large, thick, and broadly overlapped, and radiate out from the base. Lateral-line scales usually number greater than 61 and less than 80. There are usually eight (rarely seven or nine) dorsal and anal fin-rays; pelvic fin-rays typically number eight, but sometimes nine (Rinne 1976, Minckley and DeMarais 2000, Minckley and March 2009).

Taxonomy

The Gila chub is a member of the minnow family Cyprinidae. Baird and Girard (1854) published a description of the Gila chub, as *Gila gibbosa*, based on the type specimen collected in 1851 from the Santa Cruz River, Arizona. For nomenclature reasons, the name was changed by Girard to *Tigoma intermedia* in 1856, working with specimens from the San Pedro River (Girard 1856). Despite that and other name changes, the Gila chub has been recognized as a distinct species since the 1850's, with the exception of a short period in the mid-1900's when it was placed as a subspecies of the roundtail chub (*Gila robusta*) (Miller 1946). For the past 30 years, *Gila intermedia* has been recognized as a full monotypic species, separate from the polytypic species *Gila robusta*, both currently accepted as valid (Nelson et al. 2004). Taxonomically problematic populations nonetheless exist, variously assigned to one or the other taxa and leading to continued confusion. Further complicating matters, Minckley and DeMarais (2000) described a new species, the headwater chub (*Gila nigra*), within the Gila River Basin. It is of hybrid origin derived from *Gila robusta* and *Gila intermedia*. Its range is similar to that of *Gila intermedia* and is another headwater-type chub, whereas, *Gila robusta* is found in the mainstem of the major rivers within the Gila River Basin. Dowling et al. (2008) reported on the genetics of many of the extant populations of these three Gila River chubs and recommended management units based on this information.

Life History

Gila chub interact with spring and small stream fishes regularly (Meffe 1985), but are usually restricted to deeper waters (Minckley and March 2009). Adults are often found in deep pools and eddies below areas with swift current. Young-of-the-year inhabits shallow water among plants or eddies, while older juveniles use higher velocity stream areas (Minckley 1973). Gila chub feed on both plants and animals. Adults appear to be principally carnivorous, feeding on large and small terrestrial and aquatic insects and sometimes other small fishes. Smaller individuals often feed on organic debris and aquatic plants, especially filamentous (threadlike) algae, and less intensely on diatoms (unicellular or colonial algae) (Griffith and Tiersch 1989, Rinne and Minckley 1991).

Spawning typically occurs from late spring into summer (Minckley 1973, Griffith and Tiersch 1989, Nelson 1993). Breeding males display deep red or orange coloration on ventral surfaces and paired fin bases (Minckley 1973, Rinne 1976). Spawning is likely sporadic over a long reproductive season (Rinne and Minckley 1991), and in constant warm water temperature settings such as springs; and Gila chubs can spawn throughout the year (Minckley 1973, 1985, Griffith and Tiersch 1989). Spawning likely occurs over beds of submerged aquatic vegetation or root wads, with large females being followed by several smaller males (Minckley 1973). Males and females reach sexual maturity in 1 to 3 years at lengths of 3.6-3.8 in (90 to 95 mm) (Griffith and Tiersch 1989). Gila chub spawn at water temperatures warmer than 62 °F (17 °C), with optimal water temperatures of 68 to 75 °F (20 to 24 °C) (Nelson 1993), and optimal temperatures for growth of 75 to 82 °F (24 to 28 °C) (Schultz and Bonar 2007). Gila chub likely live up to 4 years or more (Griffith and Tiersch 1989).

Status and Distribution

The Gila chub was listed as endangered with CH on November 2, 2005 (FWS 2005a). Historically, Gila chub have been recorded in approximately 43 rivers, streams, and spring-fed tributaries throughout the Gila River basin in southwestern New Mexico, central and southeastern Arizona, and northern Sonora, Mexico (Miller and Lowe 1967, Rinne and Minckley 1970, Minckley 1973, Rinne 1976, DeMarais 1986, Weedman et al. 1996, FWS 2005a). The Gila chub now occupies an estimated 10 to 15 percent of its historical range, and is limited to about 30 small, isolated, and fragmented populations throughout the Gila River basin in Arizona and New Mexico (Weedman et al. 1996, FWS 2005a). Populations occur in tributaries of the Agua Fria, Babocamari, Gila, San Francisco, San Pedro, Santa Cruz, and upper Verde Rivers in Cochise, Coconino, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, and Yavapai Counties in Arizona, and in Grant County, New Mexico (Weedman et al. 1996, FWS 2005a). Approximately half of all known Gila chub occupied habitat occurs on NFS lands. Of these populations, ten are estimated to be stable-threatened, meaning the Gila chub are considered common, but face threats from nonnative species, land–uses practices, and lack of recruitment. The remaining known extant populations are considered unstable-threatened, indicating that Gila chub are rare, have a limited distribution, predatory or competitive nonnative species are present, or the habitat is modified or poor land-uses practices occur (Weedman et al. 1996, FWS 2005a).

In the Verde River basin, the Walker Creek, Red Tank Draw, and Spring Creek populations (Yavapai County) are considered stable-threatened, but the status of the Williamson Valley Wash population is unknown. The Santa Cruz River has three tributaries with extant populations of Gila chub: Sabino Canyon (Pima County) and Sheehy Spring (Santa Cruz County) have unstable-threatened populations, and Cienega Creek (Pima and Santa Cruz Counties) has the only known naturally-occurring stable-secure population of Gila chub. The San Pedro River basin has three extant, stable-threatened populations in Redfield Canyon (Graham and Pima Counties), O'Donnell Creek (Santa Cruz County), and Bass Canyon (Graham and Cochise Counties). Gila chub still occupy T4 Spring in the Babocomari River basin (Santa Cruz and Cochise Counties), but it is very rare in this spring. The San Carlos River and the Blue River, (Gila and Graham Counties), tributaries of the Gila River located on the San Carlos Apache Indian Reservation, are currently occupied by Gila chub (FWS 2005a).

The San Francisco River has two tributaries with extant stable-threatened populations, Harden Cienega Creek and Dix Creek (Greenlee County). The Agua Fria River has four tributaries with stable-threatened populations, Larry, Lousy, Silver and Sycamore Creeks (Yavapai County), as well as two unstable-threatened populations in Little Sycamore Creek and Indian Creek (Yavapai County). Two tributaries of the Gila River in Arizona have extant populations of Gila chub: Eagle Creek (Graham and Greenlee Counties), has an unstable threatened population and Bonita Creek (Graham County), has a stable-threatened population which is now somewhat protected by placement of a fish barrier and chemical renovation of the stream in 2008, although green sunfish since reinvaded and additional renovation is planned (FWS 2005a, Marsh and Associates 2009, U.S. Bureau of Reclamation and Bureau of Land Management 2010).

In Mexico, Gila chub occurred in two small spring areas, Cienega los Fresnos and Cienega la Cienegita, adjacent to the Arroyo los Fresnos (tributary to the San Pedro River), within 1 mi (2 km) of the Arizona-Mexico border as recently as 1992, but are now thought to be extirpated (Varela-Romero et al. 1992). No Gila chub remain in the Mexican portion of the Santa Cruz River (Weedman et al. 1996).

Reestablishment of Gila chub has been attempted in at least six Arizona sites. Lousy Canyon and Larry Creek, stocked with 200 Gila chub from Silver Creek in July 1995, are extant. Gardner Canyon (Cochise County) was stocked from Turkey Creek (Santa Cruz County) with 150 Gila chub in July 1988. In May 1995, no Gila chub or any other fish were captured during surveys. Turkey Creek, a tributary to the Babocomari River, was stocked with a small number of Gila chub in 2005, but is now thought to be extirpated. In 2005, Bear and Romero Canyons in the Santa Rita Mountains were stocked with Gila chub from Sabino Canyon. Gila chub now appear extirpated from Bear Canyon, but are doing well in Romero Canyon, where they can be considered stable-threatened (Ehret and Dickens 2009).

Habitat

Gila chub commonly inhabit pools in smaller streams, springs, and cienegas, and can survive in small artificial impoundments (Miller 1946, Rinne 1975, Weedman et al. 1996, Minckley and March 2009). Gila chub are highly secretive, preferring quiet, deeper waters, especially pools, or remaining near cover including terrestrial vegetation, boulders, and fallen logs (Rinne and

Minckley 1991, Carman 2006, Minckley and March 2009). Undercut banks created by overhanging terrestrial vegetation with dense roots growing into pool edges provide ideal cover (Nelson 1993). Gila chub can survive in larger stream habitat such as the San Carlos River and artificial habitats like the Buckeye Canal (Stout et al. 1970, Rinne 1976). Gila chub are also easily cultured in a hatchery setting (Schultz and Bonar 2007). Gila chub interact with spring and small stream fishes regularly (Meffe 1985), but adults are usually restricted to deeper waters (Minckley and March 2009). Native fish found in Gila chub habitat include desert sucker (*Catostomus clarki*), Sonora sucker (*Catostomus insignis*), longfin dace (*Agosia chrysogaster*), and speckled dace (*Rhinichthys osculus*) (USFS 2011a). They are often found in deep pools and eddies below areas with swift current, as in the Gila chub habitats found in Bass Canyon and Hot Springs in the Muleshoe Preserve area along the western slopes of the Galiuro Mountains. Young-of-the-year inhabit shallow water among plants or eddies, while older juveniles use higher velocity stream areas and then retire to pools when adults (Minckley 1973, 1991). In general, key habitat components for Gila chub of all life stages appear to be deep pools with cover in the form of undercut banks, root wad and instream organic debris (Rinne and Minckley 1991, Carman 2006, Minckley and March 2009).

Critical Habitat

Critical habitat for Gila chub is designated for approximately 160 mi (258 km) of stream reaches in Arizona and New Mexico that includes cienegas, headwaters, spring-fed streams, perennial streams, and spring-fed ponds. Critical habitat includes the area of bankfull width plus 300 ft (91 m) on either side of the banks. The bankfull width is the width of the stream or river at bankfull discharge (i.e., the flow at which water begins to leave the channel and move into the floodplain) (Rosgen 1996, FWS 2005a). Critical habitat is organized into seven areas or river units:

Area 1 - Upper Gila River, Grant County, New Mexico, and Greenlee County, Arizona, includes Turkey Creek (New Mexico), Eagle Creek, Harden Cienega Creek, and Dix Creek;

Area 2 - Middle Gila River, Gila and Pinal Counties Arizona, consists of Mineral Creek;

Area 3 - Babocomari River, Santa Cruz County, Arizona includes O'Donnell Canyon and Turkey Creek (Arizona);

Area 4 - Lower San Pedro River, Cochise and Graham Counties, Arizona, includes Bass Canyon, Hot Springs Canyon, and Redfield Canyon;

Area 5 - Lower Santa Cruz River, Pima County, Arizona, includes Cienega Creek, Mattie Canyon, Empire Gulch, and Sabino Canyon;

Area 6 - Upper Verde River, Yavapai County, Arizona, includes Walker Creek, Red Tank Draw, Spring Creek, and Williamson Valley Wash; and

Area 7 - Agua Fria River, Yavapai County, Arizona, includes Little Sycamore Creek, Sycamore Creek, Indian Creek, Silver Creek, Lousy Canyon, and Larry Creek (FWS 2005a).

There are seven PCEs of CH, which include those habitat features required for the physiological, behavioral, and ecological needs of the species:

1. Perennial pools, areas of higher velocity between pools, and areas of shallow water among plants or eddies all found in headwaters, springs, and cienegas, generally of smaller tributaries;

2. Water temperatures for spawning ranging from 63 to 75 °F (17 to 24 °C), and seasonally appropriate temperatures for all life stages (varying from about 50 to 86 °F (10 to 30 °C);

3. Water quality with reduced levels of contaminants, including excessive levels of sediments adverse to Gila chub health, and adequate levels of pH (e.g., ranging from 6.5 to 9.5), dissolved oxygen (e.g., ranging from 3.0 to 10.0 ppm) and conductivity (e.g., 100 to 1,000 mmhos);

4. Prey base consisting of invertebrates (i.e., aquatic and terrestrial insects) and aquatic plants (i.e., diatoms and filamentous green algae);

5. Sufficient cover consisting of downed logs in the water channel, submerged aquatic vegetation, submerged large tree root wads, undercut banks with sufficient overhanging vegetation, large rocks and boulders with overhangs, a high degree of stream bank stability, and a healthy, intact riparian vegetation community;

6. Habitat devoid of nonnative aquatic species detrimental to Gila chub or habitat in which detrimental nonnative species are kept at a level that allows Gila chub to continue to survive and reproduce; and

7. Streams that maintain a natural flow pattern including periodic flooding.

The FWS assembled a recovery team for Gila chub to develop and implement a recovery plan for the species. Until the recovery plan is completed, there is limited information with which to evaluate the ability of CH to meet the recovery needs of the species, or how an action may alter the ability of CH to meet recovery needs. In lieu of a recovery plan, assessing the functionality of each of the PCEs of a given reach of CH, and how an action might affect the PCEs of that reach, can provide some insight into the effects of an action on the functionality of CH in terms of recovery.

Reasons for Listing

The Gila chub was listed as endangered with CH on November 2, 2005 (FWS 2005a). The listing stated that the species has been reduced in numbers and distribution in the majority of its

historical range (Minckley 1973, Weedman et al 1996). Where it is still present, populations are often small, scattered, and at risk from known and potential threats and from random events.

Threats

Decline of Gila chub is primarily due to habitat loss from various land-use practices and predation and competition from non-native fish species, and the highly fragmented and disconnected nature of the remaining Gila chub populations increases their vulnerability to these threats (FWS 2005a). Land uses that have caused past habitat loss and continue to threaten Gila chub habitat include hydrologic modification of rivers, springs, and cienegas for human uses (groundwater pumping, dewatering, diversion of water channels, impoundments, and flow regulation), poorly managed livestock grazing, logging and fuel wood cutting, road construction and use, recreation, mining, and urban and agricultural development (FWS 2005a). All of these activities have promoted erosion and arroyo formation and the introduction of predaceous and competing non-native fish species (Miller 1961, Minckley 1985), and at least one or some combination of these activities is occurring in all of the remaining populations. Wildfires and wildfire suppression activities also pose a threat to the remaining populations by causing water quality changes that can kill fish, (Rinne 2004, FWS 2005a, Rhodes 2007), negatively altering food base for fishes (Earl and Blinn 2003), and resulting in stream and riparian vegetation alteration that negatively affects fish habitat (FWS 2005a).

Perhaps the most serious threat to Gila chub is predation by and competition with non-native organisms, including numerous non-native fish species, bullfrogs (*Lithobates catesbeiana*), and virile crayfish (*Orconectes virilis*). The impacts of non-native fish species on native fish including Gila chub have been well documented (Hubbs 1955, Miller 1961, Minckley and Deacon 1968, Minckley 1973, Meffe 1985, Minckley 1985, Williams and Sada 1985, Moyle et al. 1986, Minckley and Deacon 1991, Ruppert et al. 1993, Clarkson et al. 2005). Dudley and Matter (2000) correlated green sunfish presence with Gila chub decline, documented green sunfish predation on Gila chub, and found that even small green sunfish readily consume young-of-year Gila chub. Dudley (1995) found that green sunfish appeared to displace both subadult and adult Gila chub from preferred habitats, found that Gila chub utilized similar habitat types to green sunfish indicating competition for food and space was likely occurring, and concluded that predation by and competition with green sunfish virtually eliminated small chub from where the two species co-occurred, indicating recruitment failure. Unmack et al. (2003) similarly found that green sunfish presence was correlated with the absence of young-of-year Gila chub in Silver Creek, Arizona. Nonnative fish parasites, such as Asian tapeworm (*Bothriocephalus acheilognathi*) also may be a threat to Gila chub (FWS 2005a).

The U.S. Census predicts that Arizona will be the second fastest growing state in the country through 2030, adding an additional 5.6 million people (U.S. Census 2005). During the 2010 Census, Arizona maintained its standing as having the second fastest population growth rate by growing more than 20 percent between 2000 and 2010 (Pollard and Mather 2010). If these predictions hold true, already severe threats to Gila chub and its habitat will worsen, primarily due to increased human demand for surface and ground water and decreased supply. Water demands continue to increase as the population increases. The agriculture population is also increasing and agriculture is Arizona's largest water demand. Most of Arizona's developed

areas groundwater is pumped out faster than the aquifer can recharge, resulting in more dependence on freshwater sources from nearby rivers (U.S. Environmental Protection Agency 2011).

Climate Change

General climate change effects on federally listed species are described earlier. Here we describe factors that might affect the Gila chub.

Several climate-related trends have been detected since the 1970s in the southwestern U.S. including increases in surface temperatures, rainfall intensity, drought, heat waves, extreme high temperatures, and average low temperatures (Overpeck 2008). Annual precipitation amounts in the southwestern U.S. may decrease by 10 percent by the year 2100 (Overpeck 2008).

Current predictions of drought and/or higher winter low temperatures may also stress ponderosa pine forests in which Gila chub occurs. Ganey and Vojta (2010) studied tree mortality in mixed conifer and ponderosa pine forests in Arizona from 1997-2007, a period of extreme drought. They found the mortality of trees to be severe; the number of trees dying over a five-year period increased by over 200 percent in mixed-conifer forest and by 74 percent in ponderosa pine forest during this time frame (Ganey and Vojta 2010). Ganey and Vojta (2010) attributed drought and subsequent insect (bark beetle) infestation for the die-offs in trees.

Drought stress and a subsequent high degree of tree mortality from bark beetles make high-elevation forests more susceptible to unnaturally intense wildfires. Climate is a top-down factor which synchronizes with fuel loads which is a bottom-up factor; combined, these factors correlate to supporting larger, more frequent, and more severe wildfires in the southwestern U.S., influenced by a predicted reduction in snowpack and an earlier snowmelt (Fulé 2010). Wildfires are expected to reduce vegetative cover and result in greater soil erosion from increased droplet splash-erosion and reduced infiltration capacity, subsequently resulting in increased sediment flows in streams (Fulé 2010).

For a detailed discussion on climate change, refer to the Climate Change section within the Gila chub Environmental Baseline section in this BO.

Overall, the populations of Gila chub rangewide (Arizona and New Mexico) currently appear to be stable. The current distribution Gila chub populations remain extant to the Agua Fria, Blue, Gila, San Francisco, Santa Cruz and Verde Rivers. These populations are spread across the drainages, and most are isolated from other populations.

ENVIRONMENTAL BASELINE

Under section 7(a) (2) of the ESA, when considering the effects of the action on federally listed species, we are required to take into consideration the environmental baseline. Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal actions in the action area that have

undergone section 7 consultation, and the impacts of state and private actions that are contemporaneous with the consultation in progress. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. We have defined the action area for the LRMP as the Coronado NF. The Coronado NF has a land base of approximately 2.63 million acres (1.06 million ha). This land base is drained by several major drainages with considerable occupied or potential habitat within the historical range of Gila chub.

Status of the species within the action area

The Gila chub is a secretive species (Rinne and Minckley 1991). Most of the known recent and historical locations described above and in the final listing rule continue to lack extensive surveys, at least since the comprehensive status review by Weedman et al. (1996). The Gila chub may thus persist in some of the locations now considered extirpated, and may occur in localities as yet undiscovered. Although Gila chub have not been found in some of the localities listed in the final rule in recent years, these streams may still be occupied.

The Gila chub is currently restricted to small isolated populations scattered throughout its historical range. Approximately half of all known Gila chub occupied habitat occur of NFS lands. Most population on NFS lands are considered to be small isolated and threatened. Populations of Gila chub are present on land managed by the Coronado NF in Bear Creek, Romero Creek, and Sabino Creek on the Santa Catalina Ranger District and Turkey Creek and O'Donnell Creek on the Sierra Vista Ranger District. In 2005 all Gila chub streams on the Forest except Turkey Creek were considered unstable- threatened (FWS, 2005b). Turkey Creek was classified as extirpated at the time of the designation of CH, but a small population of chub was reestablished in November 2005.

Critical Habitat

There are two designated CH areas on the Coronado NF. Area 3 - Babocomari River, Santa Cruz County, Arizona includes O'Donnell Canyon and Turkey Creek (Arizona); Area 5 - Lower Santa Cruz River, Pima County, Arizona, includes Cienega Creek, Mattie Canyon, Empire Gulch, and Sabino Canyon. The following creeks are all within designated CH on the Coronado NF: Sabino Creek, Turkey Creek and O'Donnel Creek. Coronado NF contains 8.7 mi (13.9 km) of designated CH for Gila chub. Since our issuance of the 2005 LRMP BO/CO, the status of CH has been most impacted by flooding in Sabino Canyon following a fire, which filled in portions of occupied habitat. Two populations were established in the Santa Catalina Mountains on the Coronado in Bear Creek and Romero Creek in 2005; these populations do not occur within any designated CH area (FWS 2005b). Bear, Romero, and Sabino Creek populations are all considered "unstable-threatened" (FWS 2005b).

Factors affecting the species environment within the action area

On the Coronado NF, past and present federal, state, private, and other human activities that may affect Gila chub and their habitat include livestock grazing, wildfires and any other habitat

alterations. We describe activities that have occurred within the Coronado NF to qualify the environmental baseline.

Livestock grazing

Historically improper 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). However, on NFS lands today, improper livestock grazing does not occur.

Improper livestock grazing has been shown to increase soil compaction, decrease water infiltration rates, increase runoff, change vegetative species composition, decrease riparian vegetation, increase stream sedimentation, increase stream water temperature, decrease fish populations and change channel form (Meehan and Platts 1978, Kauffman and Kruger 1984, Schulz and Leininger 1990, Platts 1991, Fleischner 1994, Ohmart 1996). Although direct impacts to the riparian zone and stream can be the most obvious sign of livestock grazing, upland watershed condition is also important because soil compaction, changes in percent cover, and vegetative type can influence the timing and amount of water delivered to stream channels (Platts 1991, Ohmart 1996, Belsky and Blumenthal 1997). As a consequence, streams are more likely to experience flood events that negatively affect the aquatic and riparian habitats and are more likely to become intermittent or dry in the fall (groundwater recharge is less when water runs off quickly) (Platts 1991, Ohmart 1996).

The emphasis of the rangeland management program on the Coronado NF is to improve watershed condition and wildlife habitat. Livestock grazing is currently active in both occupied and designated CH within the following watersheds: Harden Cienega Creek, Dix Creek, Coalson Creek-San Francisco River, Dry Prong Creek, East Eagle Creek, West Prong Creek, Middle Prong Creek and Mud Springs Canyon-Eagle Creek.

Fire

Since 2002, there have been several fires that have burned over 60,700 hectares (150,000 acres) in the Coronado NF that are near or around both occupied and designated CH for Gila chub. In May 2005, Gila chub were salvaged from Sabino Canyon during the Aspen Fire and were subsequently returned and now thriving in Sabino Creek. Gila chub continue to persist, post-fire in O'Donnel and possibly Turkey Creeks.

Because Gila chub are now found primarily in isolated, small streams, avoidance of ash flows may be impossible and opportunities for natural recolonization usually do not exist, as documented for Gila trout (Brown et al. 2001). Persistence of Gila chub in streams affected by fire and subsequent ash flows depend on management actions. In some instances, evacuation of Gila chub from streams in watersheds that have burned is deemed necessary and actions are taken, and in other cases populations are lost and must be replaced through stocking.

Climate change

Climate change predicts four major effects on the Gila chub habitat:

1. increased water temperature;
2. decreased streamflow;
3. a change in the hydrograph; and
4. an increased occurrence of extreme events (fire, drought, and floods).

Increased water temperature

Kundzewicz et al. (2007) state that of all ecosystems, freshwater ecosystems will have the highest proportion of species threatened with extinction due to climate change. 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). High temperatures suppress appetite and growth, foster disease, can influence behavioral interactions with other fish (Schrank et al. 2003), or be lethal (McCullough 1999). The temperature preferences and tolerances of Gila chub is less than 98.6 °F (37.0 °C). However, increased stress from elevated temperatures could lead to greater susceptibility to disease and reduced reproductive success.

Decreased streamflow

Current models suggest a decrease in precipitation in the Southwest (Kundzewicz et al. 2007, Seager et al. 2007) which would lead to reduced streamflows and a reduced amount of habitat for Gila chub. Streamflow is predicted to decrease in the Southwest even if precipitation were to increase moderately (Nash and Gleick 1993, State of New Mexico 2005, Hoerling and Eischeid 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 can lead to a longer dry season. Warmer air temperatures lead to increased evaporation, increased evapotranspiration, and decreased soil moisture. These three factors would lead to decreased streamflow even if precipitation increased moderately.

The effect of decreased streamflow is that streams become smaller, intermittent or dry, and thereby reduce the amount of habitat available for aquatic species. 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 isolated in pools may be subject to increased predation from terrestrial predators.

Change in the hydrograph

Another documented effect of climate change is a shift of the timing of spring snowmelt. Stewart et al. (2005) show that timing of spring streamflow in the western U.S. during the last 5 decades has shifted so that the major peak now arrives 1 to 4 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 from 37 to 41 °F (3 to 5 °C), snowmelt driven runoff in the western U.S. could occur as much as 2 months earlier than present. Changes in the hydrograph could potentially alter native fish assemblages. Variability in the hydrographs and greater flow volume has been shown to sustain native fishes (e.g., as seen for spikedace and loach minnow) over nonnatives between periodic flood events (Rinne and Miller 2006).

Increased occurrence of extreme events

Extreme events such as drought, fires, and floods are predicted to occur more frequently 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

The Southwest U.S. is currently experiencing drought conditions (University of Nebraska-Lincoln 2010). Portions of New Mexico are also considered abnormally dry, but not in areas currently occupied by Gila chub (University of Nebraska-Lincoln 2010). Although Gila chub evolved in the Southwest and have survived drought in the past, it is anticipated that a prolonged, intense drought would affect many populations, in particular those occupying small headwater streams which are likely to dry or become intermittent. In addition with streams drying there is a clear association between severe droughts and large fires in the Southwest (Swetnam and Baisan 1996) that can harm fish.

Fire

Since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970 to 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 to 2003 was 78 days longer compared to 1970 to 1986 and the average time between fire discovery and control increased from about 8 to 37 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 and fires in the western U.S. will be more frequent and 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).

Severe wildfires capable of extirpating or decimating fish populations are a relatively recent phenomena and result from the cumulative effects of historical or ongoing grazing, which removes the fine fuels needed to carry fire and fire suppression (Madany and West 1983, Savage and Swetnam 1990, Swetnam 1990, Touchan et al. 1995, Swetnam and Baisan 1996, Belsky and Blumenthal 1997, Gresswell 1999). Historical wildfires were primarily cool-burning understory fires with return intervals of 3 to 7 years in ponderosa pine (Swetnam and Dieterich 1985). Cooper (1960) concluded that prior to the 1950s; crown fires were extremely rare or nonexistent in the region.

Effects of fire may be direct and immediate or indirect and sustained over time (Gresswell 1999). The cause of direct fire-related fish mortalities has not been clearly established. Fatalities are most likely during intense fires in small, headwater streams with low flows (less insulation and less water for dilution) (Gresswell 1999). In these situations, water temperatures can become elevated or changes in pH may cause immediate death (Cushing and Olson 1963). Spencer and Hauer (1991) documented 40-fold increases in ammonium concentrations during an intense fire in Montana. The inadvertent dropping of fire retardant in streams is another source of direct mortality during fires.

Indirect effects of fire include ash and debris flows, increases in water temperature, increased nutrient inputs, and sedimentation (Swanston 1991, Bozek and Young 1994, Gresswell 1999). Ash and debris flows can cause mortality months after fires occur when barren soils are eroded during monsoonal rain storms (Bozek and Young 1994, Brown et al. 2001). Fish can suffocate when their gills are coated with fine particulate matter, they can be physically injured by rocks and debris, or they can be displaced downstream below impassable barriers into habitat occupied by nonnative fish. Ash and debris flows or severe flash flooding can also decimate aquatic invertebrate populations that fish may depend on for food (Molles 1985, Rinne 1996, Lytle 2000). In larger streams, refugia are typically available where fish can withstand the short-term adverse conditions; small headwater streams are usually more confined, concentrating the force of water and debris (Pearsons et al. 1992, Brown et al. 2001).

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 extirpated as a result of ash flows from floods after fire (Rinne 1996, Brown et al. 2001). Consequently, an increase in rain or snow events, intense precipitation that is unseasonable or heavy precipitation that occurs after fire, could extirpate affected Gila chub.

The conjunction of climate change with ongoing habitat loss and alteration; and nonnative species competition has caused a general loss of resiliency in the ecosystem that has serious consequences for Gila chub.

EFFECTS OF THE ACTION

The S&Gs listed in the proposed Coronado NF LRMP and the 1996 Regional Amendment provide direction for the development of site-specific actions. The Gila chub designated CH and occupied sites are within or near MAs 1, 3, 4, 7, 8, 8a, and 9. Multiple S&Gs within the Coronado NF LRMP are applicable to the Gila chub and its habitat. These S&Gs may result in both indirect and direct effects to the species. Please refer to the 2005 BO/CO for a summary of the S&Gs presented to the FWS by the USFS as applicable to the Gila chub.

No new significant scientific information or data have become available that would change the 2004 effects analysis for Gila chub. Based on the 2011 BA (USFS 2011b) it was determined that there have been no changes in NF policy or programs that would change the 2004 BA (USFS 2004) or 2005 BO/CO (FWS 2005b) effects determination for the species. The current analysis evaluated all S&Gs identified by the USFS 2011 BA). Although, two additional S&Gs were added to the Coronado NF LRMP (2025 and 2026), that prohibit the use of motor vehicles off designated systems of road in the Recreation Program.

The FWS found two S&Gs that could cause a lethal response, three that could cause a sublethal response, and one that could cause a negative behavioral response to the species. However, many were found to be maintaining habitat or moving towards recovery for the species on this Forest. Additionally, there were several S&Gs that were beneficial in the long-term but had some short-term adverse effects. For additional information about the Gila chub effects analysis see 2005 BO/CO (FWS 2005b).

<u>1996 Regional Amendment</u>

The management direction provided by the 1996 Regional Amendment S&Gs was related to the conservation of MSO and northern goshawks. The S&Gs promote healthy forest ecosystems; function watersheds; and riparian and aquatic systems (USFS 2004). Refer to the 2005 BO/CO for a summary of the effects to Gila chub from the applicable 1996 Regional Amendment S&Gs. There may be short-term adverse effects to the Gila chub as a result of the implementation of the 1996 Regional Amendment.

Standard & Guideline 1432 allows no timber harvest except for fire risk abatement in mixed conifer and pine-oak forests on slopes greater than 40 percent where timber harvest has not occurred in the last 20 years. S&G 1445 allows treatment of fuel accumulations to abate fire risk. S&G 1455 directs the NFs to use combinations of thinning trees less than 9 in (23 cm) in diameter, mechanical fuel removal, and prescribed fire. S&G 1458 allows prescribed fire where appropriate within Reserved Lands (Wilderness, Research Natural Areas, Wild and Scenic Rivers, and Congressionally Recognized Wilderness Study Areas). S&G 1468 encourages prescribed and prescribed natural fire to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and the risk of crown fire. S&G 1476 directs the NF to apply ecosystem approaches to manage for landscape diversity mimicking natural disturbance patterns, incorporating natural variation in stand conditions and retaining special features such as snags and large trees, utilizing appropriate fires, and retention of existing old growth in accordance with NF plan old growth S&Gs.

Each of the aforementioned S&Gs permits short-term adverse effects on forested environments in order to secure long-term stability and to create conditions more desirable for the northern goshawk and MSO. The range of the Gila chub is generally situated downstream of much of the habitat occupied by (or suitable for) these raptors and thus, the fish can be expected to experience indirect, short-term adverse effects in exchange for long term habitat stability or improvement.

S&G 1508 allows for low intensity ground fires at any time in all forested cover types, but high intensity crown fires are not acceptable in the post-fledgling family area or nest areas. This S&G directs the Forests to avoid burning the entire home range of a goshawk pair in a single year. For fires planned in the occupied nest area, a fire management plan should be prepared. The fire management plan should minimize the risk of goshawk abandonment while low intensity ground fire burns in the nesting area. Prescribed fire within nesting areas should be planned to move with prevailing winds away from the nest tree to minimize smoke and risk of crown fire developing and driving the adults off or consuming the nest tree.

Collectively, implementation of the MSO and northern goshawk guidelines may affect the following Gila chub CH PCEs: 1) by reducing the availability of perennial pools; areas of higher velocity between pool areas; and areas of shallow water among plants or eddies by increasing sedimentation into pool habitat; 2) by opening up the overstory resulting in increased water temperatures; 3) by increasing sedimentation resulting in contamination of water quality; 4) by reducing the food base including invertebrates; filamentous algae; and insects; 5) by reducing sufficient hiding and spawning cover consisting of downed logs in the water channel; submerged large tree root wads; undercut banks with sufficient overhanging vegetation; and large rocks and boulders with overhangs; and 6) by altering a streams natural unregulated flow pattern including periodic natural flooding.

S&Gs 1432, 1445, 1455, 1458, 1468, 1476 and 1508 are all related to the fuels treatment for fire suppression. As was discussed previously, there are potential short-term effects from fuels treatments; however, the beneficial effect of reduced catastrophic fire risk far outweighs those short-term adverse effects.

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.

Activities on residential and commercial inholdings within watersheds containing Gila chub can adversely affect the species through poor land management practices and water withdrawal. These effects have not been quantified within the action area.

CONCLUSION

After reviewing the current status of the Gila chub, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's BO that the proposed action will not jeopardize the continued existence of the Gila chub or its recovery. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the CH to satisfy essential requirements of the species" (FWS and National Marine Fisheries Service 1998).

Effects to the Gila chub from the Coronado NF LRMP and the 1996 Regional Amendment were analyzed in the 2005 BO/CO. Potential adverse effects from the implementation of the LRMP and associated S&Gs were found likely to occur on the Coronado NF. In addition, short-term adverse effects were identified for activities associated with S&Gs that have a long-term benefit to the species. However, the FWS does not believe the impacts of the proposed action will rise to the level of jeopardy for the species. The FWS bases this conclusion on the following reasons:

- There are several S&Gs within the Coronado NF LRMPs that support conservation and recovery of Gila chub. These are S&Gs 629, 633, 707, 709, 757, 770, 774, 779, 786, 791, 800, 814, 821, 825, and 828 within the Coronado NF LRMP. They state that management of sensitive species will take precedence over other species except T&E. All of these S&Gs guide the NF to implement recovery plans, improve habitat for T&E species by structural and nonstructural means, and to delist T&E species.

- Prior to the Gila chub being federally listed, the USFS has taken proactive measures in an attempt to reduce the decline of the species. For example, during the last several years Sabino Canyon, Romero Canyon and Paige Creeks on the Coronado NF have been treated using piscicides to remove nonnative species of fish that compete with and prey upon native fish (USFS 2004). Monitoring of all three areas continues

in order to detect invasion by nonnative green sunfish which persist downstream on non-USFS lands, so that the Forest could be proactive in removing the threat of predation and competition by green sunfish (USFS 2004).

Due to the fact that the Gila chub is a hard-to-find, secretive species and because there have been no extensive survey efforts for this species since the comprehensive status review by Weedman et al. (1996), it is possible that Gila chub still persist in areas thought to be extirpated and may occur in localities yet to be discovered. Proactive efforts by the USFS in the past and the continued monitoring of those actions contribute positively to the overall status of the Gila chub. In addition, there are activities being conducted by other land management agencies to enhance habitat for the chub that benefit its status rangewide. All these actions together with the implementation of the beneficial S&Gs outlined above should continue to improve habitat conditions and increase populations of Gila chub on NFS lands in the southwest. For these reasons, we conclude that the proposed action is not likely to jeopardize the continued existence of Gila chub.

Based on the above analyses, it is the FWS's BO that the proposed action will not alter the ability of the PCEs to function properly. As such, Gila chub designated CH will remain functional to serve its intended conservation role for the species. Therefore, we conclude that the proposed action is not likely to destroy or adversely modify Gila chub designated CH.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Per the ESA, "take" is defined in section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) 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 which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined (50 CFR 402.02) as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of the agency action, is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Amount or Extent of Take Anticipated

Incidental take of the Gila chub is reasonably certain to occur as a result of the continued implementation of the Coronado NF LRMP, as well as the 1996 Regional Amendment. On the Coronado NF, incidental take is expected to be in the forms of harm, harassment, and mortality to the species.

The FWS anticipates, however, that the aforementioned incidental take will be difficult to detect for the following reasons: finding a dead or impaired specimen is unlikely, and losses may be masked by seasonal fluctuations in environmental conditions and fish numbers. Therefore, it is not possible to provide precise numbers of Gila chub that will be harassed, harmed, or killed as a result of the proposed action. For purposes of this BO, we define incidental take in terms of the number of extant populations. The extant populations of Gila chub within the Coronado NF are Bear, Romero, O'Donnell, Turkey and Sabino Creeks. The FWS concludes that incidental take of Gila chub will be considered to be exceeded if, during a period of 3 consecutive years, any currently extant population of Gila chub (Bear Creek, Romero Creek, and Sabino Creek on the Santa Catalina Ranger District and Turkey Creek and O'Donnell Creek on the Sierra Vista Ranger District) are lost due to the implementation of the proposed action (e.g. absent).

Effect of the Take

In the accompanying BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the Gila chub.

REASONABLE AND PRUDENT MEASURES

The FWS believes the following reasonable and prudent measure is necessary and appropriate to minimize take of Gila chub:

1. Minimize or eliminate adverse effects to Gila chub on the Coronado NF lands due to LRMP activities.

2. Minimize or eliminate impacts to Gila chub habitat on the Coronado NF lands due to LRMP activities.

3. Monitor the impacts of implementing the proposed action on Gila chub and report the findings to the FWS.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the USFS must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1.1 Manage riparian areas adjacent to and upstream of Gila chub populations for conditions to minimize direct and indirect effects to Gila chub and its habitat.

1.2 Develop and implement projects in LRMP programs within the Coronado NF with the goal of minimizing or eliminating adverse effects to the Gila chub.

The following terms and conditions will implement reasonable and prudent measure 2:

2.1 Develop and implement projects (i.e., watershed or riparian restoration) in occupied Gila chub habitat with the goal of minimizing or eliminating adverse effects to Gila chub habitat

The following terms and conditions will implement reasonable and prudent measure 3:

3.1 The Coronado NF shall monitor incidental take resulting from the proposed action and report their findings to the FWS. Incidental take (implementation) monitoring shall include information such as when or if the project was implemented, whether the project was implemented as analyzed in the site-specific BO (including CMs, and BMPs), relevant survey information, and any other pertinent information about the project's effects on the species.

3.2 Annual reports, which will include this species, shall be sent to the appropriate local FWS Ecological Services field office by March 1st of each year.

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 USFS must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. Continue to identify factors that limit the recovery of the Gila chub on NF lands and work to correct them.

2. Acquire instream flow water rights to ensure perennial flow in streams with Gila chub.

3. Work with the FWS and AGFD to remove nonnative species and reestablish Gila chub throughout its historical range in and Arizona.

4. Continue fish surveys on the NFS lands to determine to what extent other chub, such as the roundtail or headwater chub, may occupy those streams.

5. Work cooperatively with the FWS, BLM, NMDGF, and AGFD to establish refugia populations of Gila chub wherever possible.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effect or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

GILA TOPMINNOW

STATUS OF THE SPECIES

Description

Gila topminnow (*Poeciliopsis occidentalis occidentalis*) is a small live-bearing minnow belonging to the family Poeciliidae. The Gila topminnow is a subspecies of *Poeciliopsis occidentalis* that also includes the Yaqui topminnow (*Poeciliopsis occidentalis sonoriensis*) and are collectively known as the Sonoran topminnow. Males are rarely greater than 1 inch in length, while females are larger, reaching 2 inches in length. Both males and females range in coloration from tan to olive bodies, usually with white on the belly. Breeding males are often blackened, with a golden coloration about the midline, and have orange or yellow at the base of their dorsal fin.

General topminnow habitat includes quiet, warm waters with slow current and abundant aquatic vegetation. However, topminnow can survive in swiftly flowing streams with vegetation providing adequate cover.

Legal Status: The Gila topminnow was listed as endangered in 1967 without CH (U.S. Fish and Wildlife Service 1967). The species was later revised to include two subspecies, *P. o. occidentalis* and *P. o. sonoriensis* (Minckley 1969, 1973). Both subspecies are protected under the ESA. Only Gila topminnow populations in the U.S., and not in Mexico, are listed under the ESA.

The original Recovery Plan for the Gila and Yaqui topminnows (The Sonoran Topminnow Recovery Plan) was completed on March 15, 1984. The Recovery Plan calls for the downlisting or delisting of both species. Criteria for downlisting were met for a short period. However, due to concerns regarding the status of several populations, downlisting was delayed. Subsequently, the number of reintroduced populations dropped below that required for downlisting, where it has remained. It was also recognized shortly after completion of the recovery plan that the criteria in the plan were inadequate to recover the species (FWS files).

The Yaqui topminnow is now included within the Yaqui Fishes Recovery Plan (FWS 1995). A draft revised recovery plan for the Gila topminnow is available (Weedman 1999). The plan's short-term goal is to prevent extirpation of the species from its natural range in the US and reintroduce it into suitable habitat within historical range.

Distribution and Abundance (Rangewide)

Historically, the Gila topminnow was abundant in the Gila River drainage in Arizona and was one of the most common fishes of the Colorado River basin, particularly in the Santa Cruz system (Hubbs and Miller 1941). Gila topminnows were also recorded from the Gila River basin in New Mexico. In the last 50 years, this was reduced to only 16 naturally occurring populations. Presently, only 10 of the 16 known natural Gila topminnow populations are considered extant (Table 3) (Weedman and Young 1997, Voeltz and Bettaso 2003, FWS files). Only eight have no non-native fish present and therefore can be considered secure for the moment from non-native fish threats. There have been at least 200 wild sites stocked with Gila topminnow, however, topminnow persist at only 30 of these localities. Of these, one site is outside topminnow historical range and one contains non-native fish (Voeltz and Bettaso 2003). All of these sites except one are in Arizona. Many of the reestablished sites are very small and may not contain viable populations. In addition several of the 30 sites have been reestablished in the last few years, and their eventual disposition is unknown.

Table 3. Status of natural Gila topminnow populations in the US.

Site	Ownership	Extant?[1, 8]	Non-natives?	Mosquitofish?	Habitat Size[2]	Threats[3]
Bylas Spring[5]	San Carlos	YES	NO[4]	NO[4]	S D	M/ N G
Cienega Creek	BLM	YES	NO	NO	L	M/ R N
Coal Mine Spring	AGFD	YES	NO	NO	S	L/ G
Cocio Wash	BLM	NO 1982	DRY	DRY	S	H/ M
Cottonwood Spring	Private	YES	NO	NO	S	M/ N
Fresno Canyon[7]	State Parks	YES	NO[9]	NO[4]	M	H/ N G U
Middle Spring[5]	San Carlos	YES	NO[4]	NO[4]	S	H/ N G
Monkey Spring	Private	YES	NO	NO	S	L/ W U
Redrock Canyon	USFS	NO 2005	YES	YES	M D	H/ W R G N
Salt Creek[5]	San Carlos	YES	NO[4]	NO[4]	S	M/ N G
San Pedro River	Private	NO 1976	YES	YES	-	H/ W N G R
Santa Cruz River San Rafael Tumacacori	Private, State Parks, TNC	 NO[6] YES 2003	 YES YES[4]	 YES YES	L D	H/ W N R G C U
Sharp Spring	State Parks	NO 2004	YES	YES	M	H/ N G U
Sheehy Spring	TNC	NO 1987	YES	YES	S	H/ N G U
Sonoita Creek	Private, TNC, State Parks	YES	YES	YES	L D	H/ W N G

[1] if no, last year recorded
[2] L = large M= medium S = small D = disjunct
[3] Immediacy H = high M = moderate L = low
Type W = water withdrawal C = contaminants R = recreation N = non-natives G = grazing M = mining U = urbanization
[4] none recently, they have been recorded
[5] recently renovated
[6] in Mexico 2006, US in 1993
[7] includes Sonoita Creek below Patagonia Lake
[8] Recent records are those less than 10 years old
[9] Fresno Canyon renovated in 2007 and is free of non-native- Sonoita Creek has many non-natives

Habitat
For a detailed description of Gila topminnow habitat please refer to the 2005 BO/CO.

Life History
Gila topminnow are viviparious fish, where embryos grow and mature within the female and are born living. Fertilization also occurs internally through deposition of spermatophores (packets of sperm). Breeding generally occurs from January to August, but can occur throughout the year in thermally constant springs (Heath 1962, Minkley 1973, Schoenherr 1974). Brood size ranges from one to 31, dependent upon standard length of the female (Constantz 1974, Schoenherr 1974, 1977), with 21.5 days as a mean interval between broods (Schoenherr 1974).

Gila topminnow are opportunistic omnivorous feeders (Schoenherr 1974), consuming detritus, vegetation, amphipods, ostracods, and insect larvae; and rarely, other fishes (Schoenherr 1974, Gerking and Plantz 1980, Meffe et al. 1983, Meffe 1984).

Reasons for Listing
The Gila topminnow was listed as endangered in 1967 without CH (U.S. Fish and Wildlife Service 1967). The listing stated the species was threatened with extinction based on declining populations.

Threats: According to the Recovery Plan, threats to the Gila topminnow include habitat loss and predation by introduced mosquitofish. Habitat destruction and introduction of non-native species are the primary reasons for reductions in Gila topminnow populations, and are the causes for its listing as an endangered species (U.S. Fish and Wildlife Service 1984, Williams et al. 1985, 1989, Simmons et al. 1989).

During the early 20th century, several factors caused widespread habitat changes throughout the Southwest. These events include both biotic and abiotic factors, such as loss of vegetation through improper livestock grazing and timber wood harvesting, periods of flooding and drought, and the construction of water diversions and dams (Minckley 1993).
Although historic events occurring in the early 20th century permanently altered much of the aquatic habitat in the southwest, it is current and future activities that threaten the continued existence and reestablishment of this species. Current land use practices such as improper livestock grazing, mining, timber harvesting, road maintenance, and recreation pose major threats to habitat as well as existing and future populations. Additionally, population growth and

development continue to affect potential recovery of the species through increased groundwater pumping and diversions to supply the growing populations, stream and river channelization, and increased water pollution (Weedman 1999).

The subspecies is highly vulnerable to adverse effects from non-native aquatic species (Johnson and Hubbs 1989), including non-native crayfish (Fernandez and Rosen 1996). Predation and competition from these species have resulted in Gila topminnow declines and continue to be a major threat to the remaining populations (Meffe et al. 1983, Meffe 1985, Brooks 1986, Marsh and Minckley 1990, Stefferud and Stefferud 1994, Weedman and Young 1997). Bullfrogs (*Rana catesbiana*) are widespread and abundant throughout Gila topminnow historical range and are known to prey on fishes (Rosen and Schwalbe 1996). However, Meffe et al. (1983) identify the introduction of the western mosquitofish as causing the most problems for the Gila topminnow because mosquitofish can tolerate similar environmental extremes, and can therefore occupy similar habitats as Gila topminnow. It has been documented that mosquitofish can eliminate a population of topminnow within a year (Minckley and Deacon 1968, Schoenherr 1974, Voeltz and Bettaso 2003). To date, the spread of mosquitofish has continued virtually unchecked since their introduction to Arizona in 1926 (Minckley et al. 1977, Meffe et al. 1983).

Because the native fish fauna of the Gila basin and of the Colorado basin in general was naturally depauperate and contained few predatory fish (Carlson and Muth 1989), the Gila topminnow did not evolve mechanisms for protection against predation or competition. In the riverine backwater and side-channel habitats that formed the bulk of Gila topminnow natural habitat, predation and competition from other fishes was essentially absent. Therefore, the introduction of large numbers of predatory and competitive non-native fish, frogs, crayfish, and other species, provided conditions within which the Gila topminnow could no longer survive in many of their former habitats, or the small pieces of those habitats that had not been lost to human alteration.

Recovery Actions

The Arizona Department of Transportation has completed a Safe Harbor Agreement for the Gila topminnow and the desert pupfish (Arizona Department of Transportation 2000). This agreement covers all properties managed by Arizona Department of Transportation. The AGFD also has a Safe Harbor Agreement, which allows Gila topminnow and desert pupfish populations to be established on non-federal lands. Implementation of this Safe Harbor Agreement has allowed for the establishment of eight new populations and maintenance of genetic stocks and refuge populations in natural, semi-natural, or manmade habitats, which will aid in recovery efforts for the two species.

As discussed previously, there have been over 200 sites stocked with Gila topminnow. However, topminnows persist at only 10 of these localities. Thirteen sites occur on NFS lands. There are many reasons for failure of many of the stocked populations, but flooding, desiccation, water development, livestock, and non-native species have been identified as the major reasons (Brooks 1985, Weedman and Young 1997, Voeltz and Bettaso 2003).

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, 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 which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

The Coronado NF population in Redrock Canyon (Sierra Vista Ranger District) was, until 2005, the only natural relict population (USFS 2004). The Redrock population now appears to be extirpated. Many occupied Gila topminnow sites' watersheds contain or adjoin NFS lands (i.e. Redfield Canyon, Cienega Creek, Bass Canyon, O'Donnell Canyon, and Aravaipa Creek downstream from the Coronado NF). However, no occupied sites currently occur on the Coronado NF.

Factors Affecting the Species within the Action Area

The FWS transmitted a BO to the Coronado NF regarding the release of Gila topminnow into Sabino Creek (22410-2009-F-0143) on August 12, 2009. The action consulted on was recreation, and how that would affect the topminnows once they were released. No Gila topminnow have been released as of yet.

In June 2008, the FWS transmitted a BO to the Coronado NF regarding the application of piscicide in Redrock Canyon to remove non-native invasive fish and to re-establish populations of native species, including Gila topminnow. The Forest completed analysis of this proposal under the National Environmental Policy Act and authorized the project in 2011. However, AZGFD has placed the project on hold pending statewide review of their piscicide program.

The Gila topminnow's status within the action area is not secure; the previously occupied sites in Redrock Canyon have not demonstrated occupancy since 2005. The reestablishment history of Gila topminnow illustrates that even sites that were thought to be secure may fail for various reasons. Gila topminnow on federal lands is widely dispersed and in some cases vulnerable to events beyond the respective land management agencies' control. Such actions would include invasions or unauthorized introductions of non-native fishes and stochastic events such as floods. Infrequent yet large floods have transported topminnow (Unnamed Drainage 68B) or destroyed structures intended to minimize the effects of livestock use (BLM's Tule Creek and Cienega Creek). The risk associated with maintaining Gila topminnow for the long-term across such a diversity of sites renders the species' status within the action area as tenuous as it is rangewide.

EFFECTS OF THE ACTION

Although, the Gila topminnow currently does not occur on the Coronado NF, suitable habitats for reestablishment occur in at least two sites (Sabino and Redrock Canyons). We will conduct an analysis of the effects of the Coronado NF LRMP as if the Forest was occupied; however, we will not issue an incidental take statement at this time. If during the life of this consultation, Gila topminnow are reintroduced back into the Coronado NF, it will be the responsibility of the Forest

to reinitiate consultation for topminnow at that time. The S&Gs listed in this Forest LRMP and the 1996 Regional Amendment provides direction for the development of site-specific actions. Please refer to the 2004/2005 BA and BO/CO for a list of S&Gs within this LRMP that are applicable to the Gila topminnow and its habitat. These S&Gs may result in both indirect and direct effects to the species.

There were five S&Gs within the Coronado NF may result in adverse effects to the Gila topminnow. Although the majority of S&Gs are positive and provide for some level of recovery of the species, there were several that were beneficial in the long-term but had some potential short-term adverse effects.

Fire Management Program

Overall, there is little direction within the Coronado NF LRMP to address conflicts between fire management and its effects to the Gila topminnow. Fire is often used to meet management objectives, such as improving wildlife habitat and livestock forage, reducing fuel hazards, and improving watershed condition. The Fire Management Program within the Coronado NF LRMP seeks to improve forest health, watershed condition, and wildlife habitat. Although fire management will result in many beneficial effects to the Gila topminnow, prescribed burning may result in direct and indirect short-term effects.

Standard and Guideline 695 seeks to conduct fire suppression activities in a manner that protects both watershed and visual resource values. Although this S&G exists, fire suppression is not part of the proposed action for this project and therefore will not be analyzed in this consultation. The effects of fire suppression are addressed during emergency consultations.

Additionally, S&Gs 713, 798, and 812 discuss the use of prescribed fire, but occur within different MAs. Prescribed fire may result in short-term negative effects to Gila topminnow, yet decreases the likelihood of catastrophic burns in the future. Thus, short-term adverse effects are anticipated with the implementation of the above S&Gs.

Forestry and Forest Health Program

Standards and Guidelines within the Forestry and Forest Health program are aimed at addressing land management practices, such as vegetation manipulation for disease control or insect outbreaks, removing slash/dead and down material to prevent catastrophic wildfires, or using pesticides to control outbreaks.

Standard and Guideline 697 allows for the use of pesticides in recreation and administrative sites, and it does not offer alternative land management practices to that of pesticide use. Pesticides are selected for their biocidal properties and are applied to kill or control organisms. Thus, they are all toxic to some forms of life. Pesticides may be introduced into natural aquatic systems by various means: incidentally during manufacture, during their application (i.e., through aerial spray drift), and through surface water runoff from agricultural/range land after application.

A number of generalizations can be made about pesticides. First, effective pesticides are designed to be selective in their effects: they are extremely toxic to some forms of life and

relatively harmless to others. Few are absolutely specific to their target organisms, so other related and unrelated species may be affected. Second, the mode of application of pesticides varies according to the circumstances. Third, in stagnant lentic (i.e., non-flowing) aquatic systems, certain pesticides are more likely to be persistent at low levels (Rand et al. 1995). Runoff that may contain pesticides could cause sublethal toxic effects in a species, affecting hormone regulation, reproduction, and embryonic development. Pesticides may affect not only aquatic species larval development, but also adult immune systems, rendering organisms more susceptible to disease. With fewer healthy adults in the breeding population, fewer young will be produced, and of those produced, more offspring will not develop normally. Constant pesticide applications that affect immune system development can only suppress an already small population as those characterized by an endangered or threatened species (Pattee et al. 2003).

Rangeland Management Program

The Coronado NF LRMP seeks to provide livestock grazing on a sustainable basis and maintaining or improving riparian and watershed conditions (USFS 2004). Within this Forest, guidance for rangeland management is directed at the MA level rather than Forest-wide (e.g., 710, MA1; 780, MA4; 805, MA7B; 792, MA7A). Standard and Guideline 762 allows for various levels of grazing within suitable rangelands of MA 3. This S&G was noted for possible sublethal effects to Gila topminnow. Additionally, S&Gs 792 and 805 seek to manage suitable rangeland at either Level A (no grazing) or Level D (intensive livestock management with higher density of water developments and interior fencing). Livestock management activities on the Coronado NF can have indirect effects, through upland/watershed effects on riparian and aquatic habitats. As stated in the recovery plan, one of the primary threats to Gila topminnow is loss of habitat.

Activities related to grazing could result in some limited direct effects to all listed aquatic species. Maintenance of viable populations Gila topminnow is compatible with well-managed livestock grazing. However, adverse effects to aquatic species from grazing may occur under certain circumstances. These effects include facilitating dispersal of non-native predators; trampling of eggs, juvenile fish; deterioration of watersheds; erosion or siltation of stream courses; elimination of undercut banks that provide cover; loss of wetland and riparian vegetation and backwater pools; and spread of disease (Hendrickson and Minckley 1984, Ohmart 1995, Jancovich et al. 1997, Belsky et al. 1999, U.S. Fish and Wildlife Service 2000). If topminnows are reintroduced into the Coronado NF, livestock grazing and trampling may potentially indirectly affect fish by altering the shape and form of the aquatic habitat, riparian soils and vegetation composition, density, and structure; water quality, quantity, and flow patterns (Kauffman and Krueger 1984, Fleischner 1994, and Belsky et al. 1999).

Watershed Management Program

The Watershed Management Program seeks to maintain or improve watershed conditions and maintain water quality. This program in particular provides beneficial guidance for the Gila topminnow within the Coronado NF LRMP.

Standard &Guideline 678 provides guidance for management of the aquatic-riparian resources, and seeks to perform the following objectives: (1) maintain at least 80 percent of natural shade

over water surfaces in fish bearing streams, (2) maintain at least 80 percent of natural bank protection, and (3) maintain the composition of sand, silt, and clay within 20 percent of natural levels in fish bearing streams. This S&G allows a certain amount of riparian habitat to be maintained at less than optimal conditions. For example, if 80 percent of the streambank linear distance is maintained in stable condition, then the assumption is that 20 percent of the streambank is at less than stable conditions. Hypothetically, degraded streambank conditions could extend downstream until the majority of the streambank is unstable. This could result in increased sedimentation into the stream channel, thus lowering water quality and integrity. As a result, potential effects to the species include a reduction of invertebrate food supplies, interference with reproduction, and direct mortality.

Standard and Guideline 677 intends to classify all riparian areas within a certain time period, while completing plans to improve all unsatisfactory areas. This S&G is beneficial because it is moving toward satisfactory riparian conditions; however, there may be some short-term adverse effects that may continue to occur until the riparian habitat reaches satisfactory conditions.

Several S&Gs (711, 782, 784, 794, and 807) concern improving watershed conditions, but apply to different MAs. They allow for short-term, temporary impacts to water quality and watershed condition in exchange for longer-term improvement in watershed condition, sediment reduction, and riparian status.

Wildlife, Fish and Rare Plants Program

Standards and Guidelines 667 & 668 are likely to cause short-term adverse effects in order to achieve long-term beneficial goals. Standard and Guideline 667 allows for prescribed burning. While it is advantageous to reduce the risk of catastrophic wildfire, the prescribed fire itself may have short-term impacts on water quality in adjacent streams inhabited by Gila topminnow. Standard and Guideline 668 also allows for short-term, temporary impacts from the construction of habitat improvements and fencing. These impacts may include direct mortality of fish as well as indirect impacts to the habitat such as temporary alterations of stream flow, or short-term isolated increases in sediment entering the stream.

1996 Regional Amendment

In the 2005 BO/CO, we concluded that there were no adverse effects to the Gila topminnow from the implementation of the S&Gs for the 1996 Regional Amendment. All applicable S&Gs were determined to maintain habitat for the Gila topminnow. Also, we found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

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.

Residential and commercial development on lands within watersheds containing T&E native fishes, are cumulative effects and can adversely affect the species through a variety of avenues.

Additional cumulative effects to Gila topminnow include ongoing activities in watersheds such as improper livestock grazing and associated activities outside of federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank de-stabilization, channelization without a federal nexus, and increased, intense and localized recreation that may have effects to populations occurring downstream. Some of these activities, such as irrigated agriculture are declining and are not expected to contribute substantially to cumulative long-term adverse effects to native fishes.

Other activities, such as recreation, are increasing. Increasing recreational, residential, or commercial use of the non-federal lands near the riparian areas would likely result in increased cumulative adverse effects to occupied, as well as potentially-occupied native fish habitat through increased water use, increased pollution, and increased alteration of the streambanks through riparian vegetation suppression, bank trampling, and erosion.

Additional cumulative impacts to the species may occur from cross-border activities along the U.S./Mexico border. The following cross-border activities include, but may not be limited to the following: human traffic, deposition of trash, new trails from human traffic, soil compaction and erosion, increase fire risk from human traffic, water depletion and contamination, introduction and spread of disease, and interference of survey, monitoring and research.

CONCLUSION

We analyzed Gila topminnow as if it occurred on the Coronado due to the fact that it is likely that reintroduction attempts may occur during the life of this plan. However, we did not issue an Incidental Take Statement because the species currently does not occur on the Coronado NF. After reviewing the current status of the Gila topminnow, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the FWS's opinion that the proposed action is not likely to jeopardize the continued existence of the Gila topminnow. Pursuant to 50 CRF 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. No CH has been designated for the species; therefore, none will be affected.

If the Gila topminnow were established on the Coronado NF, the FWS anticipates adverse effects to the Gila topminnow from the implementation of the Coronado NF LRMP. However, the FWS does not believe the impacts of the proposed action would rise to the level of jeopardy for the species. The FWS bases this conclusion on the following reasons:

- Continuing efforts to stock Gila topminnow in various wild sites and within NFS lands have allowed the status of topminnow populations to remain stable.
- The effects from most programs are minimized greatly by S&Gs in the Watershed Program and the 1996 Regional LRMP Amendment. Generally, the overall guidance of the LRMP S&Gs is to protect resources while maintaining multiple use activities.

- The Coronado NF LRMP specifically states that habitat for Gila topminnow will be maintained at current levels of occupied habitat.

Therefore, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of the Gila topminnow if it were to be reestablished on the Forest. If the species is reintroduced into the Coronado NF, reinitiation of this consultation is required.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Per the Act, "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) 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 which include, but are not limited to, breeding, feeding, or sheltering. "Incidental take" is defined (50 CFR 402.02) as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

Amount or Extent of Take Anticipated

No take is anticipated to occur as a result of the proposed action because the species is currently not found on the NFS lands and the potential adverse indirect effects that were analyzed in the opinion, do not rise to the level of take. If the species becomes established on the NFS within the life of the current LRMP, reinitiation will be necessary.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to

minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. Continue your efforts to reintroduce the Gila topminnow into the Coronado NF.

2. Assist with the development of a Gila topminnow monitoring plan that addresses all actions occurring within pertinent watersheds on the Coronado NF.

3. In cooperation with the AGFD and academia, assess habitat dynamics and fish- habitat relationships of the Gila topminnow.

4. Cooperate with state conservation agencies to eliminate the introduction and presence of non-native fish species within Gila topminnow habitat.

GILA TROUT

STATUS OF THE SPECIES (rangewide)

Description

The Gila trout is a member of the salmon and trout family (Salmonidae). Gila trout is a moderate-sized salmonid that typically attains lengths of 8-10 in (200-250 mm); older individuals can exceed 14 in (355 mm) in total length. Gila trout were formally described by Miller (1950) using trout collected from Main Diamond Creek, Sierra County, New Mexico in 1939. Gila trout is closely related to Apache trout (*O. apache*), which is endemic to the upper Salt and Little Colorado River drainages in east-central Arizona. Gila trout and Apache trout are more closely related to rainbow trout (*O. mykiss*) than to cutthroat trout (*O. clarki*) suggesting that Gila and Apache trout were derived from an ancestral form that also gave rise to rainbow trout (Behnke 1992, Dowling and Childs 1992, Utter and Allendorf 1994, Nielsen et al. 1998, Riddle et al. 1998).

The Gila trout is readily identified by its iridescent gold sides that blend to a darker shade of copper on the operculum (gill covers). Spots on the body are small and profuse, generally occurring above the lateral line and extending onto the head, dorsal (back, top) fin, and caudal (tail) fin. Spots are irregularly shaped on the sides and increase in size on the back. On the dorsal surface of the body, spots may be as large as the pupil of the fish eye and are rounded. A few scattered spots are sometimes present on the anal fin, and the adipose fin (fleshy fin located behind dorsal fin) is typically large and well-spotted. Dorsal, pelvic, and anal fins have a white to yellowish tip that may extend along the leading edge of the pelvic fins. A faint, salmon-pink band is present on adults, particularly during spawning season when the normally white belly may be streaked yellow or reddish orange. A yellow cutthroat mark is present on most mature specimens. Parr marks (diffuse splotches on the sides of body, usually seen on young trout) are commonly retained by adults, although they may be faint or absent (Miller 1950, David 1976).

The golden coloration of the body, parr marks, and fine profuse spots above the lateral line distinguish Gila trout from other co-occurring nonnative trout species in the field (FWS 2003).

Legal Status: The Gila trout was designated as an endangered species under the Federal Endangered Species Preservation Act of 1966 (FWS 1967), and subsequent designation of the species as endangered continued under the ESA (1973). Reasons for listing included hybridization, competition, and predation by nonnative rainbow trout (*O. mykiss*), cutthroat trout (*O. clarkii*), and brown trout (*Salmo trutta*), and habitat degradation. No CH was designated at the time of listing.

In 1987, the FWS proposed to reclassify the Gila trout as threatened (FWS 1987). The FWS withdrew the 1987 proposal for reclassification on September 12, 1991 (FWS 1991) because: 1) severe flooding in 1988 reduced the Gila trout populations in McKnight Creek by about 80 percent; 2) wildfires 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 known predator, were found present in Iron Creek, which at the time was thought to harbor a relict population of Gila trout.

Gila trout was listed as endangered by the NMDGF in 1975 under the Wildlife Conservation Act and was downlisted to threatened in 1988. Gila trout are considered a Species of Concern by the AGFD in 1966.

On May 11, 2005, the FWS proposed to reclassify Gila trout from endangered to threatened (FWS 2005) with a special 4(d) rule to allow recreational angling to occur according to regulations implemented by the NMDGF and AGFD. The final rule for the reclassification became effective on August 17, 2006 (FWS 2006a). The reclassification was justified on the basis of replication of the relict trout populations, the viability and security of the population replicates, documented increases in trout numbers, and the creation and use of appropriate management plans (i.e., broodstock management, evacuation plan, updated Recovery Plan, etc.).

Distribution and Abundance

The historical distribution of Gila trout is not known with certainty (Behnke 2002). Although, Gila trout were believed to occupy the upper Gila in New Mexico and parts of the San Francisco systems of Arizona and New Mexico (Behnke 2002). The Arizona populations were believed to be extirpated around the turn of the 20th century (FWS 2003). A native trout identified as Gila trout in spotting, but as Apache trout from other characteristics once occurred in the Verde and Agua Fria drainages in Arizona (Behnke and Zarn 1976, Behnke 2002). Trout collected in Oak Creek (1888-89), a tributary of the Verde River, were originally identified as Gila trout. Trout collected in Sycamore Creek (1975), a tributary of the Agua Fria, were reported to be Gila hybrids (Behnke and Zarn 1976, FWS 2003). Distribution of both Gila and Apache trout is not known for certain in the Verde River during the last glacial period to hybridize and produce a form intermediate to the two still existing trout.

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 7 mi (11.3 km) 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 15 mi (25 km) (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 (FWS 2003).

When the Gila trout was listed as endangered, it was thought that its range had been reduced to five streams within the Gila NF, New Mexico: Iron, McKenna, Spruce, Main Diamond, and South Diamond Creeks. Main Diamond Creek was the largest of the five populations which has been attributed to numerous pools formed by log dams built by the Civilian Conservation Corps in the 1930s (Behnke 2002). Beginning in 1970, Gila trout from each of the five relict populations were translocated into other streams. In 1992, a relict population in Whiskey Creek was discovered (Leary and Allendorf 1998). It was later 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, FWS 2003). 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 (Table 4).

Surveys on most of the 18 existing populations indicate that the recovery efforts to remove nonnative fish and prevent their return to the renovated areas have been successful (FWS 2003, 2011b) (Table 4). 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 (not included in Table 4); however, the stream is presently fishless and has been determined unsuitable of Gila trout (AGFD 2010, FWS 2010). 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 Fire. In November 2004, 14 fish were restocked into the uppermost portions. Few individuals have been observed between 2008 and 2010, but are currently in good condition and reproduction is taking place. Given the low number of individuals augmentation may be needed to maintain this population (AGFD 2010, FWS 2010). On the Coronado NF, Frye Creek was stocked in October 2009 with 500 Gila trout of the South Diamond lineage, and in February of 2011, a supplemental stocking of Gila trout will be done in Frye Creek (USFS 2011). In addition, Frye Creek was augmented with additional Gila trout and five Gila trout were introduced into Ash Creek in November 2011. Fry Creek population is doing well, reproducing with two age classes present. On the Prescott NF, Grapevine Creek, a tributary to Big Bug Creek, was stocked with 160 Gila trout of the South Diamond Creek lineage in November of 2009, and in 2010, personnel from AGFD went back to Grapevine Creek and visually observed Gila trout throughout a 1-mi (0.8-km) reach (USFS 2011).

Table 4. Summary of streams rangewide inhabited by Gila trout in 2011 (Sorted by state). Relict lineages in bold.

State	County	Stream Name	Drainage	Length of stream inhabited (km (mi))
NM	Sierra	**Main Diamond Creek**	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	**South Diamond Creek**[1]	East Fork Gila	6.7 (4.2)
NM	Catron/Grant	Mogollon Creek[2]	Gila River	28.8 (17.9)
NM	Catron/Grant	Sheep Corral	Gila River	1.6 (1.0)
NM	Catron	**Spruce Creek**	San Francisco	3.7 (2.3)
NM	Catron	Big Dry Creek	San Francisco	1.9 (1.2)
NM	Catron	**Whiskey Creek**	West Fork Gila	2.6 (1.6)
NM	Catron	Langstroth Canyon	West Fork Gila	5.4 (3.3)
NM	Catron	Rawmeat Canyon	West Fork Gila	0.8 (0.5)
NM	Catron	Cub Creek	West Fork Gila	6.9 (4.3)
NM	Catron	Mainstem West Fork Gila	West Fork Gila	18.6 (11.6)
AZ	Greenlee	Raspberry Creek	Blue River	6.0 (3.7)
AZ	Graham	Frye Creek	San Francisco	8.0 (5.0)
AZ	Yavapai	Grapevine	Agua Fria	3.2 (2.0)

[1]includes Burnt Canyon.
[2]includes Trail Canyon, Woodrow Canyon, Corral Canyon, and South Fork Mogollon Creek.

Habitat

Gila trout are a typical cold-water species requiring well-oxygenated water; coarse sand, gravel and cobble substrate; stable stream back conditions; and abundant overhanging banks, pools and cover for optimal habitat. They are found in moderate to high gradient (from 1 to over 14 percent gradient) perennial streams above 5,400 ft (1,600 m) to over 9,200 ft (2,838 m) in elevation (McHenry 1986, Propst and Stefferud 1997). The species requires water temperatures below 77 ºF (25 ºC), adequate stream flow to maintain survivable conditions, and clean gravel substrates for spawning (FWS 2003). Gila trout use substrates of fine gravel and coarse sand (0.07-1.50 in; 0.31-1.50 in [1.8-38.1 mm; 8.0-38 mm]) during spawning (Rinne 1980). Spawning habitat of Gila trout in Main Diamond, South Diamond, and McKnight creeks average substrate composition consisted of 6.6 percent silts, clays, and very fine to coarse sands (<0.04 in [1mm] diameter), 14.4 percent very coarse sand (0.04-0.08 in [1 to 2 mm]); 27.4 percent very fine to medium gravels (0.08-0.35 in [2 to 9 mm]); 6.9 percent to very coarse gravels (1.50-2.48 in [38 to 63 mm]), and 6.7 percent cobbles (2.52-10.08 in [64 to 256 mm]) (Rinne 1980, Rosgen 1998).

Nursery and rearing habitats are areas used by larval and juvenile Gila trout. Although no studies have focused on habitat use by these life stages of Gila trout, generalizations can be made based on characteristics of related trout species. Suitable nursery habitat for trout includes areas with slow current velocity such as stream margins, seeps, shallow bars, and side channels (Behnke 1992). Low flows during emergence from the egg and early growth of larval trout may result in strong year classes (young fish are not displaced downstream) (Behnke 1992), as may constant, elevated flows during summer (improved water quality) (FWS 2003). Absence of predation by or competition with nonnative trout, particularly brown trout, is another essential element of nursery and rearing habitat.

Subadult and adult habitats are defined as areas suitable for spawning, breeding, feeding, survival or growth to maturity of various life stages. Subadults are sexually immature individuals, generally less than 6 in (150 mm) total length and adults are sexually mature individuals typically greater than 6 in (150 mm) total length (Propst and Stefferud 1997). Subadult Gila trout occur primarily in riffles (shallow water flowing over cobbles), riffle-runs, and runs, while adults are found mainly in pools (Rinne 1978). Cover (large woody debris, undercut banks, boulders, deep water, and overhanging woody and herbaceous vegetation) is an important component of subadult and adult habitat (Stefferud 1994).

The quantity and quality of adult habitat typically limits the population (Behnke 1992). Essential elements of subadult and adult habitat relate principally to channel dimensions, cover, and hydrologic variability. Absence of predation by and competition with non-native trout (brown and rainbow) for foraging habitat is also an essential element of subadult and adult habitat.

Variation in stream flow is a major factor affecting subadult and adult population size (McHenry 1986, Turner 1989, Propst and Stefferud 1997). In particular, high flow events may cause marked decrease in population size. These events result in short-term, radical changes in habitat conditions, primarily in flow velocity. Because most streams occupied by Gila trout have relatively narrow floodplains, the forces associated with high flow events are concentrated in and

immediately adjacent to the bankfull channel. High stream flow velocities can cause channel scouring and displacement of fish downstream, often into unsuitable habitats (Rinne 1982). Overwintering habitat is defined as areas that afford shelter during periods of low water temperature, generally from November through February. Rinne (1981) and Propst and Stefferud (1997) indicated the importance of pool habitat for overwinter survival of Gila trout. Essential elements of overwintering habitat are deep water with low current velocity and protective cover (Behnke 1992). These elements are important because small streams can freeze, but deep pools provide areas that do not freeze. Trout are coldwater species and therefore are typically more sluggish in the winter and cover is important to protect them from predators. Barriers to fish movement (e.g., waterfalls, dry stream bed) that prevent fish from accessing overwintering habitat may benefit populations of Gila trout. Gila trout are now restricted to small, headwater streams that typically have fewer deep pools and suitable overwintering habitat than do larger streams (Harig and Fausch 2002).

Life History

Spawning occurs mainly in April (Rinne 1980) when temperatures are 43 to 46 °F (6 to 8 °C); however, day length may also be an important cue. Stream flow is apparently of secondary importance in triggering spawning activity (Rinne 1980). Young fish less than 25 mm (1 in) emerge from gravel nests 56 to 70 days after egg deposition (Rinne 1980). By the end of the first summer, young attain a total length of 2.7 to 3.5 in (70 to 90 mm) at lower elevation streams and 1.6 to 2.0 in (40 to 50 mm) at higher elevation sites (Rinne 1980, Turner 1986). Growth rates are variable, but Gila trout generally reach 7.1 to 8.7 in (180 to 220 mm) total length by the end of the third growing season in all but higher elevation streams. Mean survival rates for life history stages of Gila trout from 0.128 to 0.497, where survival rate is defined as the proportion of individuals of age x that survive to age $x + 1$ (Ricklefs 1990, Brown et al. 2001). On average, approximately half of every 100 eggs will survive to the juvenile life stage. Of the surviving fish, only approximately six will make it to the subadult stage, and of those six subadults, only two will survive to the adult life stage. The average life expectancy of an adult Gila trout is 5 years (Turner 1986), with a maximum age of nine reported by Nankervis (1988). As a result of these survival rates, the majority of the adult female Gila trout will only spawn twice before dying, while males will spawn three to four times before dying (FWS 2003). Normally a single fish or a pair of fish occupied a spawning redd, but occupancy by three to four fish can be common (Rinne 1980).

Aquatic insects are the primary food of Gila trout. Regan (1966) reported that adult flies (diptera), caddisfly larvae (trichoptera), mayfly nymphs (ephemeroptera), and aquatic beetles (coleoptera) were the most abundant food items in stomachs of Gila trout in Main Diamond Creek. There was little variation in food habits over the range of size classes sampled (1.8 to 6.6 in [47 to 168 mm] total length). Gila trout diet shifted seasonally as the relative abundance of various prey changed. Insect taxa consumed by Gila trout were also common in stomach contents of nonnative trout species in the Gila River drainage, indicating the potential for interspecific competition. Hanson (1971) noted that Gila trout established a feeding hierarchy in pools during a low flow period in Main Diamond Creek. Larger fish aggressively guarded their feeding stations and chased away smaller fish. Large Gila trout occasionally consume speckled

dace and may also cannibalize smaller Gila trout (Van Eimeren 1988, Propst and Stefferud 1997).

Adult Gila trout are typically sedentary and movement is influenced by population density and territoriality (Rinne 1982). Although individual fish may move considerable distances (e.g., over 0.9 mi [1.5 km]), Rinne (1982) found that after 8 months, 75 percent of tagged fish were less than 328 ft (100 m) from their release sites in Main Diamond, South Diamond, and McKnight Creeks. Gila trout showed a tendency to move upstream in South Diamond Creek, possibly to perennial reaches with suitable pool habitat in response to low summer discharge. Downstream movement in Main Diamond and McKnight Creeks involved primarily smaller fish and probably occurred because of nocturnal migrations or displacement downstream during flooding (Rinne 1982). High density of log structures in Main Diamond Creek appeared to reduce mobility of Gila trout in that stream (Rinne 1982).

Population dynamics

Factors affecting population size and dynamics of Gila trout are not well understood. Inferences about factors that control population size have been made from analysis of time-series data (Turner and McHenry 1985, Turner 1989, Propst and Stefferud 1997). Hydrologic variability appears to be most important in regulating population size of Gila trout in many of the streams occupied by the species (e.g., Regan 1966, Mello and Turner 1980, McHenry 1986, Turner 1989, Brown et al. 2001). Gila trout populations typically have high densities during relatively stable flow periods (Platts and McHenry 1988). The overall importance of environmental factors, specifically quantity and variability of stream discharge, in determining persistence of Gila trout populations is evidenced by the effects of fire, flood, and low flow on population size and density of this species. Examples of the effects of severe wildfires and subsequent floods and ash flows are the elimination of the Gila trout populations from Main Diamond Creek (1989) and South Diamond Creek (1995).

Reasons for Listing

The Gila trout was listed as endangered in 1967 without CH (FWS 1967). The listing stated the species was threatened with extinction based on declining populations.

Threats: Major threats to this species include habitat alterations, competition, hybridization and predation by nonindigenous fish (FWS 1987).

The decline in Gila trout populations and available habitat is due to a multitude of factors: 1) habitat degradation, including the impacts of grazing and logging; 2) uncontrolled angling; 3) predation from and competition with nonnative trout, especially piscivory of brown trout; 4) inadequacy of legal protections up to 1967 when federal listing occurred; and 5) introgressive hybridization with nonnative rainbow trout (FWS 2003).

Climate Change

General climate change effects on federally listed species are described earlier. Here we describe factors that might affect the Gila trout.

Several climate-related trends have been detected since the 1970s in the southwestern U.S. including increases in surface temperatures, rainfall intensity, drought, heat waves, extreme high temperatures, average low temperatures (Overpeck 2008). Annual precipitation amounts in the southwestern U.S. may decrease by 10 percent by the year 2100 (Overpeck 2008).

Current predictions of drought and/or higher winter low temperatures may also stress ponderosa pine forests in which Gila chub occurs. Ganey and Vojta (2010) studied tree mortality in mixed conifer and ponderosa pine forests in Arizona from 1997-2007, a period of extreme drought. They found the mortality of trees to be severe; the number of trees dying over a 5-year period increased by over 200 percent in mixed-conifer forest and by 74 percent in ponderosa pine forest during this time frame (Ganey and Vojta 2010). Ganey and Vojta (2010) attributed drought and subsequent insect (bark beetle) infestation for the die-offs in trees.

Drought stress and a subsequent high degree of tree mortality from bark beetles make high-elevation forests more susceptible to unnaturally intense wildfires. Climate is a top-down factor which synchronizes with fuel loads which is a bottom-up factor; combined, these factors correlate to supporting larger, more frequent, and more severe wildfires in the southwestern U.S., influenced by a predicted reduction in snowpack and an earlier snowmelt (Fulé 2010). Wildfires are expected to reduce vegetative cover and result in greater soil erosion from increased droplet splash-erosion and reduced infiltration capacity, subsequently resulting in increased sediment flows in streams (Fulé 2010).

For a detailed discussion on climate change, refer to the Climate Change section within the Gila trout Environmental Baseline section in this BO.

Recovery Actions

The initial Recovery Plan for Gila trout was released in 1979, and was revised in 1984, 1993, and 2003. Initial efforts to conserve Gila trout began in the 1920's with attempts to propagate Gila trout in hatchery settings (FWS 2003). By the late 1940's the hatchery efforts were abandoned and NMDGF implemented a policy of not stocking nonnative trout into known Gila trout streams. In the 1960's study of Gila trout ecology began (Regan 1966). In the 1970's taxonomic analyses (David 1976, Beamish and Miller 1977) and population and habitat evaluations were conducted (Rinne 1978), and comprehensive distribution assessments (Mello and Turner 1980). In the 1980's the focus was on stream renovation and barrier construction, along with the establishment of new populations by direct transfer from both wild and hatchery populations. Further studies on ecology and systematics were also conducted (Lee and Rinne 1980, Rinne 1980, Rinne 1981, Rinne 1982, Loudenslager et al. 1986, Pittenger 1986, Medina and Martin 1988, Nankervis 1988, Van Eimeren 1988).

The range of the Gila trout was expanded in the 1990's, although controversy around the use of antimycin A stalled expansion efforts from 1994 to 1997 (FWS 2003). Broodstock kept at Mescalero National Fish Hatchery, were transferred to Mora National Fish Hatchery and Technology Center (MNFHTC) in the late 1990's. The MNFHTC facility continues to play a critical role in maintaining Gila trout for broodstock, as well as holding populations rescued from wildfire impacts. The MNFHTC facility is currently investigating enhancement of rearing to mimic more natural conditions, which is hoped to better maintain the wild characteristics of Gila trout held in a hatchery environment (USFS 2004, FWS 2011a).

In 1999, Gila trout were stocked into Dude Creek and in 2000 they were stocked into lower Little Creek, upper Little Creek, and Raspberry Creek. However, the upper Little Creek population was lost in 2003 due to ash flow from a wildfire. The remaining populations are currently being monitored for survival and impacts on the populations due to drought and overall stream condition.

The Gila NF, in cooperation with the NMDGF and the FWS recently completed the West Fork Gila Environmental Assessment which will add five populations and approximately 21.3 mi (34.3 km) of occupied streams in the Gila RU (Blue Earth Ecological Consultants 2002). The 2003 Recovery Plan proposes 23 new populations for re-introduction. Nearly half (11) are proposed on the Gila NF (including the 21.3 mi [34.3 km] above), which would result in occupancy of about an additional 53.7 mi (83.3 km) (FWS 2003).

Recovery efforts have included waters in Arizona where Gila trout had been extirpated until 1999. An expansive proposed effort includes reestablishing viable populations in 12 different stream segments in Arizona. These 12 segments are on three NFs. The Apache-Sitgreaves NF has seven population segments proposed which would occupy streams in the Blue, Campbell Blue and Eagle drainages, totaling 31.9 mi (51.4 km). The Coronado NF has three population segments proposed which would occupy streams in the Gila and Aravaipa drainages, totaling 24.6 mi (39.7 km). The Coconino NF has two population segments proposed which would occupy streams in the Verde drainage, totaling 33.0 mi (53.1 km) (FWS 2003). Current efforts are focused on the Apache-Sitgreaves NF, which has begun to cooperate with AGFD to analyze introduction into Chitty Creek, and the Coconino NF in cooperation with AGFD and the Federation of Fly Fishers has begun to analyze introduction into the West Fork of Oak Creek.

Overall, the population of Gila trout rangewide, both in Arizona and New Mexico, currently appear to stable and increasing. The New Mexico population is our strongest populations of Gila trout within its range. Arizona on the other hand has experienced several impediments to recovery due to several wildfires that have impact both repatriated and renovation streams for recovery. In addition, renovation efforts have been set back due to new regulation which placed a moratorium on the use of piscicides in the State of Arizona. Given these setback, the Recovery Team has worked hard to renovate and add new population of Gila trout in both Arizona and New Mexico. When Gila trout was downlisted in 2005, there was only 13 population of Gila trout range wide. Currently, there are 18 population of Gila trout within is range and plans for repatriating other streams in the new future.

ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the ESA, when considering the effects of the action on federally listed species, we are required to take into consideration the environmental baseline. Regulations implementing the ESA (50 FR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal actions in the action area that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. We have defined the action area for the LRMP as the Coronado NF. The Coronado NF has a land base of approximately 1.78 million acres (720,340 hectares ha). This land base is drained by several major drainages with considerable occupied or potential habitat within the historical range of Gila trout.

Status of the species within the action area

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. Only one stream, Frye Creek, currently has Gila trout within the action area. Frye Creek was stocked with South Diamond lineage in 2009 (500 fish), and again in February 2011.

Factors affecting the species environment within the action area

On the Coronado NF, past and present federal, state, private, and other human activities that may affect Gila trout and their habitat include: livestock grazing, timber harvest, wildfire, recreational activities, and any other habitat alterations. In addition, the stocking of nonnative trout by AGFD and private citizens in the early to mid-1900s is also included in the environmental baseline. We describe activities that have occurred within the Coronado NF to qualify the environmental baseline.

Recreational activities
In 2005, the FWS published a 4(d) rule states that you may take Gila trout in accordance with applicable State fish and wildlife conservation laws and regulations to protect this species in the States of New Mexico or Arizona. Fishing is allowed in Arizona at Frye Mesa Reservoir.

Livestock grazing
In the late 1800s and early 1900s, livestock grazing was uncontrolled and unmanaged over many of the watersheds that contained 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. Cost-effective management systems and techniques, including fencing and water development, are designed and applied to obtain relatively uniform livestock distribution and use of forage and to maintain plant vigor. Improved management grazing practices (e.g., fencing) have reduced livestock access and impacts to streams. Frye Creek is found within one grazing

allotment, the Hawk Hollow allotment. Hawk Hollow allotment is currently the only active grazing allotment for cattle near Frye Creek.

Timber harvest
Logging activities in the early to mid-1900s likely also caused major changes in watershed characteristics and stream morphology (Chamberlin et al. 1991). Early logging efforts were often concentrated along canyon bottoms 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). Timber harvest is not currently allowed in wilderness or primitive areas.

Fire
High-severity wildfires and subsequent floods and ash flows caused the extirpation of seven populations of Gila trout since 1989 including in: Main Diamond Creek (1989), South Diamond Creek (1995), Burnt Canyon (1995), Trail Canyon (1996), Woodrow Canyon (1996), Sacaton Creek (1996), and Upper Little Creek (2003) (Propst et al. 1992, Brown et al. 2001, FWS 2002). Gila trout in Frye Creek were introduced in November of 2009 and February 2011, and the most recent fire in this area was the Frye Mesa Fire in 2008 that burned more than 3,460 acres (1,400 ha). This fire was downstream of Frye Creek and did not impact the introduction effort of Gila trout in 2009 and 2011.

Gila trout are now found primarily in isolated, small streams, avoidance of ash flows may be impossible and opportunities for natural recolonization usually do not exist (Brown et al. 2001). Persistence of Gila trout in streams affected by fire and subsequent ash flows depend on management actions. In some instances, evacuation of Gila trout from streams in watersheds that have burned is deemed necessary and actions are taken, and in other cases populations are lost and must be replaced through stocking (FWS 2006b). There have been at least 7 different Gila trout evacuation due to fire, where either rescued Gila trout are used as broodstock for future reintroduction or reintroduce at a later time when both direct and indirect fire impacts are no longer a threat.

Nonnative species
Perhaps the most serious threat to Gila trout is predation, competition and hybridization with nonnative salmonids (i.e. brown and rainbow trout). The impacts of nonnative trout species on native fish including Gila trout or other trout species have been well documented (Miller 1950, Behnke and Zarn 1976, Sublette et al. 1990, Propst et al. 1992, Turner 1996). All non-native trout were eliminated from Frye Creek during flooding following the 2004 Nuttall-Gibson fire. The Forest is currently cooperating with FWS and AGFD to eliminate non-native trout from Ash Creek and Marijilda Creek.

Climate change
Four major effects on the Gila trout habitat are expected as a result of climate change:

1. increased water temperature;
2. decreased streamflow;
3. a change in the hydrograph; and
4. an increased occurrence of extreme events (fire, drought, and floods).

Increased water temperature

Kundzewicz et al. (2007) state 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 on 59 °F (15 °C) (Shuter and Meisner 1992). High temperatures suppress appetite and growth, foster disease, 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. However, increased stress from elevated temperatures could lead to greater susceptibility to disease and reduced reproductive success.

Gila trout are found within small ranges with limited dispersal capabilities and narrow physiological tolerance (i.e., temperature) making them susceptible to extinction as the climate changes (Kennedy et al. 2009). Because Gila trout occur in the upper reaches of the watershed there is no suitable habitat to move to with increasing temperature. Based on the documented loss of occupied habitat, downstream temperatures may already be marginally suitable and in the future, they may become too warm to be suitable for Gila trout (Miller 1950). For example, by 1950, water temperature in the Gila River at Sapillo Creek was considered too warm to support any trout species (Miller 1950). Kennedy et al. (2009) determined that warm season habitat for Gila trout will be reduced by 70 percent, due to warmer temperature in combination with decrease precipitation in the summer, leading to increase in intensity and frequency of wildfires.

Decreased stream flow

Current models suggest a decrease in precipitation in the Southwest (Kundzewicz et al. 2007, Seager 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 and Eischeid 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 can lead to a longer dry season. Warmer air temperatures lead to increased evaporation, increased evapotranspiration, 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, and thereby reduce the amount of habitat available for aquatic species. 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 isolated in pools may be subject to increased predation from terrestrial predators.

Change in the hydrograph

Another documented effect of climate change is a shift of the timing of spring snowmelt. Stewart et al. (2005) show that timing of spring streamflow in the western U.S. during the last 5 decades has shifted so that the major peak now arrives 1 to 4 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 from 37 to 41 °F (3 to 5 °C), snowmelt driven runoff in the western U.S. 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).

Increased occurrence in extreme events

Extreme events such as drought, fires, and floods are predicted to occur more frequently 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

The Southwest U.S. is currently experiencing drought conditions (University of Nebraska-Lincoln 2010). Portions of New Mexico are also considered abnormally dry, but not in areas currently occupied by Gila trout (University of Nebraska-Lincoln 2010). 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 populations, in particular those occupying small headwater streams which are likely to dry or become intermittent. In addition to stream drying, there is a clear association between severe droughts and large fires in the Southwest (Swetnam and Baisan 1996).

Fire

Since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970 to 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 to 2003 was 78 days longer compared to 1970 to 1986 and the average time between fire discovery and control increased from about 8 to 37 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 and fires in the western U.S. will be more frequent and 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).

Severe wildfires capable of extirpating or decimating fish populations are a relatively recent phenomena and result from the cumulative effects of historical or ongoing grazing, which

removes the fine fuels needed to carry fire and fire suppression (Madany and West 1983, Savage and Swetnam 1990, Swetnam 1990, Touchan et al. 1995, Swetnam and Baisan 1996, Belsky and Blumenthal 1997, Gresswell 1999). Historical wildfires were primarily cool-burning understory fires with return intervals of 3 to 7 years in ponderosa pine (Swetnam and Dieterich 1985). Cooper (1960) concluded that prior to the 1950s; crown fires were extremely rare or nonexistent in the region.

Effects of fire may be direct and immediate or indirect and sustained over time (Gresswell 1999). The cause of direct fire-related fish mortalities has not been clearly established. Fatalities are most likely during intense fires in small, headwater streams with low flows (less insulation and less water for dilution) (Gresswell 1999). In these situations, water temperatures can become elevated or changes in pH may cause immediate death (Cushing and Olson 1963). Spencer and Hauer (1991) documented 40-fold increases in ammonium concentrations during an intense fire in Montana. The inadvertent dropping of fire retardant in streams is another source of direct mortality during fires.

Indirect effects of fire include ash and debris flows, increases in water temperature, increased nutrient inputs, and sedimentation (Swanston 1991, Bozek and Young 1994, Gresswell 1999). Ash and debris flows can cause mortality months after fires occur when barren soils are eroded during monsoonal rain storms (Bozek and Young 1994, Brown et al. 2001). Fish can suffocate when their gills are coated with fine particulate matter, they can be physically injured by rocks and debris, or they can be displaced downstream below impassable barriers into habitat occupied by nonnative trout. Ash and debris flows or severe flash flooding can also decimate aquatic invertebrate populations that trout may depend on for food (Molles 1985, Rinne 1996, Lytle 2000). In larger streams, refugia are typically available where fish can withstand the short-term adverse conditions; small headwater streams are usually more confined, concentrating the force of water and debris (Pearsons et al. 1992, Brown et al. 2001).

Increases in water temperature occur when the riparian canopy is eliminated by fire and the stream is directly exposed to the sun. After fires in Yellowstone National Park, Minshall et al. (1997) reported that maximum water temperatures were significantly greater in headwater streams affected by fire than in reference (unburned) streams and subsequent water temperatures often surpassed tolerance levels of salmonids. Warm water is stressful for salmonids and can lead to increases in disease and lowered reproductive potential (Bjornn and Reiser 1991).

Salmonids need clean, loose gravel for spawning sites (Bjornn and Reiser 1991). Ash and fine particulate matter created by fire can fill the interstitial spaces between gravel particles eliminating spawning habitat or, depending on the timing, suffocating eggs that are in the gravel. Increases in water temperature and sedimentation can also impact aquatic invertebrates changing species composition and reducing population numbers (Minshall 1984, Wiederholm 1984, Roy et al. 2003), consequently affecting the food supply of trout.

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 extirpated as a result of ash flows after fire (Rinne 1996, Brown et al. 2001). Consequently, an increase in rain

or snow events, intense precipitation that is unseasonable or heavy precipitation that occurs after fire, could extirpate affected Gila trout.

The conjunction of climate change with ongoing habitat loss and alteration; and nonnative species competition has caused a general loss of resiliency in the ecosystem that has serious consequences for Gila trout.

EFFECTS OF THE ACTION

The S&Gs listed in the proposed Coronado NF LRMP and the 1996 Regional Amendment provides direction for the development of site-specific actions. The Gila trout and streams identified as recovery sites occur in MAs 1, 2, 2a, 4, 7 and 9. Multiple S&Gs within the Coronado NF LRMP are applicable to the Gila trout and its habitat. These S&Gs may result in both indirect and direct effects to the species. Please refer to the 2005 BO/CO for a summary of the S&GS provided to FWS by USFS as applicable to the species.

No new significant scientific information or data have become available that would change the 2004 effects analysis for Gila trout. Based on the 2011 BA (USFS 2011) it was determined that there have been no changes in Forest policy or programs that would change the 2004 BA (USFS 2004) or 2005 BO/CO (FWS 2005) effects determination for the species. The current analysis evaluated all S&Gs identified by the USFS 2011 BA, which includes two new S&Gs identified for the Coronado NF. These additional S&Gs prohibit the use of motor vehicles off the designated road system on the Coronado NF.

In the previous 2005 BO/CO (FWS 2005) we indicated that there was only one S&G that has the potential to have a lethal effect to the Gila trout within the Coronado LRMP within the Watershed Management Program). S&G 678 discusses aquatic resources and states the following: 1) maintain at least 80 percent of natural shade over water surfaces in fish bearing streams; 2) maintain at least 80 percent of natural bank protection; and 3) maintain the composition of sand, silt, and clay within 20 percent of natural levels in fish bearing streams. This S&G provides guidance for management of the riparian resources in the action area. The FWS recognizes that the intent of this S&G is positive; however, this S&G allows a certain amount of riparian habitat to be maintained at less than optimal conditions. For example, if protection of the natural bank is 80 percent, then the assumption is that 20 percent of the streambank is allowed to deteriorate to less than stable conditions. This could result in the streambank collapsing into the stream, thereby increasing sedimentation into the stream channel and lowering water quality by allowing contamination of those streams. As a result, potential effects to the species may include a reduction of invertebrate food supplies, interference with reproduction, and direct mortality.

There are also two S&Gs (792 and 805) that have the potential to have a sublethal effect on Gila trout that are within the Rangeland Management Program. S&Gs 792 and 805 allows the Forest to manage suitable rangeland at Level D. If level D is not achievable, manage at Level A (no livestock) in MA7A and MA7B. Management seeks full utilization of forage allocated to livestock. Cost-effective management systems and techniques, including fencing and water development, are designed and applied to obtain relatively uniform livestock distribution and use

of forage and to maintain plant vigor. The following acres for projected range conditions were provided within the S&G: 15,412 acres (6,237 ha) within satisfactory and 1,712 acres (693 ha() in unsatisfactory conditions.

The LRMP predicts no change in the number of acres in an unsatisfactory condition for MA 7B over a period of 50 years. Unsatisfactory range conditions may contribute to unhealthy watersheds resulting in adverse effects to the species. As stated in the Recovery Plan, one of the primary threats to this species is watershed deterioration. As a result of poor upstream watershed condition, downstream effects could potentially lead to increased erosion into Gila trout habitat, thereby increasing sedimentation into the stream channel and lowering water quality by allowing contamination of those streams. Potential effects to the species may include a reduction of invertebrate food supplies, interference with reproduction, and direct mortality.

The majority of the S&Gs maintain habitat and provide for recovery of this species. Additionally, there are several S&Gs that are beneficial in the long-term but have some short-term adverse effects.

1996 Regional Amendment

The management direction provided by the 1996 Regional Amendment S&Gs was related to the conservation of MSO and northern goshawks. The S&Gs promote healthy forest ecosystems; functioning watersheds; and healthy riparian and aquatic systems (USFS 2004). For a summary of the effects to Gila trout from the applicable 1996 Regional Amendment S&Gs please refer to the 2005 BO/CO. There may be short-term adverse effects to the Gila trout as a result of the implementation of the 1996 Regional Amendment.

S&G 1432 allows no timber harvest except for fire risk abatement in mixed conifer and pine-oak forests on slopes greater than 40 percent where timber harvest has not occurred in the last 20 years. S&G 1445 allows treatment of fuel accumulations to abate fire risk. S&G 1455 directs the Forests to use combinations of thinning trees less than 23 cm (9 in) in diameter, mechanical fuel removal, and prescribed fire. S&G 1458 allows prescribed fire where appropriate within Reserved Lands (Wilderness, Research Natural Areas, Wild and Scenic Rivers, and Congressionally Recognized Wilderness Study Areas). S&G 1468 encourages prescribed fire to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and the risk of crown fire. S&G 1476 directs the Forest to apply ecosystem approaches to manage for landscape diversity mimicking natural disturbance patterns, incorporating natural variation in stand conditions and retaining special features such as snags and large trees, utilizing appropriate fires, and retention of existing old growth in accordance with forest plan old growth S&Gs.

Each of the aforementioned S&Gs permits short-term adverse effects on forested environments in order to secure long-term stability and to create conditions more desirable for the northern goshawk and MSO. The range of the Gila trout is generally situated downstream of much of the habitat occupied by (or suitable for) these raptors and thus, the fish can be expected to experience indirect, short-term adverse effects in exchange for long term habitat stability or improvement.

S&G 1508 allows for low intensity ground fires at any time in all forested cover types, but high intensity crown fires are not acceptable in the post-fledgling family area or nest areas. This S&G directs the Forests to avoid burning the entire home range of a goshawk pair in a single year. For fires planned in the occupied nest area, a fire management plan should be prepared. The fire management plan should minimize the risk of goshawk abandonment while low intensity ground fire burns in the nesting area. Prescribed fire within nesting areas should be planned to move with prevailing winds away from the nest tree to minimize smoke and risk of crown fire developing and driving the adults off or consuming the nest tree.

S&Gs 1432, 1445, 1455, 1458, 1468, 1476 and 1508 are all related to the fuels treatment for fire risk abatement. As discussed previously, there are potential short-term effects from fuels treatments; however, the beneficial effect of reduced catastrophic fire risk far outweighs those short-term adverse effects.

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.

The one watershed occupied by Gila trout occurs entirely within the NF. As such, no cumulative effects were identified.

CONCLUSION

After reviewing the current status of the Gila trout, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's BO that the proposed action will not jeopardize the continued existence of the Gila trout or its recovery. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. No CH has been designated for the species; therefore, none will be affected.

The FWS anticipates adverse effects to the Gila trout from the implementation of the Coronado NF LRMPs, as well as the 1996 Regional Amendment. However, the FWS does not believe the impacts of the proposed action will rise to the level of jeopardy for the species. The FWS bases this conclusion on the following reasons:

- The status of the Gila trout has been downlisted because three of the four original pure population lineages are currently protected and replicated in 67 mi (109 km) of stream; each replicate is geographically separate from its remnant population.

- An Emergency Plan (Plan) has been developed and implemented. This Plan addresses wildfire-related impacts and nonnative salmonid invasion (FWS 2006b).

- Recovery actions by the USFS in the past have included stocking Gila trout into multiple creeks and watersheds in the last 10 years in coordination with the FWS, NMDGF, and AGFD. These populations are currently being monitored for survival, and impacts on the populations due to drought and overall stream condition to assess recovery efforts in implementing the recovery plan.

- The Coronado NF, in cooperation with the AGFD and FWS, has completed nonnative salmonid removal and established new Gila trout populations.

- There are S&Gs that support conservation and recovery of Gila trout. These S&Gs guide the USFS to implement recovery plans, improve habitat for T&E species, and to delist T&E species.

Proactive efforts by the USFS in the past and the continued monitoring of those actions have contributed positively to the overall status of the Gila trout such that the trout was downlisted from endangered to threatened in 2005 (FWS 2005). Although several S&Gs may cause lethal or sublethal responses to the Gila trout and result in take of individuals, implementation of these S&Gs would not cause jeopardy to the species because all the actions described above, together with, the implementation of the beneficial S&Gs outlined above should not result in a decline in population numbers or habitat conditions of Gila trout on NFS lands in the Southwest. For these reasons, the FWS concludes that the proposed action will not jeopardize the continued existence of Gila trout or its recovery.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the FWS 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 which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the USFS so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity

covered by this incidental take statement. If the USFS 1) fails to assume and implement the terms and conditions or 2) fails to require adherence to the terms and conditions included in the incidental take statement through enforceable terms that are added to the permit or grant document issued by the USFS, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USFS must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement. [50 CFR 402.14(i)(3)].

Amount or Extent of Take Anticipated

Incidentals take of Gila trout is reasonably certain to occur as a result of the continued implementation of the Coronado NF LRMP. On the Coronado NF, take in the form of harm and harassment of Gila trout is expected. Harassment to individual fish may occur from activities conducted within occupied streams. Harm to the species occurs through activities that alter the suitability of the habitat to support Gila trout and activities that improve habitat to support nonnative trout species, which may prey on Gila trout.

The FWS anticipates incidental take of Gila trout will be difficult to detect because finding a dead or impaired specimen is unlikely and losses may be masked by seasonal fluctuations in environmental conditions and fish numbers. Although we cannot estimate the number of individual trout that will be incidentally taken, we are providing a mechanism to quantify when take would be considered to be exceeded at the population level. For purposes of this BO, we define incidental take in terms of the number of extant populations. The only extant population within Coronado NF is Frye Creek. The FWS concludes that incidental take of Gila trout will be considered to be exceeded if, during a period of 3 consecutive years, there is a loss of any currently extant population of Gila trout on Coronado NF lands as a result of the proposed action.

Effect of the Take

In the accompanying BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the Gila trout.

REASONABLE AND PRUDENT MEASURES

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the Gila trout:

1. Minimize or eliminate adverse effects of Gila trout on the Coronado NF lands due to LRMP activities.

2. Minimize or eliminate adverse effects to Gila trout habitat on the Coronado NF lands due to LRMP activities.

3. Monitor the impacts of the proposed action on Gila trout populations on the Coronado NF.

TERMS AND CONDTIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the USFS must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1.1 Manage riparian areas adjacent to and upstream of Gila trout populations in order to minimize direct effects and indirect effects to Gila trout and its habitat. This should be applied to current extant populations identified above, as well as recently introduced and future replicate Gila trout populations in the action area as identified in the Gila Trout Recovery Plan.

1.2 Develop and implement projects in LRMP programs within the Coronado NF with the goal of minimizing or eliminating adverse effects to Gila trout.

The following terms and conditions will implement reasonable and prudent measure 2:

3.1 Develop and implement projects in occupied Gila trout habitat or potential repatriation sites with the goal of minimizing or eliminating adverse effects to Gila trout habitat.

The following terms and conditions will implement reasonable and prudent measure 3:

3.1 The Coronado NF shall monitor incidental take resulting from the proposed action and report their findings to the FWS. Incidental take (implementation) monitoring shall include information such as when or if the project was implemented, whether the project was implemented as analyzed in the site-specific BO (including CMs, and BMPs), breeding season(s) over which the project occurred, relevant Gila trout survey information, and any other pertinent information about the project's effects on the species.

3.2 Annual reports, which will include this species, shall be sent to the appropriate local FWS Ecological Services field office by March 1st of each year.

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 USFS must immediately provide an

explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. In cooperation with AGFD and the FWS, remove all nonnative species affecting the Gila trout and take measures to prevent reoccurrence of nonnative species from identified recovery stream segments.

2. In cooperation with AGFD and the FWS, secure, renovate, and maintain streams in order to provide additional habitat for Gila trout.

3. Populations of Gila trout should continue to be replicated into streams that are geographically separate to increase the range of the species and streams that are within watersheds of currently occupied habitat to ensure that natural or human-induced disasters do not extirpate the populations.

4. Implement recovery actions identified in the Gila Trout Recovery plan, and emphasize efforts in replicating Spruce Creek and Gila-San Francisco lineages.

In order to be kept informed of action minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations in the annual report.

LOACH MINNOW

STATUS OF THE SPECIES RANGEWIDE

Loach minnow was listed as a threatened species on October 28, 1986 (FWS 1986). However, we determined in 1994 that reclassifying loach minnow to endangered status was warranted but precluded (59 FR 35303, July 11, 1994), and restated this conclusion on January 8, 2001 (66 FR 1295). We reanalyzed the determination each year in our Candidate Notice of Review, and determined that reclassification to endangered is warranted, in the Candidate Notice of Review published on November 9, 2009 (74 FR 57804). In 2010, we published a proposed rule to reclassify loach minnow to endangered status (75 FR 66482). During the preparation of this BO,

the proposed rule changing the loach minnow's status from threatened to endangered was finalized on February 23, 2012 (77 FR 10810).

Critical habitat for the loach minnow was originally designated on March 21, 2007 (FWS 2007). The 2007 designation included as CH portions of the East Fork Black River, North Fork East Fork Black River, Coyote Creek, and Boneyard Creek; Aravaipa Creek and its tributaries Deer and Turkey creeks; the San Francisco River and its tributary Whitewater Creek; Eagle Creek, the Blue River and its tributaries, Campbell Blue Creek, Little Blue Creek, Dry Blue Creek, Pace Creek, and Frieborn Creek; the Tularosa River and its tributary, Negrito Creek; ; the Gila River, and its tributaries West, Middle, and East Forks. Following a legal challenge to that designation, we filed a motion for voluntary remand in 2009 and began re-evaluating critical habitat. Those areas originally designated as CH in the 2007 rule remained in place until the new designation was finalized. As mentioned above, USFWS published the final rule reclassifying the species as endangered and revising the loach minnow's designated CH on February 23, 2012 (77 FR 10810). The final rule became effective on March 26, 2012. While there are some differences between the 2007 designation and the 2012 revised designation, much of the geographic area included for loach minnow CH is the same in both proposals. Specific details regarding the areas included as designated CH can be found in these rules. Key features, or PCEs for loach minnow are: 1) Habitat to support all egg, larval, juvenile, and adult loach minnow; (2) An abundant aquatic insect food base; (3) Streams with no or no more than low levels of pollutants; (4) Perennial flows, or interrupted stream courses that are periodically dewatered but that serve as connective corridors when wetted; (5) No or low levels of nonnative aquatic species that allow for persistence of loach minnow; and (6) Streams with a natural, unregulated flow regime that allows for periodic flooding or, if regulated, that allows for adequate river functions. Additional details on each of these PCEs are found in the CH rule.

Loach minnow is a small fish from the minnow family Cyprinidae. Loach minnow are olive colored, and highly blotched with darker spots. Whitish spots are present at the front and back edges of the dorsal fin, and on the dorsal and ventral edges of the caudal fin. A black spot is usually present at the base of the caudal fin. Breeding males have bright red-orange coloration at the bases of the paired fins and on the adjacent body, on the base of the caudal lobe, and often on the abdomen. Breeding females are usually yellowish on the fins and lower body (Minckley 1973, FWS 1991).

The limited taxonomic and genetic data available for loach minnow indicate there are substantial differences in morphology and genetic makeup between remnant loach minnow populations. Tibbets (1993) concluded that results from mitochondrial DNA (mtDNA) and allozyme surveys indicate variation for loach minnow follows drainage patterns, suggesting little gene flow among rivers. The levels of divergence present in the data set indicate that populations within rivers are unique, and represent evolutionarily independent lineages. The main difference between the mtDNA and allozyme data was that mtDNA suggest that the San Francisco/Blue and Gila groups of loach minnow are separate, while the allozyme data places the Gila group within the San Francisco/Blue group. Tibbets (1993) concluded that the level of divergence in both allozyme and mtDNA data indicated that all three main populations (Aravaipa Creek, Blue/San Francisco Rivers, and Gila River) were historically isolated and represent evolutionarily distinct lineages. No genetic information is currently available for loach minnow in the White River system.

Loach minnow is a bottom-dwelling inhabitant of shallow, swift water over gravel, cobble, and rubble substrates (Rinne 1989, Propst and Bestgen 1991). Loach minnow uses the spaces between, and in the lee of, larger substrate for resting and spawning (Propst et al. 1988; Propst and Bestgen 1991; Rinne 1989). It is rare or absent from habitats where fine sediments fill the interstitial spaces (Propst and Bestgen 1991). Some studies have indicated that the presence of filamentous algae may be an important component of loach minnow habitat (Barber and Minckley 1966). Loach minnow feeds exclusively on aquatic insects (Schrieber 1978, Abarca 1987). Loach minnow live two to three years with reproduction occurring primarily in the second summer of life (Minckley 1973, Sublette et al. 1990). Spawning occurs March through May (Britt 1982, Propst et al. 1988); however, under certain circumstances loach minnow also spawn in the autumn (Vives and Minckley 1990). The eggs of loach minnow are attached to the underside of a rock that forms the roof of a small cavity in the substrate on the downstream side. Limited data indicate that the male loach minnow may guard the nest during incubation (Propst et al. 1988, Vives and Minckley 1990). Additional details on habitat preferences are provided in the 2007 CH designation (72 FR 13356), the proposed rule for CH designation from 2010 (75 FR 66482), and the recently-published final rule for CH designation (77 FR 10810).

Loach minnow are believed to occupy approximately 15 to 20 percent of their historic range, and are now restricted to portions of the Gila River and its tributaries, the West, Middle, and East Fork Gila River (Grant, Catron, and Hidalgo Counties, New Mexico) (Paroz and Propst 2007, p. 16; Propst 2007, pp. 7–8, 10–11, 13–14); the San Francisco and Tularosa rivers and their tributaries Negrito and Whitewater creeks (Catron County, New Mexico) (Propst et al. 1988, p. 15; ASU 2002; Paroz and Propst 2007, p. 16; Propst 2007, pp. 4–5); the Blue River and its tributaries Dry Blue, Campbell Blue, Pace, and Frieborn creeks (Greenlee County, Arizona and Catron County, New Mexico) (Miller 1998, pp. 4–5; ASU 2002; Carter 2005, pp. 1–5; C. Carter, AGFD, pers. comm. 2008a; Clarkson et al. 2008, pp. 3–4; Robinson 2009, p. 3); Aravaipa Creek and its tributaries Turkey and Deer creeks (Graham and Pinal Counties, Arizona) (Stefferud and Reinthal 2005, pp. 16–21); Eagle Creek (Graham and Greenlee Counties, Arizona), (Knowles 1994, pp. 1–2, 5; Bagley and Marsh 1997, pp. 1–2; Marsh et al. 2003, pp. 666–668; Carter et al. 2007, p. 3; Bahm and Robinson 2009a, p. 1); and the North Fork East Fork Black River (Apache and Greenlee Counties, Arizona) (Leon 1989, pp. 1–2; M. Lopez, AGFD pers. comm. 2000; S. Gurtin, AGFD, pers. comm. 2004; Carter 2007a, p. 2; Robinson et al. 2009, p. 4); and possibly the White River and its tributaries, the East and North Fork White River (Apache, Gila, and Navajo Counties, Arizona).

Our information indicates that, rangewide, more than 390 consultations have been completed or are underway for actions affecting spikedace and loach minnow, which often co-occur. The majority of these opinions concerned the effects of road and bridge construction and maintenance, grazing, water developments, fire, species control efforts, or recreation. There are a high number of consultations for urban development and utilities, however, these projects typically do not result in adverse effects to the species but are for technical assistance only. Small numbers of projects occur for timber, land acquisition, agriculture, sportfish stocking, flooding, Habitat Conservation Planning, native fish restoration efforts, alternative energy development, and mining.

The status of loach minnow is declining rangewide. Although it was originally listed as threatened, the FWS determined in 1994 that a petition to uplist the species to endangered status was warranted but precluded (FWS 1994). The FWS confirmed this decision in 2008 (FWS 2008). As noted above, we published a proposed rule to for redesignation of CH as well as reclassification of loach minnow to endangered status in October 2010, and the final rule was published on February 23, 2012, and became effective on March 26, 2012.

Recovery Actions Rangewide

The Loach Minnow Recovery Plan (U.S. Fish and Wildlife Service 1991) was completed in 1991. Recovery goals include protection of existing populations, restoration of populations in portions of historic habitat, and eventual delisting, if possible. The Recovery Plan is currently being revised by a new recovery team, which was convened in 2011 and began meeting in 2012. We anticipate that a new recovery plan will be released within approximately two years.

The following recovery efforts for the loach minnow have been conducted by NFs in Region 3 (USFS 2004). Many of these recovery efforts were implemented as part of the "seven species direction" (USFS 1997). Riparian areas on NFS lands have been excluded from livestock grazing to protect habitat along the Gila, Mangas Creek, Bear Creek, San Francisco, Tularosa River, Negrito Creek, Verde, Blue, North Fork East Fork Black Rivers, and Campbell Blue and Eagle Creeks. Forest Road 586 on the Apache-Sitgreaves NF was obliterated to reduce sediment input to Boneyard Creek which is a tributary to occupied habitat in the North Fork East Fork Black River. A fish barrier is under construction on the Blue River, which completion anticipated for late spring 2012. The barrier will help to prevent the upstream movement of non-native predators and competitors. Off-highway vehicles can cause significant damage. Areas to focus efforts to control and enforce existing regulations on the Prescott NF have been identified.

ENVIRONMENTAL BASELINE

Status of the Species within the Action Area

The loach minnow is not currently found on the Coronado NF; however, a population does occur downstream in Aravaipa Creek, Arizona. At the request of the USFS, the applicable S&Gs were analyzed for their effects on the loach minnow in the event this species were to become established on the Coronado NF or it is present but currently undetected. Were the loach minnow in fact currently present on the Coronado NF, most of the S&Gs would maintain habitat and provide for recovery of this species. There are a few S&Gs that may result in potential lethal and sublethal effects to the species. Additionally, there were several S&Gs that are beneficial in the long-term, but would likely have some short-term adverse effects. As it stands, no applicable S&Gs are likely to result in either direct or indirect downstream effects to the loach minnow because the species is not known to occur on the Coronado NF.

Factors Affecting the Species within the Action Area

Loach minnow and its designated CH may be affected on NFs by groundwater pumping, watershed conditions, stormwater runoff, non-native fish species, livestock grazing, timber harvest, wildfire, recreational activities, and other habitat alterations.

EFFECTS OF THE ACTION

Since the 2004 BA for The Continued Implementation of the LRMP for the 11 NFs and NGs, no new significant scientific information or data has become available that would change the 2004 effects analysis for loach minnow and designated and proposed CH for the Coronado NF. Accordingly, the following effects analysis is consistent with the USFS's 2004 BA and 2008 BA, and the FWS's 2005 BO/CO and 2010 BO.

The S&Gs listed in the Coronado NF LRMPs and the 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs within these LRMPs are applicable to the loach minnow and its habitat. These S&Gs may result in both indirect and direct effects to the species.

The loach minnow is not currently found on the Coronado NF; however, a population does occur downstream in Aravaipa Creek, Arizona. At the request of the USFS, the applicable S&Gs were analyzed for their effects on the loach minnow in the event this species were to become established on the Coronado NF or it is present but currently undetected. Were the loach minnow in fact currently present on the Coronado NF, most of the S&Gs would maintain habitat and provide for recovery of this species.

There are a few S&Gs that may result in potential lethal and sublethal effects to the species. Additionally, there were several S&Gs that are beneficial in the long-term, but would likely have some short-term adverse effects. As is stands, no applicable S&Gs are likely to result in either direct or indirect downstream effects to the loach minnow.

<u>Fire Management Program</u>
Standard and Guideline 695 allows the Coronado NF to conduct fire suppression activities in a way to protect watershed and visual resource values. Although this S&G exists, fire suppression is not part of the proposed action for this project and therefore will not be analyzed in this consultation. The effects of fire suppression are addressed during emergency consultations.

Standards and Guidelines 713, 798, and 812 allow for the use of prescribed fire to reduce fuel hazards, enhance wildlife values and visual resources, improve livestock forage and watershed condition. All three of these S&Gs are the same for different MAs. Short-term effects of prescribed fire include direct effects of the fire itself (ash) as well increased inputs of sediment as a result of initial soil disturbing activities from the construction of fire lines and the presence of vehicle traffic (i.e. engines). These effects are short-term and the S&Gs are considered beneficial because the long-term result is a reduction in the risk of catastrophic wildfire.

<u>Forestry and Forest Health Program</u>
Standard and Guideline 699 and 702 allow for the use of chemicals within the guidelines approved by other agencies for the purpose of insect and disease control on timber and rangelands as well as allowing the use of cyanide leaching as part of mining operations. Considering cyanide leaching has not been conducted on the Coronado NF in over twenty years, it is extremely unlikely there will be negative effects resulting from this S&G. Pesticides and

herbicides are selected for their biocidal properties and are applied to kill or control organisms. Thus, they are all toxic to some forms of life. Pesticides may be introduced into natural aquatic systems by various means: incidentally during manufacture, during their application (i.e., through aerial spray drift), and through surface water runoff from agricultural/range land after application.

A number of generalizations can be made about pesticides and herbicides. First, effective pesticides and herbicides are designed to be selective in their effects: they are extremely toxic to some forms of life and relatively harmless to others. Few are absolutely specific to their target organisms, so other related and unrelated species may be affected. Second, the mode of application of pesticides varies according to the circumstances. Third, in stagnant lentic (i.e., non-flowing) aquatic systems, certain pesticides are more likely to be persistent at low levels (Rand et al. 1995).

Runoff that may contain pesticides and herbicides could cause sublethal toxic effects in a species, affecting hormone regulation, reproduction, and embryonic development. Pesticides may affect not only aquatic species larval development, but also adult immune systems, rendering organisms more susceptible to disease. With fewer healthy adults in the breeding population, fewer young will be produced, and of those produced, more offspring will not develop normally. Constant pesticide applications that affect immune system development can only suppress an already small population as those characterized by an endangered or threatened species (Pattee et al. 2003).

Watershed Management Program

Standard and Guideline 678 provides guidance in the management of the aquatic resources on the Coronado NF. The FWS believes the intent of this S&G to be positive. However, due to the conditions of these arid landscapes, the continued decline of the species, and the continual threat of drought, this S&G may be no longer adequate for maintaining habitats capable of supporting loach minnow.

Standard and Guideline 677 directs the Forest to complete classifications and inventories of all riparian areas, and complete action plans to improve all unsatisfactory riparian areas. In addition it directs the Coronado to improve all riparian areas to satisfactory or better condition by the end of Period 5. Although this S&G is definitely beneficial as it is moving toward satisfactory riparian conditions, there may be some short-term adverse effects that could be occurring and may continue to occur until such a time as that riparian habitat reaches satisfactory conditions. Refer to the discussion under the Wildlife Program for adverse effects to fish from less than satisfactory riparian habitats.

Standard and Guideline 711, 782, 794, and 807 direct the Forest to restore damaged watersheds to satisfactory watershed condition. Water and soil resources improvements may consist of channel stabilization and revegetation using native or non-native species. All these S&Gs are the same but they are applied to different management units. They allow for short-term, temporary impacts to water quality and watershed condition in exchange for longer-term improvement in watershed condition, sediment reduction, and riparian status.

Rangeland Management Program

Standards and Guidelines 792 and 805 allow the Forest to manage suitable rangeland at Level D in MA7A and MA7B. If level D is not achievable, manage at Level A (no livestock). Management seeks full utilization of forage allocated to livestock. Cost-effective management systems and techniques, including fencing and water development, are designed and applied to obtain relatively uniform livestock distribution and use of forage and to maintain plant vigor. The following acres for projected range conditions were provided within the S&G: 15,412 acres within satisfactory and 1,712 in unsatisfactory conditions.

The LRMP predicts no change in the number of acres of unsatisfactory condition for MA 7B over a period of 50 years. Unsatisfactory range conditions may contribute to un-healthy watersheds resulting in adverse effects to the species. As stated in the recovery plan, one of the primary threats to this species is watershed deterioration. As a result of poor upstream watershed condition, downstream effects could potentially lead to increased erosion into loach minnow habitat, thereby increasing sedimentation into the stream channel and lowering water quality by allowing contamination of those streams. Potential effects to the species may include a reduction of invertebrate food supplies, interference with reproduction, and direct mortality. Although loach minnow do not occur on the Coronado NF, these watersheds occur upstream of occupied loach minnow habitats.

The short lifespan of the loach minnow, coupled with the comparatively low fecundity of the species and the small population sizes makes it vulnerable to serious adverse effects from activities which may only impact the species' habitat for relatively short time periods, especially during the spawning season. Any situation that eliminated or greatly reduced a year-class would severely deplete recruitment to a population. For example, excessive sedimentation during the spawning season might suffocate a large portion of that year's reproductive effort. In the succeeding year, total reproductive effort would be diminished. The net effect would be a major reduction in population size (Propst et al. 1988). The way in which the effects of livestock grazing are manifested and the magnitude of the effects in the watershed is dependent on local site conditions.

Standard and Guideline 829 states that riparian areas will be managed to achieve and maintain satisfactory riparian conditions as described in the forest-wide prescription. This may be accomplished through the use of structural improvements, movement of livestock, or the exclusion of livestock. This S&G may result in some short-term adverse effects during the construction of structural improvements. In addition the movement of livestock could also cause adverse effects if they are trailed through the riparian area. However, these effects would be localized and short-term and would contribute to the overall health of the riparian habitat in the long-term.

Wildlife, Fish, and Rare, Plants Program

Standard and Guideline 667 allows for the use of structural and nonstructural improvements to meet the specific wildlife habitat objectives as shown for each MA. Nonstructural Wildlife Improvements may include: 1) prescribe burn feasible areas on a 20-year cycle; 2) seed suitable wildlife forage species as needed in fuelwood and timber areas; 3) transplant listed T&E and other identified species into suitable habitat following guidelines of species recovery plans and

Memoranda of Understanding; 4) revegetate wildlife areas with wildlife forage, cover, and riparian species (native species should be used when available); and 5) thin or patch cut an average of 10 acres of aspen, gambel oak, and timber species per year.

Standard and Guideline 668 also allows for the use structural and nonstructural improvement guidelines as follows: 1) construct water developments or potholes to accomplish one per section within four decades; 2) consider structural improvements and maintenance for T&E species as technology develops; 3) construct fish habitat improvement structures as needed for T&E species; and 4) fence riparian areas where prescribed by approved allotment management plans. Miles of fence constructed will vary with management plan.

The S&Gs 667 & 668 fall into the category of activities that cause short-term adverse effects in order to achieve long-term positive effects; a net beneficial effect. Standard and Guideline 667 allows for prescribed burning. While it is advantageous to reduce the risk of catastrophic wildfire, the prescribed fire itself may have short-term impacts on water quality in adjacent streams inhabited by loach minnow. Standard and Guideline 668 also allows for short-term, temporary impacts from the construction of habitat improvements and fencing. These impacts may include direct mortality of fish as well as indirect impacts to the habitat such as temporary alterations of stream flow, or short-term isolated increases in sediment entering the stream. However, in the long-term implementation of these S&Gs should reduce the risk of catastrophic wildfire.

1996 Regional Amendment

Short-term adverse effects to the loach minnow may occur from the implementation of the 1996 Regional Amendment. However, the majority of the S&Gs within the 1996 Regional Amendment maintain habitat and provide for recovery of the species. Also, we found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

The following S&Gs under the 1996 amendment are those that will ultimately result in a long-term beneficial effect; however there may be some potential short-term adverse effects. They are 1432, 1445, 1448, 1455, 1458, 1468, 1476, and 1508. All these S&Gs direct the Forests to use prescribed fire as a tool for fire risk abatement as well as thinning and other fuels management activities. Potential short-term effects include those associated with ground disturbance (i.e., sedimentation) as well as those from the fire itself. See previous discussion under the Fire Management Program, Coronado NF for discussion of those effects.

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.

Residential and commercial development on lands within watersheds containing T&E native fishes, are cumulative effects and can adversely affect the species through a variety of avenues.

Cumulative effects to native fishes include ongoing activities in the watersheds in which the species occurs such as livestock grazing and associated activities outside of federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization without a federal nexus, and recreation. Some of these activities, such as irrigated agriculture are declining and are not expected to contribute substantially to cumulative long-term adverse effects to native fishes.

Other activities, such as recreation, are increasing. Increasing recreational, residential, or commercial use of the non-federal lands near the riparian areas would likely result in increased cumulative adverse effects to occupied, as well as potentially-occupied native fish habitat through increased water use, increased pollution, and increased alteration of the streambanks through riparian vegetation suppression, bank trampling, and erosion.

CRITICAL HABITAT EFFECTS ANALYSIS

A complete list of the S&Gs that may affect loach minnow CH can be viewed in Appendix H of the April 2005, BO (Consultation #2-22-03-f-366).

Engineering Program

The Engineering Programs on the NFs with loach minnow CH or watersheds that drain into CH (i.e., the Coronado NF) manage roads, facilities and structures. Degradation and destruction of loach minnow CH may take place directly or indirectly as the result of road, facility, or structure construction or maintenance. In general, S&Gs do not exist in the LRMPs for facility or structure construction or maintenance. The lack of S&Gs that prevent effects to the loach minnow CH and the varying nature of such projects may make it necessary to address these activities at the project-level. Region-wide, the administration of the variety of roads on NF lands has the most direct link between management activities and CH effects. Although the LRMPs generally lack S&Gs directly related to the Engineering Program, S&Gs do exist in other programs (e.g., Watershed) that are directly related to activities administered by the Engineering Program, primarily roads. The FWS and the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) recommendation is that a given watershed should have less than 2.5 mi/mile^2 of road system; if in excess, the watershed is said to be not properly functioning. The FWS ranked S&G 63 as being an adverse effect because of the potential for increased run-off and other pollutants from high road densities possibly entering loach minnow CH.

As stated in the April 2005, BO, road density is defined as the total miles of road in a defined area divided by the defined area in square kilometers (miles). The analysis in the BO recognizes that the numbers that were being evaluated were the known system roads and that the non-system (unclassified) roads were unknown. Therefore, the total road densities represented in the BO do not include the non-system roads. As noted above, road density is used by the FWS and the NOAA Fisheries as one way to measure watershed condition as it relates to resident fish in the Pacific Northwest. The joint agencies', recommendation is that a given watershed should have less than 2.5 mi/mile^2 of road system; if in excess, the watershed is said to be not properly functioning.

The Coronado NF LRMP guides the NF to develop a transportation system at a minimum to adequately meet management, protection, and utilization needs (S&G 693). Existing roads will be maintained primarily to protect investment and resources, provide user safety, and user economy (S&G 694). S&G 694 guides the NF to close roads if maintenance cannot be performed due to budget constraints if the road is causing "unacceptable" resource damage. Implementation of this S&G may result in effects to loach minnow CH downstream if not implemented simultaneously with BMPs such as those included in S&Gs 785 and 785a. S&G 785a and 785 direct the NF to maintain roads or close, drain, and revegetate roads and trails that are determined to be unneeded for further use in MA 4. MA4 consists of areas designated for Level D livestock grazing, game habitat, and fuelwood harvest. This encompasses a large amount of area within the watershed that drains into CH for the loach minnow. Additionally, S&G 810 and 842 direct the NF to avoid new road development in riparian areas. A significant amount of guidance is contained within the LRMP for avoiding effects to CH from roads. Depending on how the S&Gs are implemented, the PCEs that address increased sedimentation and quality of habitat may be adversely affected by those S&Gs as discussed above.

Fire Management Program

The Coronado NF LRMP has one Forest-wide S&Gs identified for potential effects to loach minnow that are applicable to the Fire Management Program. Forest-wide S&G (703) describes the use of prescribed fire as one tool which may be used to control invading plants potentially resulting in short-term effects to CH but ultimately resulting in habitat devoid of undesirable plant species. The NF is directed to use prescribed fire (S&G 713) to reduce fuel hazards, enhance wildlife values, and enhance visual resources in several different MAs. S&G 713 directs the Forest to enhance wildlife habitat and watershed condition in wet deciduous and wet coniferous riparian and dry desert and dry oak riparian areas. In general, guidance provided by the LRMP should assist in minimizing or under certain circumstances, avoiding adverse effects to the loach minnow CH.

Forestry and Forest Health Program

The Coronado NF LRMP has few S&Gs that specifically address the Forestry and Forest Health Program and the interaction with listed species and CH. S&G 704 states that “Threatened, endangered, and sensitive species habitat requirements will take precedence over vegetation manipulation to control insects and disease.” Otherwise, implementation of program activities is permitted with no direction under the LRMP to consider impacts to federally listed species or their CH. Due to the distance from timberlands on the Coronado to the CH and the guidance provided through S&G 704, effects to loach minnow CH are insignificant or discountable.

Lands and Minerals Program

The Coronado NF LRMP contains S&Gs that address impacts associated with roads, and recommends mineral withdrawals for certain MAs, maintenance of withdrawals in others, and prohibition for mineral materials removal in others.

Rangeland Management Program

The Coronado NF LRMP seeks to provide livestock grazing on a sustainable basis and maintaining or improving riparian and watershed conditions. Indirect effects to CH may take

place as the result of the implementation of S&Gs pertinent to rangeland management, but effects may be considered insignificant or discountable due to the distance of (5.8 km or 3.6 mi) CH from NF boundaries.

Recreation, Heritage, and Wilderness Programs

Standard & Guideline 692 may have a minimal impact to loach minnow CH due to the emphasis placed on "water-oriented property" lands acquisition within NF boundaries. S&G 692 guides the Forest to acquire property for much needed high quality public recreation use, as well as high value wildlife and fish habitat. High recreation use in the riparian areas may create resource conflicts not realized when the property was in private ownership and may cause downstream effects to loach minnow CH. S&Gs 612, 613, and 626 guide the Coronado NF to determine capacities for recreation and develop plans for managing these activities with the goal to protect resources from damage caused by recreation, roads, and trails. The use of motorized vehicles is restricted to existing roads and trails in some MAs and recommends closure if not needed (e.g., MA1, S&G 705; MA2, S&G 715). This guidance should minimize effects to loach minnow CH.

Watershed Program

The LRMP guidance for the Watershed Program seeks to maintain or improve watershed conditions and maintain good water quality. The guidance is cross-program in orientation in that it seeks to mitigate impacts from other program activities. The guidance for the Watershed Program can be used to fill in the gaps for other programs with inadequate guidance. Abundant guidance is provided in the LRMPs to assist the NFs in avoiding or minimizing adverse effects to loach minnow CH.

Standards and Guidelines 672, 782, and 794 within the Coronado NF LRMP guide the Watershed program to improve watersheds. In addition S&Gs 673, 674, 675, and 807 allow for the protection of soils and S&Gs 673, 675, 698, 783, 784, 795, 808 protect water quality and quantity. S&Gs 675, 676, 677, 678, 679, 680, and 681 protect and improve riparian areas and protect resources dependent on riparian areas. S&G 676 guides the NF to “give preferential consideration to resources dependent on riparian areas…”, and can be used to protect all riparian-dependent resources. This S&G (676) states, “Other resource uses and activities may occur to the extent that they support or do not adversely affect riparian-dependent resources.” Implementation of this S&G should result in insignificant and discountable effects to designated loach minnow CH.

Wildlife, Fish, and Rare Plants Program

The intent of LRMP and most of the S&Gs applicable to the Fish, Wildlife and Rare Plants Program is to maintain or improve conditions for wildlife habitat Forest-wide. The S&Gs for this program are often cross-program in nature, therefore, some S&Gs seek to restrict or encourage activities in other programs in consideration of wildlife, fish or rare plants.

1996 Regional LRMP Amendment

The 1996 Regional LRMP Amendment is specific to Forest management within MSO habitat, however, it will potentially contribute to the protection of other imperiled species and their habitats. The amendment addressed several activities in several Resource Programs. One S&G provides guidance for Engineering and Recreation, Heritage and Wilderness Programs. S&G

1437 suggests avoidance of roads or trails in MSO PACs. This restricts the location of road and trail placement that could have varying effects to the loach minnow CH depending on location specifics. Additional guidance is provided for the Recreation, Heritage, and Wilderness Program. S&G 1438 allows recreation to continue at the levels that were occurring prior to the listing of the MSO. Site-specific effects may remain as the result of maintaining those levels of recreation, particularly in riparian areas. S&G 1445, 1454, 1455, 1468, and 1508 apply to fire management and provided the Forests with guidance to treat fuel accumulations to abate fire risk and protect areas important to MSO and northern goshawk. The management of fuels should result in decreased threats or indirect effects to the loach minnow CH in the long-term, but may result in short-term adverse effects. The Forestry and Forest Health Program contains S&Gs that provide guidance primarily targeting timberland in areas that may affect the MSO and the northern goshawk.

This guidance may result in only minor influences on indirect effects to loach minnow CH or may result in neutral or no effect. Guidance provided for riparian areas has a greater influence on effects to loach minnow CH. Standard & Guideline 1473 emphasizes maintenance and restoration of healthy riparian ecosystems and should have beneficial effects to loach minnow CH. S&Gs 1448, 1474, 1477, 1479, 1489, and 1510, within the Rangeland Management Program, have significant influence on activities that may affect loach minnow CH. These S&Gs provide guidance for managing range in good to excellent condition, emphasizing maintenance and restoration of riparian habitats, and maintaining satisfactory soil conditions, hydrologic function, and nutrient cycles. Standard and Guideline 1489 provides guidance for forage use by grazing ungulates such that range conditions will not impede the conservation and recovery of a federally listed species. The implementation of S&Gs contained within the amendment should result in the minimization of potential adverse effects by the Fire Management, Rangeland Management and Forestry Programs.

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.

Residential and commercial development on lands within watersheds containing T&E native fishes, are cumulative effects and can adversely affect the species through a variety of avenues.

Cumulative effects to loach minnow CH include ongoing activities in the watersheds in which the species occurs such as livestock grazing and associated activities outside of federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization without a federal nexus, and recreation. Other activities, such as recreation, residential, or commercial use on non-federal lands near the riparian areas would likely result in cumulative adverse effects to occupied, as well as potentially-occupied native fish habitat through increased water use, increased pollution, and increased alteration of the streambanks through riparian vegetation suppression, bank trampling, and erosion.

CONCLUSION

After reviewing the current status of the loach minnow, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the loach minnow. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

The FWS anticipates adverse effects to the loach minnow from the implementation of the Coronado NF LRMP, as well as the 1996 Regional Amendment. However, the FWS does not believe the impacts of the proposed action will rise to the level of jeopardy for the species. The FWS bases this conclusion on the following reasons:

- The loach minnow does not occur on the Coronado NF.
- There are several S&Gs within the Coronado NF LRMP that support conservation and recovery of the loach minnow. These S&Gs guide the Forest to implement recovery plans, improve habitat for T&E species by structural and non-structural means, and to delist T&E species.
- One S&G for the Coronado NF may substantially reduce or eliminate adverse effects to listed species and CH for all Coronado NF programs. The 1996 Regional LRMP Amendment essentially reduces the effects caused by the Forestry and Forest Health and Rangeland Management Programs for all NFs.

Although incidental take may occur through time if sites on the Coronado NF become occupied, incidental take of individuals during site-specific project activities is not expected to be appreciable due to the distance of currently occupied habitat from the Coronado NF. For this reasons, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of loach minnow.

Critical Habitat

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss,

when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the CH to satisfy essential requirements of the species" (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998:4-34).

After reviewing the current status of loach minnow CH, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our opinion that the continued implementation of the Coronado NF LRMP is not likely to destroy or adversely modify CH for loach minnow. Several activities conducted under several programs could result in adverse effects to loach minnow CH; however, the LRMP contains guidance that seeks to minimize the magnitude of the effects. There is still a potential to implement the LRMP while causing adverse effects to CH. Although the FWS anticipates some adverse effects to loach minnow CH from the implementation of the Coronado NF LRMP, as well as the 1996 Regional Amendment, we do not believe the impacts of the proposed action will result in destruction or adverse modification to loach minnow CH. The FWS bases this conclusion on the following reasons:

- One S&G for the Coronado NF, if adhered to during implementation, should result in no or substantially reduced adverse effects to listed species and CH for all NF programs. The 1996 Regional LRMP Amendment essentially reduces the effects caused by the Forestry and Forest Health and Rangeland Management Programs for all NFs.

It is possible that loach minnow still persist in areas thought to be extirpated and may occur in localities yet to be discovered. Proactive efforts by the USFS in the past and the continued monitoring of their management actions contribute positively to the overall status of the loach minnow and its CH. Activities such as closing roads, removal of non-native fish, establishing a captive breeding program, and the exclusion of cattle from riparian areas continue to contribute toward the improvement of loach minnow habitat. In addition, there are also activities being conducted by other land management agencies to enhance habitat for the loach minnow that benefit its CH rangewide. All the actions occurring throughout the range of the species and its CH along with the implementation of the beneficial S&Gs outlined above should continue to improve habitat conditions on the Coronado NF and avoid any indirect effects to CH currently designated downstream from the Forest boundary. For these reasons, as well as the above analyses, it is the FWS's biological opinion that the proposed action will not alter the ability of the loach minnow designated CH PCEs to function properly. As such, CH for the loach minnow will remain functional to serve its intended conservation role for the species. Therefore, the FWS concludes that the proposed action is not likely to destroy or adversely modify proposed CH for the loach minnow.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Per the Act, "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by

significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) 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 which include, but are not limited to, breeding, feeding, or sheltering. "Incidental take" is defined (50 CFR 402.02) as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

Amount or Extent of Take Anticipated

Given the information available at this time, the FWS is unable to conclude that incidental take of loach minnow is reasonably certain to occur within the Coronado NF during the lifetime of the proposed action. We find this for the following reasons: loach minnow currently do not occur within the external boundaries of the Coronado NF, and it is unlikely that indirect effects of the proposed action will affect the population located downstream of the Forest in Aravaipa Creek. Secondly, if the species is present but not detected, uncertainties on their location and abundance precludes our ability to estimate the method, timing, or location of adverse effects incurred either directly or indirectly from the proposed action.

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the ESA 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. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. Design and implement projects on NFS lands and within the range of loach minnow consistent with the recovery plan. That is, the focus shall be on projects designed specifically for loach minnow recovery and not on incidental take minimization within other projects.

2. Manage streams to create additional habitat for loach minnow.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effect or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

SONORA CHUB

STATUS OF THE SPECIES

Description

The Sonora chub (*Gila ditaenia*) is a stream-dwelling member of the minnow family (Cyprinidae). The Sonora chub is a tenacious, desert-adapted species that exploits small habitats (Hendrickson and Juarez-Romero 1990), and is able to survive under severe environmental conditions. This fish species can achieve total lengths of 7.8 inches (Hendrickson and Juarez-Romero 1990). In the U.S., it typically does not exceed 5.0 inches (Minckley 1973). The body is moderately chubby and dark-colored, with two prominent, black, lateral bands above the lateral line (whence the specific epithet, ditaenia) and a dark, oval basicaudal spot. Breeding individuals are brilliantly colored (Miller 1945).

Legal Status: The FWS listed the Sonora chub in U.S. and Mexico as threatened on April 30, 1986, with CH (U.S. Fish and Wildlife Service 1986). Reasons for listing included possible introduction of exotic fishes and their parasites into its habitat, and potential mining activities. In addition, it is particularly sensitive to these threats because of its very limited range, and because of the intermittent nature of the stream.

Distribution and Abundance

It is difficult to determine if there have been appreciable changes in the species distribution because present-day distribution data are primarily anecdotal, as stated in the 2011 Second Draft 5-year review for the Sonora chub. There is no existing survey protocol for Sonora chub, though development of a rigorous protocol was identified as a recovery task in the Sonora Chub Recover Play. Despite these limitations, we believe that most of the Distribution and Abundance Information has not changed since the 2005 BO/CO so we hereby incorporate that information by reference. Additional information is incorporated from the 2011 Second Draft 5-year Review for the Sonora chub, which states that there are no data to indicate that Sonora chub numbers are increasing or decreasing in abundance within the U.S., nor does it appear that threats have been appreciably ameliorated.

Within the U.S. and at the time of listing and recovery planning, Sonora chub was known to occur only in Sycamore Creek. The AGFD (1995) discovered that a second population of Sonora chub also occurs in California Gulch, a stream located approximately 3 miles west of Sycamore Canyon, and its tributary streams. Together, the populations in Sycamore Creek and California Gulch most likely comprise a metapopulation. California Gulch has been surveyed infrequently since the initial discovery, and Sonora chub are reliably present in suitable habitat from the

International Boundary upstream to the tinaja (a deep, perennial pool situated just below a small dam).

In 2002, Sonora chub were detected in three new locations within the Sycamore Canyon watershed: one site was within an unnamed side canyon, one in Sycamore Canyon proper, and the third was in Atascosa Canyon (FWS 2002).

Hendrickson and Juarez-Romero (1990) surveyed Sonora chub in the Río de La Concepción basin in Sonóra, México and posited that threatened status was appropriate for the peripheral and geographically isolated population of Sonora chub in Arizona while rangewide, the species' status was secure. The current status of Sonora chub in Mexico is unknown, but it is presumed that predatory and competitive nonnative fishes noted by these authors are still present within the species' range there and that drought has affected Sonóra to an extent similar to Arizona.

In the agency's initial report documenting Sonora chub in California Gulch, AGFD (1995) recommended that other drainages in the Rios Altar and Magdalena watershed in the U.S. be investigated. To date, no additional populations of Sonora chub have been confirmed in these waters, though we note that drought conditions have likely reduced the extent of surface water in the region. In May 2006, FWS staff confirmed the continued presence of Sonora chub in the headwaters of the Río Cocóspera at Rancho el Aribabi in Sonora (Duncan 2006). It is presumed that predatory and competitive nonnative fishes are still present there and the drought has also affected the region.

The following information is reiterated from the 2011 BA. The majority of habitat occupied by Sonora chub within the U.S. exists within the Coronado NF, and about one-half of the drainage is within Pajarita Wilderness and Goodding Research Natural Area (RNA). The Coronado NF contains six miles of habitat occupied by Sonora chub. Various agency staff (USFS, FWS, and other entities) have reliably detected Sonora chub, though the upstream limits of the species' occurrence in California Gulch appear to be variable based on the presence of nonnative fish, largemouth bass (*Micropterus salmoides*) in particular (FWS 2010).

The absence of rigorous and repeatable species abundance surveys renders it difficult to definitively determine population trends either through direct measures of abundance or the surrogate of habitat availability. Like Sonora chub surveys in the historical record, the recent survey history is composed primarily of field notes from site visits, many of which were contained in information submitted by AGFD during the preparation of the draft 5-year review for the species (AGFD 2009). Notes from site visits conducted by USFS, FWS, and other entities' staffs indicate that Sonora chub are detected reliably when habitat is available, though the upstream limits of the species' occurrence in California Gulch appears to be variable based on the presence of nonnative fish - largemouth bass (*Micropterus salmoides*) in particular - at the tinaja.

It should be noted also that there is a safety concern associated with surveying for this species. The canyons where it occurs (Sycamore and California Gulch/Warsaw Canyon) are known routes for drug traffickers and undeclared aliens; therefore, border security issues make it difficult to monitor Sonora chub populations. As a result, population surveys are only conducted

in a major pool in the upper end of the canyon. These drainages are negatively impacted by the presence of nonnative species, including green sunfish and bullfrogs. Despite the presence of a large population of bullfrogs, Sonora chub persists in good numbers in Sycamore Canyon. Surveys conducted in 2005, 2006, and 2009, indicate that there was no known net loss of populations detected during the reporting period, nor a reduction of pool or spring habitat (USFS 2008, 2010).

Habitat

In Sycamore Creek, Sonora chub are found in the largest, deepest, most permanent pools (Carpenter 1992). Analysis of habitat use by Sonora chub showed this species preferring deep pools and some amount of floating cover (U.S. Fish and Wildlife Service 1992:11). In Mexico, Sonora chub were not randomly distributed, but were concentrated in deeper areas and under cover. Preferred cover reportedly was fallen logs, areas of dense aquatic vegetation, and undercut root-masses (Miller 1945). These forms of cover were used if associated with intermediate to low current velocity.

Although Sonora chub is regularly confined to pools during arid periods, it prefers riverine habitats. In lotic (i.e., slow moving) waters in Mexico, Hendrickson and Juarez-Romero (1990) found it commonly in pools less than 2 feet deep, adjacent to or near areas with a fairly swift current, over sand and gravel substrates. It was less common in reaches where pools with low velocities and organic sediments were predominate. Sonora chub are adept at exploiting small marginal habitats, and they can survive under severe environmental conditions. It is also apparent that they can maneuver upstream past small waterfalls and other obstructions to colonize newly-wetted habitats (Carpenter and Maughan 1993).

The species evidently maintains a population through use of perennially watered reaches during droughts and is redistributed by dispersal of small individuals during periods of greater discharge (Hendrickson and Juarez-Romero 1990). For example, following periods of drought, Sonora chub recolonized California Gulch from permanent pools located downstream in Mexico, although the fish have dispersed from pools located further upstream in California Gulch.

<u>Critical Habitat</u>: Critical habitat was designated at the time of federal listing to include areas of land and water in the Coronado NF, consisting of the following:

1. Sycamore Creek, and a riparian zone 25 feet wide along each side of the creek, from Yank's Spring downstream approximately 5 stream miles to the International Border with Mexico;

2. Yank's Spring;

3. Penasco Creek, including a riparian zone 25 feet wide along each side of the creek, from its confluence with Sycamore Creek; and

4. An unnamed tributary to Sycamore Creek, from its confluence with Sycamore Creek.

This riparian zone is believed essential to maintaining the creek ecosystem and stream channels, and to the conservation of the species (FWS 1986). Primary constituent elements were not identified in the 1986 Final Rule. However, habitat characteristics important to this species of chub include clean permanent water with pools and intermediate riffle areas, and/or intermittent pools maintained by bedrock or by subsurface flow in areas shaded by canyon walls.

Life History
For a detailed discussion of Sonora chub life history, please refer to the 2005 BO/CO.

Reasons for Listing
The FWS determined the Sonora chub to be threatened on April 30, 1986 (FWS 1986:16042). The rule stated that the fish was threatened by the possible introduction of exotic fishes and their parasites into its habitat, and by potential mining activities. The rule also stated that it is particularly vulnerable to these threats because of its very limited range, and because of the intermittent nature of the streams it occupies.

Threats: The following information is taken from the 2005 BO/CO. According to the 1992 Recovery Plan for this species, distribution of Sonora chub in the U.S. is intact and should remain secure, barring major environmental change (C.O. Minckley 1983, Minckley 1985). The limited distribution of Sonora chub in the U.S. places inordinate importance on the quality of habitat in Sycamore Creek (FWS 1992:14) and California Gulch. The Sycamore drainage has been highly modified by human activities, including grazing, mining, recreation, and the introduction of exotic taxa. It regularly sustains large floods and severe droughts. A series of environmental perturbations made worse by degraded watershed conditions could cumulatively result in extirpation of the species from the U.S.

Sycamore Creek is at the edge of the range of the species, is isolated from other populations of Sonora chub, and has marginal habitat (Hendrickson and Juarez-Romero 1990). Channel degradation, siltation, and water pollution caused primarily by livestock grazing, roads, and mining have probably affected the habitat of Sonora chub. Cattle regularly gain access to Sycamore Canyon through an un-maintained section of fence along the international border (FWS 1999), and degrade the riparian vegetation in the lower 4.0 kilometers (2.5 miles) of the stream (Carpenter 1992). In 1981, exploration for uranium occurred along an approximate 12 kilometer stretch of the upper eastern slopes of the Sycamore drainage. According to the 1992 Recovery Plan for the Sonora chub, uranium was found and claims are being maintained; however, no active mining was planned at that time.

Native fishes appear adept at maintaining populations during severe conditions so long as their habitats are unaltered (Minckley and Meffe 1987). Thus, a single catastrophic event, such as severe flood, fire or drought, is unlikely to eliminate Sonora chub from the U.S.

Predation by non-native vertebrates is also a threat to populations of Sonora chub. Green sunfish *(Lepomis cyanellus)* is a known predator on native fishes in Arizona (Minkley 1973) and has been found in Sycamore Creek below the entrance of Penasco Canyon (Brooks 1982). Coincidental introductions of exotic parasites that infest native faunas are possible when non-native fishes are brought into a drainage. Although little information is available on parasites

and diseases of Sonora chub, the effects of exotic parasites that infest native fish fauna is often adverse (FWS 1992).

Climate Change

The potential effects of climate change on Sonora chub are briefly discussed in the Draft Sonora Chub (*Gila ditaenia*) 5-Year Review: Summary and Evaluation (FWS 2010). Although a summary of that discussion is presented here, the reader is referred to the 2010 Draft 5-Year Review for the full discussion and list of references.

The state of knowledge regarding climate and potential impacts on ecosystems has expanded greatly since Sonora chub was listed in 1986. For aquatic systems, changes in temperature and stream flow are anticipated to reduce the amount of habitat available within the U.S. and degrade habitat conditions throughout the species' range.

Intensified future droughts are anticipated in the American Southwest (Seager et al. 2007) with predictions that the region "…will dry in the 21st century and that the transition to a more arid climate should already be under way." Weiss and Overpeck (2005) state that multi-year or decade-scale changes in precipitation will be difficult to forecast and will affect how ecosystems and watersheds function. These changes will be hard to predict and are likely to occur non-linearly. Therefore, while it appears reasonable to assume that the species may be affected by climate change, there is a lack of certainty as to how climate change specifically will affect Sonora chub beyond loss, reduction, and degradation of habitat. There are no expectations of measurable changes in climate within the temporal bounds of this action.

Recovery Actions

As discussed in the 2004 BA, roadways in Sycamore Canyon south of Ruby road have been obliterated and closed to OHV traffic. In addition, livestock was eliminated from the riparian corridor of Sycamore Canyon, and in portions of the riparian corridor of California Gulch. Sonora chub are also now a primary consideration in the development of allotment management plans for grazing allotments in both Sycamore Canyon and California Gulch, south of Ruby road.

Sycamore Canyon and its tributaries are relatively stable; fuel loads upslope are not excessive, and the stream and its tributaries handle flood events well. California Gulch is more prone to drought, and has far less surface water. Both systems have non-native species. Bullfrogs have become extremely abundant in Sycamore Canyon (but the chub persists), and bullfrogs and warm water game fishes are found in California Gulch. The University of Arizona, USFS, and AGFD have been eradicating bullfrogs in Sycamore Canyon. Because this canyon straddles the Mexican border, there are concerns that borderland security issues may inhibit surveys and conservation efforts (USFS 2008).

The Forest continues to work with Border Patrol, FWS and others to address issues related to border fencing and livestock trespass on NFS land (USFS 2010).

<u>Summary of Rangewide Status of the Sonora chub and critical habitat</u>

Overall, the status of the Sonora chub and its designated CH has not changed significantly range-wide (almost entirely on the Coronado NF), based upon the information we have, since issuance of the 2005 LRMP BO/CO.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, 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 which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

As mentioned above, the Coronado NF contains the majority of the Sonora chub's range in the U.S. Therefore, the reader is referred to the Distribution and Abundance section above for an overview of the species' status in the action area.

Critical Habitat

Critical habitat for the Sonora chub is discussed in the Status of the Species section above. All of the CH for the Sonora chub occurs on land and waters of the Coronado NF. The overall estimated current chub habitat is 10 stream miles in Sycamore/Penasco Creek and California Gulch including a 50-foot wide riparian area along each side of Sycamore and Penasco creeks. In Sycamore Canyon, the chub occurs within the Pajarita Wilderness and Goodding Research Natural Area of the Coronado NF. These special designations help protect a biological community characterized by Mexican floral and faunal elements that do not otherwise occur, or are rare elsewhere, in the U.S. (Goodding 1961, Curran 1973, Smith 1984, U.S Forest Service 1986).

According to the Draft Sonora Chub (*Gila ditaenia*) 5-Year Review: Summary and Evaluation (FWS 2010). it is likely that there has been a reduction in the amount of wetted habitat due to ongoing drought conditions in the region (Arizona Department of Water Resources 2009). Physical habitat conditions likely improved incrementally as a result of the Coronado NF's 1998 project to stabilize Yank Spring in Sycamore Canyon (within which Sonora chub occur) and implement other access changes and erosion control measures. In 1999, a bridge was constructed to replace the low water crossing of Ruby Road at Sycamore Canyon, thus reducing direct mortality of Sonora chub as well as the delivery of sediment to the stream.

Factors Affecting the Species within the Action Area

As described in the 2005 BO/CO, management direction for the Wilderness and RNA units where the Sonora chub occurs is to maintain the area in climax vegetation. Removal of minerals, livestock grazing, use of motorized vehicles, and harvest of timber or fuelwood is not permitted, and recreation is limited to non-developed and dispersed use. Livestock grazing is permitted within Pajarita Wilderness outside of Goodding RNA. This management direction is applicable to Sycamore Canyon portions of habitat within the Gooding RNA and /or wilderness. The remainder of Sycamore drainage and California Gulch is open to multiple uses (USFS 1986).

Sonora chub have been able to survive in this watershed by expanding into riffles, runs, and pools during wet periods, and then shrinking back to deep pools as the stream dries. Mean annual precipitation ranges from about 12 to 22 inches, which comes from gentle rains in winter and high intensity localized thunderstorms in summer (USFS 1988). On an individual basis, a substantial number of Sonora chub die when they become trapped in habitats that do not sustain perennial water during arid periods (Carpenter and Maughan 1993). Recolonization is dependent on individuals that survive dry periods. This species has an amazing capacity for reproduction and recruitment as its habitat expands; it can seemingly explode from a small number of individuals occupying newly-wetted habitats in just a few weeks or months. The capability of the population to increase by several orders of magnitude within a few months is most likely an adaptation to the harsh climate and intermittent nature of its habitat, which has allowed the Sonora chub to survive to the present (Bell 1984).

Native fishes appear adept at maintaining populations during severe conditions so long as their habitats are unaltered (Minckley and Meffe 1987). Thus, a single catastrophic event, such as severe flood, fire or drought, is unlikely to eliminate Sonora chub from the U.S. However, floods in combination with other catastrophic events, such as wildfire, have caused the loss of isolated fish populations in other areas (Propst et al. 1992). Hale and Jarchow (1988) documented the recent and sudden extirpation of Tarahumara frog from the U.S (including Sycamore Canyon). The cause of that extirpation was thought to be an environmental toxicant, possibly associated with acid precipitation.

Bluegill and largemouth bass are competitors with and predators on Sonora chub. We have no information indicating that this threat has increased since the time of listing. Efforts have been taken to remove bullfrogs (*Lithobates catesbeianus*) from areas surrounding Sycamore Canyon and California Gulch. If success is demonstrated, we anticipate a lessening of the risk of predation on Sonora chub. The risk of predation by ranid frogs would not, however, be eliminated, as we note that the intent of bullfrog removal is to encourage proliferation of Chiricahua leopard frogs (*L. chiricahuensis*), lowland leopard frogs (*L. yavapaiensis*), and/or Tarahumara frogs (*L. tarahumarae*).

The FWS has discovered that unknown mining wastes and/or drilling compounds are entering California Gulch from a series of drilling pads immediately across the international boundary in Sonóra from at least November 2009 through October 2010. Visual inspection of these compounds indicates that they are sufficiently fine-grained as to be capable of occluding the gills of Sonora chub. Depending on the chemical compositions, they may be acutely and/or chronically toxic to the species. The discharges may also result in the filling of pools within which Sonora chub seek refuge from intermittently-dry stream reaches and/or embed sediments to the extent that the species' aquatic macroinvertebrate food base is appreciably reduced. In any event, this mine waste discharge represents an additional threat from mining, as had been identified in the Final Rule. The FWS also notes that the relatively recently discovered (AGFD 1995) metapopulation of Sonora chub in California Gulch also exists in a mining district, though levels of activity vary.

During the 2011 fire season, the Murphy fire burned through 68,079 acres that included portions of the Coronado NF (Coronado National Forest, pers. comm., 2011). According to the district biologist, the effects of the fire were related to the fire itself and not the result of fire suppression. It is expected that Sycamore Canyon may be affected by ash and sediment, but only a portion of this watershed burned. Therefore, the USFS stated, and we agree, that they do not believe these effects will significantly change the amount of suitable habitat for this Sonora chub.

Critical Habitat

Water development, including water use by and impacts to water quality from mines, has already been described as a threat to the Sonora chub (FWS 1986, 1992). There are currently-inactive mines located within the watershed of California Gulch and should these be reactivated, there could be impacts to Sonora chub habitat.

As stated above, the Murphy Fire burned through a portion of Sycamore Canyon that included the CH for the Sonora chub. We anticipate that some effects to Sonora chub CH are likely and include ash and sediment, but we do not believe that these effects have significantly altered the CH for Sonora chub.

The study of climate change and its effects on ecosystems has expanded greatly since Sonora chub was listed in 1986. Changes in temperature (Weiss and Overpeck 2005) and stream flow (Seager *et al*. 2007) are anticipated to reduce the amount of habitat available within the U.S. and worsen habitat conditions throughout the species' range. Climate change may therefore result in degraded habitat conditions in the designated CH for the Sonora chub.

EFFECTS OF THE ACTION

The S&Gs listed in the Coronado NF LRMP and 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs within the Coronado NF LRMP are applicable to the Sonora chub and its habitat. These S&Gs, if applied to project-level activities, may result in both indirect and direct effects to the species and its CH.

The 2005 BO/CO included tables showing the S&Gs considered for each species' analysis and a ranking table summarizing the types of effects to species (lethal, sublethal, etc.) expected to result from the S&Gs. Because there have been no changes in Forest policy or programs that would change the 2004 BA (USFS) and 2005 BO/CO (FWS) effects determination for this species, we hereby incorporate by reference the ranking tables and effects analysis presented in the 2005 BO/CO and provide a narrative summary below.

Effects of the Action on the Sonora chub

The 2005 BO/CO estimated that approximately 60 percent of the S&Gs analyzed have a positive impact on the chub. Positive aspects of the LRMP include: a focus on restoration ecology, watershed improvement, and habitat improvement for T&E species; restrictions on OHV uses and livestock grazing in certain MAs; a road density of less than 1mi/mi^2; and a focus on interagency coordination requirements and strategic mineral withdrawals. Yet, several S&Gs found to be beneficial to the Sonora chub potentially have a short-term adverse effect on the species. Additionally, one S&G is likely to have a lethal effect to the Sonora chub, and four

S&Gs are likely to have sublethal effects on the species. These are described in more depth below.

Within the Engineering Program, there is one S&G that could result in sublethal affects to the Sonora chub. This S&G (694) states that road maintenance activities will be conducted primarily for protection of the Forest road investment, resource protection, user safety, and user economy. The S&G goes on to state that funding will continue to be the primary constraint on the intensity of road maintenance efforts. This S&G may result in a sublethal affect to the Sonora chub from decreased water quality due to run-off from the Forest's transportation system. The recovery plan for the Sonora chub states that roads should be constructed and maintained to avoid excessive surface erosion.

The Forestry and Forest Health Program includes S&G 697 that allows chemicals to be used within guidelines approved by other agencies for the purposes of use in recreation areas and administrative sites. This S&G is Forest-wide and, thus, could potentially be lethal to the Sonora chub. Agents within chemicals used as insecticides or rodenticides have been shown to be toxic to fish.

The Rangeland Management Program also includes S&Gs that may result in adverse effects to the Sonora chub. Standard and Guideline 792 allows the Forest to manage suitable rangeland at Level D (high intensity livestock grazing), and if not achievable, to manage at Level A (no livestock). This S&G is within MA 7A and is directed at riparian areas. Standard and Guideline 805 also states to manage suitable rangeland at Level D and if not achievable, to manage at Level A. Livestock grazing activities can contribute to changes in surface runoff quantity and intensity, sediment transport, and water holding capabilities of the watershed. This occurs especially where cattle tend to congregate, often near water sources (Holcheck 1983). As stated in the Recovery Plan for this species, livestock grazing in riparian areas is usually detrimental to fish habitat (U.S. Fish and Wildlife Service 1992).

Standard and Guideline 626 in the Recreation, Heritage, and Wilderness Program, states that transportation and recreation planning will consider existing and future needs for both motorized and non-motorized recreation opportunities. This S&G appears to reflect an emphasis on recreation. Sycamore Canyon receives considerable visitor use, particularly in the riparian area. Hikers and campers desiring to view plants and animals normally associated with habitats in Mexico are drawn to the area. Yanks Spring is the site of a parking area for trailhead access into Sycamore Canyon (USFS 1988a, 1988b). Adverse effects to the species could occur through habitat alteration from increases in human inhabiting the area, or from inadvertently spreading non-natives (e.g., bullfrogs, green sunfish).

In the Wildlife, Fish, and Rare Plants Program, both S&Gs 667 and 668 allows the Forest to use prescribed burning and to construct fish habitat improvement structures as needed for T&E species. The FWS determined that these S&Gs are overall positive for the chub but with some possible short-term effects. Fish habitat improvement structures that will benefit the chub could have short-term negative effects to the species in the form of displacement and disturbance.

Standard and Guideline 709 guides the Forest to delist T&E species and to reoccupy historic habitat with other identified species following guidelines in approved recovery plans. Further, S&G 707 states to maintain and improve current habitat for federally listed plant and animal species and work toward delisting. Obviously, the Sonora chub will benefit from these S&Gs.

Effects of the Action on the Sonora Chub Critical Habitat

As stated in the Status of the Species section, CH for the Sonora chub occurs on the Coronado NF. CH includes: (1) Sycamore Creek, and a riparian zone 25 feet wide along each side of the creek, from Yank's Spring downstream approximately 5 stream miles to the International Border with Mexico; (2) Yank's Spring; (3) Penasco Creek, including a riparian zone 25 feet wide along each side of the creek, from its confluence with Sycamore Creek; and (4) an unnamed tributary to Sycamore Creek, from its confluence with Sycamore Creek. Although this riparian zone is believed essential to maintaining the creek ecosystem and stream channels, and to the conservation of the species, PCEs were not identified in the 1986 Final Rule. However, habitat characteristics important to this species of chub include clean permanent water with pools and intermediate riffle areas, and/or intermittent pools maintained by bedrock or by subsurface flow in areas shaded by canyon walls.

The majority of the S&Gs that may alter these important habitat characteristics are no different than those described in the above section on Effects to Sonora chub. Grazing activities associated with the Rangeland Management Program may result in adverse effects to the Sonora chub CH. Livestock grazing activities can contribute to changes in surface runoff quantity and intensity, sediment transport, and water holding capabilities of the watershed. This occurs especially where cattle tend to congregate, often near water sources (Holcheck 1983). As stated in the Recovery Plan for this species, livestock grazing in riparian areas is usually detrimental to fish habitat (U.S. Fish and Wildlife Service 1992).

As a result of the Recreation, Heritage, and Wilderness Program, effects to Sonora chub could occur due to habitat alteration from increases in human inhabiting the Sycamore Canyon area, or from inadvertently spreading nonnatives (e.g., bullfrogs, green sunfish).

The Watershed Management Program may specifically affect the Sonora chub CH. Standard and Guideline 678 guides the Forest to maintain at least 80 percent of natural shade over water surfaces in fish bearing streams and at least 80 percent of natural bank protection. In addition, this S&G states to maintain the composition of sand, silt, and clay within 20 percent of natural levels in fish bearing streams. This S&G is Forest-wide. The limited range of Sonora chub in Arizona places inordinate importance on ensuring the integrity of riparian conditions in Sycamore drainage. Maintaining 80 percent of natural shade and bank protection may not be sufficient for protection of the chub. However, knowledge of the relationship between the occurrence of Sonora chub and various habitat parameters (e.g., substrate, overhead and instream cover, habitat type, etc) is lacking and needs to be determined (U.S. Fish and Wildlife Service 1992:35).

Standard and Guideline 677 describes improving unsatisfactory riparian areas to satisfactory or better conditions "by the end of Period 5" (i.e., 50 years from the time the LRMP was developed). While we believe that the overall intent of this S&G is positive for the species, the

length of time to achieve satisfactory conditions appears long and thus, the species could be affected by unsatisfactory watershed conditions. The importance of a stable, undisturbed watershed for maintaining the environment cannot be overstated (U.S. Fish and Wildlife Service 1992). Channel degradation, siltation, and water pollution caused primarily by livestock grazing, roads, and mining have probably affected the habitat of Sonora chub. In addition, within the species' CH, characteristics such as clean permanent water with pools and intermediate riffle areas and/or intermittent pools could be altered.

In the Wildlife, Fish, and Rare Plants Program, both S&Gs 667 and 668 allows the Forest to use prescribed burning and to construct fish habitat improvement structures as needed for T&E species. The FWS determined that these S&Gs are overall positive for the chub but with some possible short-term effects. Prescribed burning will be beneficial to the CH for the species with regards to a reduction in the risk of catastrophic wildfire. Short-term effects of prescribed fire include direct effects of the fire itself (ash) as well increased inputs of sediment as a result of initial soil disturbing activities from the construction of fire lines and the presence of vehicle traffic (i.e. engines). These short-term effects may negatively impact CH for the species. Fish habitat improvement structures that will benefit the chub could have short-term negative effects to CH for the species.

Effects of the Action on the Role of Critical Habitat in Sonora Chub Recovery

Recent case law directs the FWS to evaluate the proposed action's effects to both the species and its CH in terms of survival and recovery, to include a determination of at what point a species' recovery would be achieved and whether the proposed action would preclude progress towards that end.

The objective of the Sonora chub Recovery Plan (FWS 1992) is to protect the species as delisting is unlikely to occur due to presence of normative species, degradation of habitat, and continued demand for water for human consumptions. The Recovery Plan, therefore, lacks measurable, objective criteria and, instead, includes recovery objectives to maintain populations in all extant locations, to monitor for presence of nonnative fishes and remove these fish as necessary, to protect existing habitat from degradation, and to implement public education in the U.S. and Mexico. In our draft 5-year review of the status of the Sonora chub (FWS 2010), we determined that the aforementioned objectives are largely qualitative, and the anticipated results of their implementation are similar unquantifiable. Only one recovery task (I.A. – Recognize CH) has been completed for the Sonora chub, and this was done at the time of listing. Regardless, the FWS states in the draft 5-year review that the underlying conclusion based on the history of survey work, albeit unstructured, is that the states of the Sonora chub is unlikely to have measurably declined or improved since 1984, and that the recovery plan should be amended to provide measurable, objective recovery criteria.

In the analyses in the Effects of the Proposed Action section, above, the applicable S&Gs from the Coronado NF, including the S&Gs from the 1996 Plan Amendment, were analyzed individually to determine their effects to the species and CH. The S&Gs were also assigned numeric values during the 2005 consultation based on their effects to the species and/or CH (though not specifically on PCEs as none have been identified), and these amalgamated values are useful for a qualitative analysis of the proposed action's effect to recovery.

Out of the 95 S&Gs affecting Sonora chub, 1.1 percent could cause a lethal response, 3.2 percent could cause a sublethal response, and none could cause a negative behavioral response while 57.9 percent are maintaining habitat and providing some recovery value, 6.3 percent are moving towards recovery, and 9.5 percent are implementing the Recovery Plan. The remaining S&Gs were either open to interpretation or non-discretionary. Of the 6 S&Gs associated with the 1996 Regional Plan Amendment, 16.7 percent are maintaining habitat and providing recovery and the remainder have no application to the species. In summary, across the Coronado NF an appreciably greater proportion of S&Gs are associated with recovery of Sonora chub than with harm and mortality of the species.

While we feel the Coronado NF is working towards the recovery of the Sonora chub, we feel that the status of the species has not measurably improved or declined since the time of listing and, therefore, de-listing is not warranted (FWS 2010). We note, however, that new threats are faced by the Sonora chub since the time it was listed. At the time of listing, threats included habitat loss, nonnative fishes and parasites, and water developments; these threats still exist in both watersheds where Sonora chub occurs. Increasing cross-border incursions and the law enforcement response to them represent a new factor affecting the species. Climate change and water development threaten to alter the hydrologic conditions which sustain the stream where Sonora chub occurs, potentially reducing the species' resilience and ability to persist through stochastic events such as drought and floods. These threatening factors' combined, long-term effect may be to preclude the species' recovery, but none are the result of implementation of S&Gs on the Coronado NF.

For this analysis, we have focused on the ability for the S&Gs to protect the physical and biological factors of the Sonora chub's habitat, including CH, so that the species' natural ecological resilience can continue to ensure its survival and recovery in the wild. Watershed protection initiatives are likely to have short-term adverse effects such as sedimentation while increasing herbaceous ground cover and reducing wildfire risk over the long term. Consultation on USFS grazing allotments focuses on protecting watersheds from excessive impacts. We thus conclude that implementation of the proposed action will not preclude the recovery of the species.

1996 Regional Amendment

As described in the 2005 BO/CO (FWS 2005), the management direction provided by the S&Gs in the 1996 Regional Amendment relates to the conservation of MSOs and northern goshawks. The S&Gs promote healthy forest ecosystems; functioning watersheds; and riparian and aquatic systems (USFS 2004). Northern goshawk MAs and occupied MSO habitats, along with restricted and protected areas for the MSO, do not coincide with the range of the Sonora chub. Thus, only one S&G within the 1996 Regional Amendment is applicable to the species and we determined that this S&G will maintain habitat and provide recovery. We found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

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.

Additional cumulative impacts to the species may occur from Department of Homeland Security cross-border activities along the U.S./Mexico border. The following cross-border activities include, but may not be limited to, the following: human traffic, deposition of trash, new trails from human traffic, soil compaction and erosion, increase fire risk from human traffic, water depletion and contamination, introduction and spread of disease, and interference of survey, monitoring, and research.

Ponds associated with mining operations on private property within the action area may contain non-native fish providing a source of non-native fish into Sonora chub habitat. Natural events such as floods spread non-native species.

CONCLUSION

After reviewing the current status of the Sonora chub, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Sonora chub, and is not likely to destroy or adversely modify designated CH. Pursuant to 50 CRF 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

The FWS concludes that the continued implementation of the Coronado NF LRMP and 1996 Regional Amendment is not likely to jeopardize the Sonora chub for the following reasons:

- The Sonora chub currently exists within Atascosa Wilderness and Research Natural Areas on the Forest.

- The Sonora chub is specifically mentioned within the LRMP directing the Forest to maintain and improve habitat for the species.

- Our analysis determined relatively few S&Gs that could cause lethal or sublethal effects to the species but many that would be positive for the species (e.g., S&Gs 707 and 709), which state that the USFS will work to delist listed species, including the Sonora chub.

- The USFS implemented the following which will continue to provide conservation for the species: roadways in Sycamore Canyon south of Ruby road have been obliterated and closed to OHV traffic; livestock grazing has been eliminated from the riparian corridor of Sycamore Canyon, and in portions of the riparian corridor of California Gulch; and Sonora chub are also now a primary consideration in the development of allotment management plans for grazing allotments in both Sycamore Canyon and California Gulch, south of Ruby road.

As stated previously, native fishes appear adept at maintaining populations during severe conditions so long as their habitats are unaltered. Thus, a single catastrophic event, such as severe flood, fire or drought, is unlikely to eliminate Sonora chub from the U.S. However, floods in combination with other catastrophic events, such as wildfire, have caused the loss of isolated fish populations in other areas (Propst et al. 1992). On an individual basis, a substantial number of Sonora chub die when they become trapped in habitats that do not sustain perennial water during arid periods (Carpenter and Maughan 1993). Recolonization is dependent on individuals that survive dry periods. This species has an amazing capacity for reproduction and recruitment as its habitat expands; it can seemingly explode from a small number of individuals occupying newly-wetted habitats in just a few weeks or months. The capability of the population to increase by several orders of magnitude within a few months is most likely an adaptation to the harsh climate and intermittent nature of its habitat, which has allowed the Sonora chub to survive to the present (Bell 1984). Based on this, and the above conservation being provided by the USFS, as well as numerous beneficial S&Gs within the Coronado NF LRMP, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of Sonora chub.

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the CH to satisfy essential requirements of the species" (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998:4-34).

Based on the above analyses, it is the FWS's opinion that the proposed action will not alter the ability of the CH to function properly despite the lack of identified PCEs. As such, designated CH for the Sonora chub will remain functional to serve its intended conservation role for the species. Therefore, the FWS concludes that the proposed action is not likely to destroy or adversely modify designated CH for the Sonora chub.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined

as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the FWS 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 which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

Amount or Extent of Take Anticipated

Incidental take of the Sonora chub is reasonably certain to occur as a result of the continued implementation of Coronado NF LRMP for all programs, and all take is expected to be in the form of harm or harassment. Harm occurs through direct habitat alterations and indirectly from pollutants and run-off from activities adjacent to or upstream of the species. The FWS anticipates, however, that incidental take of Sonora chub will be difficult to detect because finding a dead or impaired specimen is unlikely, and losses may be masked by seasonal fluctuations in environmental conditions and fish numbers. Therefore, the FWS defines incidental take in terms of habitat characteristics and is using this surrogate measure to identify when take has been exceeded. The FWS concludes that the incidental take of Sonora chub will be considered exceeded if any site-specific projects implemented under the S&Gs within the LRMP and with identified potential adverse effects (through project-level Section 7 consultation) measurably reduce or diminish the quality or quantity of the currently occupied spring or pool habitats. Populations of Sonora chub currently exist in Sycamore Creek, California Gulch, Sycamore Canyon proper, Atascosa Canyon, and an unnamed canyon. If these measurable effects occur as a result of the proposed action, take will be considered exceeded and reinitiation will be necessary.

Effect of the Take

In the accompanying BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the Sonora chub.

REASONABLE AND PRUDENT MEASURES

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the Sonora chub.

1. Minimize or eliminate adverse effects of the proposed action to Sonora chub on the Coronado NF.
2. Minimize or eliminate adverse effects to Sonora chub habitat on the Coronado NF.
3. Monitor the impacts of implementing the proposed action on the Sonora chub and its habitat.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the USFS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1.1 Manage riparian areas adjacent to and upstream of Sonora chub populations for conditions to minimize or eliminate direct and indirect effects to Sonora chub.

1.2 Design projects within the Engineering, Forestry and Forest Health, Lands and Minerals, Rangeland Management, Watershed Management, and Recreation programs with the goal to minimize or eliminate adverse effects to the Sonora chub.

The following terms and conditions will implement reasonable and prudent measure 2:

2.1 Design projects in occupied Sonora chub habitat with the goal of implementing projects that will have beneficial, insignificant, or discountable effects to the Sonora chub habitat

The following terms and conditions will implement reasonable and prudent measure 3:

3.1 The Coronado NF shall monitor incidental take resulting from the proposed action and report their findings to the FWS. Incidental take (implementation) monitoring shall include information such as when or if the project was implemented, whether the project was implemented as analyzed in the site-specific BO (including CMs, and BMPs), breeding season(s) over which the project occurred, relevant Sonora chub survey information, and any other pertinent information about the project's effects on the species

3.2 Annual reports will be sent to the appropriate local FWS Ecological Services field office by March 1st of each year.

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 federal action agency must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA 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. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. In cooperation with the Border Patrol and other appropriate parties, continue efforts to construct a stronger border fence strategically located to reduce trespass cattle from Mexico into the occupied or designated CH for the Sonora chub.

2. Evaluate ways to eliminate all non-native fish that threaten the Sonora chub.

3. Assess habitat dynamics and determine fish-habitat relationships for the Sonora chub.

4. Assess the possibilities of mineral withdrawals in California Gulch that would directly benefit the Sonora chub.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effect or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

SPIKEDACE

STATUS OF THE SPECIES RANGEWIDE

Spikedace (Meda fulgida) was listed as a threatened species on July 1, 1986 (51 FR 23769). However, we determined in 1994 that reclassifying spikedace to endangered status was warranted but precluded (59 FR 35303, July 11, 1994), and restated this conclusion on January 8, 2001 (66 FR 1295). We reanalyzed the determination each year in our Candidate Notice of Review, and determined that reclassification to endangered is warranted, in the Candidate Notice

of Review published on November 9, 2009 (74 FR 57804). In 2010, we published a proposed rule to reclassify loach minnow and spikedace to endangered status (75 FR 66482). During the preparation of this BO, the proposed rule changing the status of the spikedace from threatened to endangered was finalized on February 23, 2012 (77 FR 10810).

Critical habitat was originally designated on March 21, 2007 (72 FR 13356), and included portions of the Verde, middle Gila, lower San Pedro, and upper Gila rivers, and Aravaipa Creek, as well as several tributaries of those streams. Following a legal challenge to that designation, we filed a motion for voluntary remand in 2009 and began re-evaluating critical habitat. Those areas originally designated as CH in the 2007 rule remained in place until the new designation was finalized. As mentioned above, USFWS published the final rule reclassifying the species as endangered and revising the spikedace designated CH on February 23, 2012 (77 FR 10810). The final rule became effective on March 26, 2012. While there are some differences between the 2007 designation and the 2012 revised designation, much of the geographic area included for spikedace CH is the same in both proposals. Specific details regarding the areas included as designated CH can be found in the two rules. Key features, or PCEs for spikedace are: 1) Habitat to support all egg, larval, juvenile, and adult spikedace; (2) An abundant aquatic insect food base; (3) Streams with no or no more than low levels of pollutants; (4) Perennial flows, or interrupted stream courses that are periodically dewatered but that serve as connective corridors when wetted; (5) No or low levels of nonnative aquatic species that allow for persistence of spikedace; and (6) Streams with a natural, unregulated flow regime that allows for periodic flooding or, if regulated, that allows for adequate river functions. Additional details on each of these PCEs are found in the CH rule.

Spikedace is a small silvery fish whose common name alludes to the well-developed spine in the dorsal fin (Minckley 1973). Spikedace historically occurred throughout the mid-elevations of the Gila River drainage, but is currently known only from the middle, and upper Gila River and Aravaipa Creek. The species also occurs in the upper Verde River and Eagle Creek, but appears to be declining in numbers. It has not been documented in the Verde River since 1999 despite annual surveys, and additional survey work is needed to determine its current status. Spikedace have not been detected in Eagle Creek since 1989 (Barber and Minckley 1966, Minckley 1973, Anderson 1978, Marsh et al. 1990, Sublette et al. 1990, Jakle 1992, Knowles 1994, Rinne 1999). Habitat destruction along with competition and predation from introduced nonnative species are the primary causes of the species decline (Miller 1961, Williams et al. 1985, Douglas et al. 1994).

Recent taxonomic and genetic work on spikedace indicates there are substantial differences in morphology and genetic makeup between remnant spikedace populations. Remnant populations occupy isolated fragments of the Gila basin and are isolated from each other. Anderson and Hendrickson (1994) found that spikedace from Aravaipa Creek are morphologically distinguishable from spikedace from the Verde River, while spikedace from the upper Gila River and Eagle Creek have intermediate measurements and partially overlap the Aravaipa and Verde populations. Mitochondrial DNA and allozyme analyses have found similar patterns of geographic variation within the species (Tibbets 1992, Tibbets 1993).

Spikedace live in flowing water with slow to moderate velocities over sand, gravel, and cobble substrates (Propst et al. 1986, Rinne and Kroeger 1988). Specific habitat for this species consists of shear zones where rapid flow borders slower flow, areas of sheet flow at the upper ends of mid-channel sand/gravel bars, and eddies at the downstream riffle edges (Propst et al. 1986). Spikedace spawns from March through May with some yearly and geographic variation (Barber et al. 1970, Anderson 1978, Propst et al. 1986). Actual spawning has not been observed in the wild, but spawning behavior and captive studies indicate eggs are laid over gravel and cobble where they adhere to the substrate. Spikedace lives about two years with reproduction occurring primarily in one-year old fish (Barber et al. 1970, Anderson 1978, Propst et al. 1986). It feeds primarily on aquatic and terrestrial insects (Schreiber 1978, Barber and Minckley 1983, Marsh et al. 1989). Additional details on habitat preferences are provided in the 2007 critical habitat designation (72 FR 13356), the proposed rule for critical habitat designation from 2010 (75 FR 66482), and the recently-published final rule for critical habitat designation (77 FR 10810).

The spikedace was once common throughout much of the Gila River basin, including the mainstem Gila River upstream of Phoenix, and the Verde, Agua Fria, Salt, San Pedro, and San Francisco subbasins. Habitat destruction and competition and predation by nonnative aquatic species reduced its range and abundance (Miller 1961; Lachner et al. 1970; Ono et al. 1983; Moyle 1986; Moyle et al. 1986; Propst et al. 1986). Spikedace are now restricted to portions of the upper Gila River (Grant, Catron, and Hidalgo Counties, New Mexico); Aravaipa Creek (Graham and Pinal Counties, Arizona); Eagle Creek (Graham and Greenlee Counties, Arizona); and the Verde River (Yavapai County, Arizona) (Marsh et al. 1990; M. Brouder, U.S. Fish and Wildlife Service, pers. comm. 2002; Stefferud and Reinthal 2005; Paroz et al. 2006; Propst 2007).

In 2007, spikedace were translocated into Hot Springs Canyon, in Cochise County, Arizona, and Redfield Canyon, in Cochise and Pima Counties, Arizona, and these streams were subsequently augmented (Robinson 2008a; T. Robinson, AGFD, pers. comm. 2008b; D. Orabutt, AGFD, pers. comm. 2009; Robinson 2009a; Robinson et al. 2010a; Robinson et al. 2010b). Both Hot Springs and Redfield canyons are tributaries to the San Pedro River. Spikedace were also translocated into Fossil Creek, a tributary to the Verde River in Gila County, Arizona, in 2007, and were subsequently augmented in 2008 (Carter 2007; Carter 2008; Robinson 2009b; Boyarski et al. 2010). In 2008, spikedace were translocated into Bonita Creek, a tributary to the Gila River in Graham County, Arizona (H. Blasius, U.S. Bureau of Land Management (BLM), pers. comm. 2008; D. Orabutt, AGFD, pers. comm. 2009; Robinson et al. 2009), and were repatriated to the upper San Francisco River in Catron County, New Mexico (D. Propst, New Mexico Department of Game and Fish (NMDGF), pers. comm. 2010). Augmentations with additional fish will occur for the next several years at all sites, if adequate numbers of fish are available. Monitoring at each of these sites is ongoing; however, insufficient time has elapsed to allow us to determine if these translocation efforts will ultimately be successful and result in establishment of new populations of spikedace in these locations.

Spikedace is now common only in Aravaipa Creek in Arizona (Arizona State University (ASU) 2002; P. Reinthal, University of Arizona, pers. comm. 2008, Reinthal 2009) and one section of the Gila River south of Cliff, New Mexico (NMDGF 2008; Propst et al. 2009). The Verde River is presumed occupied; however, the last captured fish from this river was from a 1999 survey

(M. Brouder, Service, pers. comm. 2002; AGFD 2004). Spikedace from the Eagle Creek population have not been seen for over a decade (Marsh 1996), although they are still thought to exist in numbers too low for the sampling efforts to detect (Carter et al. 2007; see Minckley and Marsh 2009). The Middle Fork Gila River population is thought to be very small and has not been seen since 1995. Planning among several State and Federal agencies is underway for restoration of native fish species, including spikedace, in the Blue River following construction of a barrier that will exclude nonnative fish from moving upstream from the lower San Francisco River, and allow for translocation of spikedace. Barrier construction is underway with completion anticipated in late Spring 2012. Federal land ownership throughout the majority of this CH unit would facilitate management for the species. While the Blue River and its tributaries were not included in the 2007 designation, the proposed rule in 2010 and final 2012 rule includes these areas for spikedace, and contains details on areas now considered as CH.

Our information indicates that, rangewide, more than 390 consultations have been completed or are underway for actions affecting spikedace and loach minnow, which often co-occur. The majority of these opinions concerned the effects of road and bridge construction and maintenance, grazing, water developments, fire, species control efforts, or recreation. There are a high number of consultations for urban development and utilities, however, these projects typically do not result in adverse effects to the species but are for technical assistance only. Small numbers of projects occur for timber, land acquisition, agriculture, sportfish stocking, flooding, Habitat Conservation Planning, native fish restoration efforts, alternative energy development, and mining.

The status of spikedace is declining rangewide. It is now restricted to approximately 10 to 15 percent of its historical range. Within occupied areas, it is common to very rare, but is presently common only in Aravaipa Creek and some parts of the upper Gila River in New Mexico (U.S. Fish and Wildlife Service 2000). Although was listed as threatened at the time of the 2011 BA, we published a proposed rule in October 2010 to redesignate CH and to reclassify spikedace to threatened status, and the final rule was published on February 23, 2012 and became effective on March 26, 2012.

ENVIRONMENTAL BASELINE

Status of the Species within the Action Area

On the Coronado NF, there are no streams occupied by spikedace. Redfield and Hot Springs Canyons were stocked with spikedace during 2007, and have received subsequent stockings and are considered occupied by the FWS. Occupied habitat is also located in Araviapa Creek which is 3.6 mi from the Forest boundary. Critical habitat in Redfield Canyon is less than 1 mi from the Forest boundary.

No conservation efforts have been undertaken due to the species and CH not being present on the Forest.

Critical habitat was originally designated for the spikedace in 2007 and modification to the 2007 designation became final on February 23, 2012. There is no designated CH located on the

Coronado NF. However, designated CH is located in Redfield canyon less than 1 mile downstream of the forest boundary.

Factors Affecting the Species within the Action Area

Spikedace and its designated CH may be affected by groundwater pumping, watershed conditions, stormwater runoff, non-native fish species, livestock grazing, timber harvest, wildfire, recreational activities, and other habitat alterations.

CONSERVATION MEASURES

The USFS has agreed to implement the following CMs for the spikedace:

Conservation Measure #1: Design projects in occupied spikedace habitat on NFS lands which address the appropriate components of the spikedace recovery plan, with the goal of implementing projects with beneficial, insignificant, or discountable effects to spikedace.

Conservation Measure #2: Cooperate with state game and fish agencies, other federal agencies, USFS research stations, FWS, and others (universities, etc.) to assess and prioritize habitat of stream and river segments for potential spikedace reintroduction. Report results of these efforts to the FWS in LMRP annual reports.

> a. Determine necessary habitat and watershed improvements in occupied watersheds and watersheds identified as high priority reintroduction sites and implement projects needed to contribute to recovery.

Conservation Measure #3: Participate in ongoing efforts initiated in 2003 involving state agencies, other federal agencies, universities, USFS research facilities, and FWS to document the current state of knowledge regarding the spikedace.

> a. Identify existing populations in imminent need of protection and develop and implement, to the extent possible by the USFS, a strategy for protecting the population and reducing threats to the population.

Conservation Measure #4: With state agencies and other researchers (e.g., academic and USFS), who are currently monitoring spikedace populations, participate in the development of a consistent monitoring methodology for spikedace, their associated habitat, and co-occurring aquatic species. Report results of these efforts to the FWS in the LRMP annual reports.

Conservation Measure #5: To the extent feasible within the mission and capabilities of the USFS, assist the FWS, AGFD, and the NMDGF with any spikedace reintroduction efforts.

Conservation Measure #6: Within the mission and capabilities of the USFS, continue to assist the FWS, other federal agencies, state agencies, universities, and others in the development of a captive spikedace propagation program designed to augment wild populations.

Conservation Measure #7: A long-term benefit directly attributable to wildland fire use for resource benefits is the reduction of catastrophic fire. This is very significant to long-term land management goals and objectives vital to restoring fire-adapted systems. Their absence predisposes ecosystems to the undesirable effects associated with catastrophic fires, potentially at levels of severity and intensity outside historic ranges of variability which are highly detrimental to aquatic systems. That said, the USFS agrees to the following:

a. Pre-ignition Planning: Maintain current distributions of threatened, endangered, proposed, and candidate species in Geographical Information System (GIS) layers on each NF in the Southwestern Region and provide these GIS layers to the Line Officer, Fire Management staff and/or incident commander for each species occurring in the watershed of the ignition as well as surrounding watersheds. Identify watersheds that are particularly susceptible to ash flow and sediment following high intensity fires. Use this information to guide fire use mitigation measures such as; delay, direct check and/or suppress.

b. A USFS biologist for the appropriate species will be assigned and consulted during fire management activities to ensure that concerns for T&E species are addressed. For example, implement spawning season restrictions to protect breeding activities, establish appropriate buffers to filter ash and sediment, and avoid mechanical and chemical measures within the riparian corridor, etc. During development and implementation of operational management plans, identify potential threats to listed species and designated CH and develop mitigation actions to eliminate threats.

c. Develop contingency plans in cooperation with FWS, other federal agencies, state agencies, universities, and others to preserve, rescue and secure a population in imminent danger of localized extirpation due to fire use for resource benefits.

EFFECTS OF THE ACTION

Since the 2004 BA for The Continued Implementation of the LRMP for the 11 NFs and NGs, no new significant scientific information or data has become available that would change the 2004 effects analysis for spikedace and designated CH. Accordingly, the following effects analysis is consistent with the USFS's 2004 BA and the FWS's 2005 BO/CO.

This section includes analyses of the direct and indirect effects of the proposed action on the spikedace for the Coronado NF. The spikedace does not currently occur on the Coronado NF. However, it occurs downstream of the Forest in Aravaipa Creek. At the request of the USFS, the FWS analyzed potential effects from the implementation of S&Gs within the Coronado LRMP to the spikedace. Most of the S&Gs within the Coronado NF LRMP maintain habitat and provide for recovery of spikedace. There were a few S&Gs that may result in some potential lethal and sublethal effects to the species. Additionally, there were several S&Gs that were beneficial in the long-term but had some short-term adverse effects.

<u>Fire Management Program</u>

Standard and Guideline 695 directs the Coronado NF to conduct fire suppression activities in a way to protect watershed and visual resource values. Although this S&G exists, fire suppression is not part of the proposed action for this project and therefore will not be analyzed in this consultation. The effects of fire suppression are addressed during emergency consultations. Standards and Guidelines 713, 798, and 812 allow for the use of prescribed fire to reduce fuel hazards, enhance wildlife values and visual resources, and improve livestock forage and watershed condition. All three of these S&Gs are the same but apply to different MAs. Short-term effects of prescribed fire include direct effects of the fire itself (ash) as well increased inputs of sediment as a result of initial soil disturbing activities from the construction of fire lines and the presence of vehicle traffic (i.e. engines). These effects are short-term and the S&Gs are considered beneficial because the long-term result is a reduction in the risk of catastrophic wildfire.

Forestry and Forest Health Program

Standards and Guidelines 697, 699 and 702 allow for the use of chemicals within the guidelines approved by other agencies for the purpose of insect and disease control on recreation and administrative sites, as well as timber and rangelands and allow the use of cyanide leaching as part of mining operations.

Watershed Management Program

Standard and Guideline 678 provides guidance in the management of the aquatic resources on the Coronado NF. The FWS recognizes that the intent of this S&G is positive; however, due to the current status of the spikedace across its range, it is imperative that all habitat currently occupied or that is capable of supporting spikedace be maintained in optimal condition. This S&G allows a certain amount of riparian habitat to be maintained at less than optimal conditions. For example, if protection of the natural bank is 80 percent, then the assumption is that 20 percent of the streambank is allowed to deteriorate to less than stable condition. Less than stable conditions could result in the streambank collapsing into the stream, increased sedimentation, widening of the stream, and increased summer water temperatures. In addition, the loss of riparian vegetation could impair the filtering capacity of the riparian buffer leading to an increase in nutrients and contaminants into the creek. Loss of riparian vegetation also leads to increased summer water temperatures and lower winter water temperatures. As a result, potential effects to the species may include a reduction of invertebrate food supplies, interference with reproduction, and direct mortality.

Standard and Guideline 677 provides the Forest with guidance to complete classifications and inventories of all riparian areas, and complete action plans to improve all unsatisfactory riparian areas. In addition, it allows the Coronado to improve all riparian areas to satisfactory or better condition by the end of Period 5 (i.e., 50 years from the date the LRMP was signed). Although this S&G is definitely beneficial because it is moving toward satisfactory riparian conditions, there may be some short-term adverse effects that could be occurring and may continue to occur until such a time as the riparian habitat reaches satisfactory conditions.

Standards and Guidelines 711, 782, 794, and 807 all direct the Forest to restore damaged watersheds to satisfactory watershed condition. Water and soil resources improvements may consist of channel stabilization and revegetation using native or non-native species. All these

S&Gs are the same but are applied to different management units. They allow for short-term, temporary impacts to water quality and watershed condition in exchange for longer-term improvement in watershed condition, sediment reduction, and improved riparian status.

Rangeland Management Program

Standard and Guideline 670 discontinues livestock grazing on the Redfield Allotment, which encompasses the entire upper watershed of Redfield Canyon. Therefore, there are no direct or indirect effects to spikedace in Redfield Canyon as a result of livestock grazing on the Coronado NF. In watersheds upstream from Aravaipa Canyon, S&Gs 792 and 805 allow the Forest to manage suitable rangeland at Level D within MA7A and MA7B. If level D is not achievable, the S&Gs direct the USFS to manage at Level A (no livestock). Management seeks full utilization of forage allocated to livestock. Cost-effective management systems and techniques, including fencing and water development, are designed and applied to obtain relatively uniform livestock distribution and use of forage and to maintain plant vigor. Projected range conditions include 15,412 acres in satisfactory condition, and 1,712 acres in unsatisfactory condition.

The effects that improper livestock management activities can have on riparian and aquatic habitats, both direct and through upland/watershed effects, have been well documented and discussed in recent years (Platts 1990, Bahre 1991, Meehan 1991, Fleischner 1994). Excessive sediment may smother invertebrates, reducing fish food production and availability. Spikedace are not unduly sensitive to moderate amounts of sediment, although during the spawning period egg viability may be reduced due to high substrate embeddedness and sediment loads, and larval habitat may be lost due to filling of shallow waters with sediment.

Standard and Guideline 829 states that riparian areas will be managed to achieve and maintain satisfactory riparian conditions as described in the Forest-wide prescription. This may be accomplished through the use of structural improvements, movement of livestock, of the exclusion of livestock. This S&G may result in some short-term adverse effects during the construction of structural improvements. In addition, the movement of livestock could also cause adverse effects if they are trailed through the riparian area. However, these effects would be localized and short-term and would contribute to the overall health of the riparian habitat in the long-term.

Wildlife, Fish, and Rare, Plants Program

Standard and Guideline 667 allows for the use of structural and nonstructural improvements to meet the specific wildlife habitat objectives as shown for each MA. Nonstructural Wildlife Improvements may include: 1) prescribe burn feasible areas on a 20-year cycle; 2) seed suitable wildlife forage species as needed in fuelwood and timber areas; 3) transplant listed T&E and other identified species into suitable habitat following guidelines of species recovery plans and Memoranda of Understanding; 4) re-vegetate wildlife areas with wildlife forage, cover, and riparian species (native species should be used when available); and 5) thin or patch cut an average of 10 acres of aspen, gambel oak, and timber species per year. Standard and Guideline 668 also allows for the use of structural and nonstructural improvement guidelines as follows: 1) construct water developments or potholes to accomplish 1 per section within 4 decades; 2) consider structural improvements and maintenance for T&E species as technology develops; 3) construct fish habitat improvement structures as needed for T&E species; and 4) fence riparian

areas where prescribed by approved allotment management plans. Miles of fence constructed will vary with management plan.

Standards and Guidelines 667 and 668 fall into the category of activities that cause short-term adverse effects while implementing actions that have long-term positive effects; thus, a net beneficial effect. In addition S&G 667 allows for prescribed burning. While it is advantageous to reduce the risk of catastrophic wildfire, the prescribed fire itself may have short-term impacts on water quality in adjacent streams. Short-term effects of prescribed fire include direct effects of the fire itself (ash) as well increased inputs of sediment as a result of initial soil disturbing activities from the construction of fire lines and the presence of vehicle traffic (i.e. engines). These effects are short-term and the S&Gs are considered beneficial because the long-term result is a reduction in the risk of catastrophic wildfire. Standard and Guideline 668 also allows for short-term, temporary impacts from the construction of habitat improvements and fencing. These impacts may include direct mortality of fish from trampling as well as indirect impacts to the habitat such as temporary alterations of stream flow, or short-term isolated increases in sediment entering the stream.

1996 Regional Amendment

Short-term adverse effects to the spikedace may occur from the implementation of the S&Gs within the 1996 Regional Amendment. Yet, we found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

The following S&Gs under the 1996 amendment are those that will ultimately have a long-term beneficial effect to the spikedace. They are S&Gs 1432, 1445, 1448, 1455, 1458, 1468, 1476, and 1508. All of these S&Gs allow the Forests to use prescribed fire, thinning, and other fuels management activities as a tool for fire risk abatement. Potential short-term effects include those associated with ground disturbance (e.g., sedimentation) as well as those from the fire itself. See previous discussions under the Fire Management Program for discussion of those effects. Although the implementation of all of these S&Gs will have short-term effects from using prescribed fire, there will be a long-term beneficial effect in the reduced risk of catastrophic wildfire.

CRITICAL HABITAT EFFECTS ANALYSIS

Designated CH does not occur on lands within the boundaries of the Coronado NF; however, CH occurs within watersheds that occur on this NF. Therefore, only indirect effects will be considered for this Forest.

<u>Engineering Program</u>
Degradation and destruction of spikedace CH may take place directly or indirectly as the result of road, facility, or structure construction or maintenance. In general, S&Gs do not exist in the LRMPs for facility or structure construction or maintenance. The lack of guidance for facility and structure maintenance to prevent effects to the spikedace CH may best be addressed at the project-level of analysis due to the varying nature of such projects. Region-wide, the administration of the variety of roads on USFS lands has the most direct link between

management activities and species effects. Although some NFs lack S&Gs directly related to the Engineering Program, S&Gs do exist for other programs (e.g., Watershed) that are directly related to activities administered by the Engineering Program, primarily roads.

Standard & Guideline 693 within the Coronado NF LRMP guides the NF to develop a transportation system at a minimum to adequately meet management, protection, and utilization needs. S&G 694 directs the Forest to maintain existing roads primarily to protect investment and resources, provide user safety, and user economy. In addition this S&G guides the NF to close roads if maintenance cannot be performed due to budget constraints if the road is causing "unacceptable" resource damage. Interpretation of this S&G may result in effects to spikedace CH. S&Gs 785a and 785 direct the NF to maintain roads or close, drain, and revegetate roads and trails that are determined to be unneeded for further use in MA4. MA4 consists of areas designated for Level D (rangeland in less than satisfactory condition will be treated with improved grazing management along with the installation of structural and non-structural improvements)livestock grazing, game habitat, and fuelwood harvest. This encompasses a large amount of area within suitable habitat for the spikedace. Similar S&Gs 797, 811, and 818 guide the Forest's management to protect riparian areas and research natural areas. Additionally, S&G 810 and 842 direct the NF to avoid new road development in riparian areas. A significant amount of direction is contained within the LRMP for avoiding effects to CH from roads; however, some short-term adverse effects may be realized during implementation. Other activities may affect spikedace CH; however, site- or project-specific consultation is more appropriate to ascertain effects.

Fire Management Program

There is very little guidance in the LRMP's S&Gs that addresses conflicts between fire management and spikedace CH. Fire management may potentially result in beneficial effects to the spikedace CH in the long-term. However, the use of fire, as well as fire suppression activities, may result in direct and indirect effects to spikedace CH and its PCEs in the short-term.

The Coronado NF LRMP has two Forest-wide S&Gs identified for potential effects to spikedace that are applicable to the Fire Management Program. S&G 695 guides the Forest to conduct fire suppression activities consistent with the protection of watersheds and visual quality. This S&G may avoid adverse effects to spikedace CH. Forest-wide S&G 703 allows for the use of prescribed fire as one tool which may be used to control invading plants that may result in short-term adverse effects from the fire to CH. The amount of area that is invaded each year by undesirable species is increasing. This S&G could also be beneficial in preventing the spread of noxious weeds that may be more flammable, resulting in further habitat damage from wildfire. The Forest is directed to use prescribed fire (S&G 713) to reduce fuel hazards, enhance wildlife values, and enhance visual resources in areas designated as MA1 (Visual Resources and Semi-Primitive Dispersed Recreation); to reduce fuel hazard and enhance wildlife habitat in MA7A (Wet Deciduous and Wet Coniferous Riparian); to reduce fuel hazard and maintain or improve wildlife habitat, livestock forage, and watershed condition in MA7B (Dry Desert and Dry Oak Riparian); and to control outbreaks of insects and disease in MA14 (Zoological-Botanical Areas). In general, guidance provided by the LRMP may assist in minimizing or, under certain circumstances, avoiding adverse effects to the spikedace CH.

Forestry and Forest Health Program

The Coronado NF LRMP has few S&Gs that specifically addresses the Forestry and Forest Health Program and the interaction with listed species and CH. S&G 704 states "Threatened, endangered, and sensitive species habitat requirements will take precedence over vegetation manipulation to control insects and disease." Otherwise, implementation of program activities is permitted with no direction under the LRMP to consider impacts to federally listed species or their CH. Due to the distance to CH from timberlands on the Coronado, implementation of the guidance to prevent adverse effects should result in effects that are insignificant or discountable.

Lands and Minerals Program

The Coronado NF LRMP contains S&Gs that address impacts associated with roads, and recommends mineral withdrawals for certain MAs, maintenance of withdrawals in others, and prohibition for mineral materials removal in others. The only S&G which may have an impact on the spikedace CH is the emphasis placed on "water-oriented property" lands acquisition within NF boundaries. The adverse effects expected from this emphasis should be minimal, however, due to the distance between sites and spikedace CH. S&G 692 directs the Forest to seek property for much needed high quality public recreation use, as well as high value wildlife and fish habitat. Allowing high recreation use in the riparian areas may create resource conflicts not realized when the property was in private ownership and may result in downstream effects to spikedace CH.

Rangeland Management Program

Standard and Guideline 670 discontinues livestock grazing on the Redfield Allotment, which encompasses the entire upper watershed of Redfield Canyon. There are no direct or indirect effects to spikedace CH in Redfield Canyon as a result of livestock grazing on the Coronado NF.

Recreation, Heritage, and Wilderness Program

Standards and Guidelines within the Coronado NF LRMP for the Recreation, Heritage, and Wilderness Program guide the NF to determine capacities for recreation and develop plans for managing these activities (S&G 612, 613). The goal is to protect resources from damage caused by recreation, roads, and trails (S&G 626). The use of motorized vehicles is restricted to existing roads and trails in some MAs and recommends closure if not needed (e.g., MA1, S&G 705; MA2, S&G 715). This guidance could prevent adverse effects to spikedace CH.

Watershed Program

The Watershed Program seeks to maintain or improve watershed conditions and maintain good water quality. It is cross-program in orientation in that it seeks to mitigate impacts from other program activities. The guidance for the Watershed Program should be used to minimize effects from other programs with inadequate guidance to minimize adverse effects to the spikedace CH.

The Coronado NF LRMP guides the watershed program to improve watersheds (S&G 672, 782, 794,); protect soils (S&G 673, 674, 675, 807); protect water quality and quantity (S&G 673, 675, 698, 783, 784, 795, 808); protect and improve riparian areas (S&G 675, 677, 678, 679); and protect resources dependent on riparian areas (S&G 676,680, 681). S&G 676 is important because it guides the Forest to "give preferential consideration to resources dependent on

riparian areas…", and, could be used to protect all riparian-dependent resources. This S&G (676) states, "Other resource uses and activities may occur to the extent that they support or do not adversely affect riparian-dependent resources." Therefore, no adverse effects should take place on any riparian-dependent resource on the Coronado NF, including spikedace CH. However, the use of the phrase "adversely affect" is not directly derived from the context of take and adverse effects as defined in the ESA. Therefore, interpretation of this S&G can vary and include measurable adverse effects to CH on the Coronado NF.

Wildlife, Fish, and Rare Plants Program

The intent of LRMPs and S&Gs applicable to the Fish, Wildlife and Rare Plants Program is to maintain or improve conditions for wildlife habitat Region-wide. The implementation of S&Gs for this program is often cross-program in nature, therefore, some S&Gs seek to restrict or encourage activities in other programs in consideration of wildlife, fish or rare plants. Standard and Guidelines 627-629, 631-633, 635, and 636 within the Coronado NF LRMP, direct the Forest to maintain and improve habitat for all species through coordination with other wildlife agencies to inventory, monitor, and develop direction for state- and federally-listed species in accordance with Recovery Plans; the goal being the delisting of T&E species. Specific objectives discussed in several S&Gs may mitigate or prevent impacts that may contribute to protection of CH downstream from NF boundaries.

1996 Regional LRMP Amendment

Although the 1996 Regional LRMP Amendment focuses on effects to MSO, there are some S&Gs that may contribute to the protection of imperiled species and their habitats. The amendment addressed several activities in several Resource Programs. One S&G provides guidance for the Engineering and Recreation, Heritage and Wilderness Programs. S&G 1437 suggests avoidance of roads or trails in MSO PACs. This restricts the location of road and trail placement that could have varying effects to the spikedace CH depending on location specifics. Additional guidance is provided for the Recreation, Heritage, and Wilderness Program in S&G 1438, which allows recreation to continue at the levels that were occurring prior to the listing of the MSO. Site-specific effects may continue to occur as a result of maintaining those levels of recreation, particularly in riparian areas. S&Gs within the Fire Management Program provide guidance for treating fuel accumulations to abate fire risk and protect areas important to MSO and northern goshawk (S&G 1445, 1454, 1455, 1468, and 1508). The management of fuels should result in decreased threats or indirect effects to the spikedace CH. The Forestry and Forest Health Program has S&Gs that provide guidance primarily targeting timberland in areas that may affect the MSO and the northern goshawk. This guidance may result in only minor influences on indirect effects to spikedace CH or may result in neutral or no effect. Guidance provided for riparian areas has a greater influence on effects to spikedace CH. Standard & Guideline 1473 emphasizes maintenance and restoration of healthy riparian ecosystems. This S&G should have beneficial effects to the spikedace.

With regard to Rangeland Management, S&Gs 1448, 1474, 1477, 1479, 1489, and 1510 have significant influence on activities that may affect spikedace CH. The S&Gs provide guidance for managing range in good to excellent condition (S&G 1474), emphasizing maintenance and restoration of riparian habitats (S&G 1477, 1479, 1490), and maintaining satisfactory soil conditions, hydrologic function, and nutrient cycles. Standard and Guideline 1489 directs

allowable forage use by grazing ungulates such that range conditions will not impede the conservation and recovery of federally listed species. The implementation of S&Gs contained within the amendment should result in some minimization of potential adverse effects by Fire Management, Rangeland Management and Forestry activities on spikedace CH. As noted previously, the Coronado NF has discontinued livestock grazing in the Redfield Canyon watershed.

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.

Unregulated activities non-federal lands, such as trespass livestock, inappropriate use of OHVs, illegal introduction of bait and sport fishes, and residential and commercial development on lands within watersheds containing T&E native fishes, are cumulative effects and can adversely affect the species through a variety of avenues.

Cumulative effects to native fishes include ongoing activities in the watersheds in which the species occurs such as livestock grazing and associated activities outside of federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization without a federal nexus, and recreation. Some of these activities, such as irrigated agriculture are declining and are not expected to contribute substantially to cumulative long-term adverse effects to native fishes.

Other activities, such as recreation, are increasing. Increasing recreational, residential, or commercial use of the non-federal lands near the riparian areas would likely result in increased cumulative adverse effects to occupied, as well as potentially-occupied native fish habitat through increased water use, increased pollution, and increased alteration of the streambanks through riparian vegetation suppression, bank trampling, and erosion.

Cumulative effects to spikedace CH include ongoing activities on non-federal lands within watersheds with designated CH such as livestock grazing and associated activities outside of the allotments addressed herein, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization, and recreation. Some of these activities are declining and are not expected to contribute substantially to cumulative long-term adverse effects.

Other activities, such as recreation are increasing. Increasing recreational, residential, or commercial use of the private lands near the riparian areas will likely result in increased cumulative adverse effects to loach minnow and spikedace CH through increased water use, increased pollution, and increased alteration of the streambanks through riparian vegetation suppression, bank trampling, and erosion.

CONCLUSION

After reviewing the current status of the spikedace, the environmental baseline for the action area, the effects of the proposed action which include the various CMs voluntarily brought forward by the USFS, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the spikedace. Pursuant to 50 CRF 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

The FWS does not believe the impacts of the proposed action will rise to the level of jeopardy for the species for the following reasons:

- The spikedace does not occur on the Coronado NF.
- Several S&Gs within these NF LRMPs support conservation and recovery of spikedace. These S&Gs guide the Forests to implement recovery plans, improve habitat for T&E species by structural and nonstructural means, and to delist T&E species.

In addition, the USFS will implement (i.e., as part of the proposed action) several additional CMs specifically for the spikedace. These CMs include the following:

- Designing projects in occupied spikedace habitat on NFS lands that address the appropriate components of the spikedace recovery plan, with the goal of implementing projects with beneficial, insignificant, or discountable effects to spikedace.
- Cooperating with state conservation agencies, other federal agencies, USFS research stations, FWS, and others (universities) to assess and prioritize habitat of stream and river segments for potential spikedace reintroduction. In addition, determining necessary habitat and watershed improvements in occupied watersheds and watersheds identified as high priority reintroduction sites and implement projects needed to contribute to recovery.
- Participating in ongoing efforts initiated in 2003 involving state agencies, other federal agencies, universities/colleges, USFS research facilities, and FWS to document the current state of knowledge regarding the spikedace.
- Identifying existing populations in imminent need of protection and develop and implement, to the extent possible, a strategy for protecting the population and reducing threats to the population.
- With state conservation agencies and other researchers (e.g., academia and USFS), who are currently monitoring spikedace populations, participating in the development of a consistent monitoring methodology for spikedace, their associated habitat, and co-occurring aquatic species. The USFS will cooperatively document the results in an annual report to the FWS.
- The USFS will assist the FWS, AGFD, and the NMDGF with any spikedace reintroduction effort to the extent feasible within the mission and capabilities.
- The USFS will, within the mission and capabilities, assist the FWS, other federal agencies, state agencies, universities/colleges, and others in the development of a captive

spikedace propagation program designed to augment wild populations.

The USFS has also agreed to implement the following CMs with regards to wildland fire use:

- Pre-ignition Planning: Maintain current distributions of threatened, endangered, proposed, and candidate species in Geographical Information System (GIS) layers on each NF in the Southwestern Region and provide them to the Line Officer, Fire Management staff and/or incident commander for each species occurring in the watershed of the ignition as wells as surrounding watersheds.
- Identify watersheds that are particularly susceptible to ash flow and sediment following high intensity fires. Use this information to guide fire use mitigation measures such as delay, direct check, and/or suppress.
- A USFS biologist for the appropriate species will be assigned and consulted during fire management activities to ensure that concerns for T&E species are addressed. For example, implement spawning season restrictions to protect breeding activities, establish appropriate buffers to filter ash and sediment, and avoid mechanical and chemical measures within the riparian corridor, etc.
- During development and implementation of operational management plans, identify potential threats to listed species and designated CH and develop mitigation actions to eliminate threats.
- Develop contingency plans in cooperation with FWS, other federal agencies, state agencies, universities/colleges, and others to preserve, rescue and secure a population in imminent danger of localized extirpation due to fire use for resource benefits.

The USFS has committed to the implementation of these CMs. Therefore, implementation of these CMs along with the management direction provided by the beneficial S&Gs within the NF LRMPs should not result in a further decline in population numbers or habitat conditions of spikedace on NFS lands in the Southwest. Habitat for the spikedace is expected to improve. Specifically, the conservation measure direct actions at eliminating threats and augmenting populations. These efforts, in combination with actions already on-going for the conservation benefit of the species, will provide sufficient protection for the spikedace. Therefore, we conclude that the continued implementation of the Coronado NF's LRMP is not likely to jeopardize the continued existence of the spikedace.

After reviewing the current status of the spikedace CH, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our opinion that the proposed action is not likely to destroy or adversely modify CH.

Effects to the spikedace CH from the Coronado NF LRMP and the 1996 Regional Amendment were analyzed. The Coronado NF LRMP had no S&Gs that resulted in adverse effects to the spikedace CH downstream of the forest boundaries. In addition, short-term adverse effects were identified for activities associated with S&Gs that have a long-term benefit to the species. However, the FWS does not believe the impacts of the proposed action will result in the alteration of the abilities of the PCEs to function properly. The FWS bases this conclusion on the following reasons:

- Designated CH for the spikedace does not occur on the Coronado NF.
- There are several S&Gs within the Coronado NF LRMP that support conservation and recovery of spikedace. One S&G for the Coronado NF should result in no adverse effects to CH, for all NF programs. The 1996 Regional LRMP Amendment essentially reduces the effects caused by the Forestry and Forest Health and Rangeland Management Programs for all NFs.

- Standards and Guidelines 629, 633, 707, 709, 757, 770, 774, 779, 786, 791, 800, 814, 821, 825, and 828 within the Coronado LRMP give preference to T&E species and their habitats. In addition, all of these S&Gs guide the Forests to implement recovery plans, improve habitat for T&E species by structural and non-structural means, and to recover T&E species.

- The USFS has taken proactive measures in an attempt to reduce the decline of the spikedace. For example, the USFS and FWS jointly developed a set of CMs for the spikedace which became part of the proposed action under the 2004/2005 consultation and this consultation. According to the USFS Annual Reports, the Forest has implemented those CMs into their projects designs as appropriate. In addition, the Coronado has discontinued livestock grazing in Redfield Canyon.

- The Southwestern Region of the USFS has hosted the Spikedace Conservation Coordination Meetings to identify priority sites for reintroducing spikedace. During these meetings, the team has identified existing populations of spikedace in imminent need of protection due to natural occurrences as well as management activities. Since then, the USFS has developed and implemented a strategy for protecting and reducing threats to the populations.

- The USFS has been involved with others in discussions on the development of a captive spikedace propagation program designed to augment wild populations. The Southwestern Region has contributed funding in support of the captive propagation program for the spikedace. The Bureau of Reclamation is funding the establishment of a captive facility for spikedace and loach minnow at the Bubbling Springs Hatchery operated by the AGFD. Applicable Forests have cooperated with others to provide access to wild populations to serve as sources for the captive stock.

- In compliance with an RPM described in the 2005 BO/CO, the USFS agreed to maintain current distributions of threatened, endangered, proposed, and candidate species in Geographical Information System (GIS) layers on each NF in the Southwestern Region and these GIS layers will be provided to the Line Officer, Fire Management staff and/or incident commander for each species occurring in the watershed that the ignition occurs, as well as, surrounding watersheds. In addition, they have identified watersheds that are particularly susceptible to ash flow and sediment following high intensity fires. This information is used to guide fire use mitigation measures such as; delay, direct check and/or suppress.

After reviewing the current status of spikedace critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our opinion that the continued implementation of the LRMP will not destroy or adversely modify critical habitat for spikedace. The LRMPs contain guidance that seeks to minimize the magnitude of the effects; however, there is still a potential to implement the LRMPs while causing adverse effects to critical habitat. Although the FWS anticipates some adverse effects to CH from the implementation of the Tonto NF's LRMP, as well as the 1996 Regional Amendment, we do not believe the impacts of the proposed action will result in adverse modification to CH.

The PCEs for spikedace include habitat to support all life stages of the fish, including perennial flows, appropriate stream habitats and microhabitats, low levels of pollutants, an appropriate prey base, no or low levels of nonnative aquatic species, and a natural, unregulated flow regime that allows for periodic flooding (77 FR 10810). The various USFS programs may include activities such as road development or eradication, vegetation removal, and grazing which could impact these PCEs by removing vegetation, disturbing soils, or other activities. Consultation on site-specific projects under these programs will be conducted to more adequately address specific impacts to the PCEs.

It is possible that spikedace still persist in areas thought to be extirpated and may occur in localities yet to be discovered. Proactive efforts by the USFS in the past and the continued monitoring of those areas contribute positively to the overall status of the spikedace and its CH. Activities such as closing roads, removal of non-native fish, establishing a captive breeding program, and the exclusion of cattle from riparian areas continue to contribute toward the improvement of loach minnow and spikedace habitat. In addition, there are activities being conducted by other land management agencies to enhance habitat for the spikedace that benefit its CH rangewide. All these actions together with the implementation of the beneficial S&Gs outlined above should continue to improve habitat conditions on NFS lands in the Southwest. For these reasons, as well as the above analyses, it is the FWS's biological opinion that the proposed action will not alter the ability of the PCEs to function properly. As such, CH for the spikedace will remain functional to serve its intended conservation role for the species. Therefore, the FWS concludes that the proposed action is not likely to destroy or adversely modify designated CH for the spikedace.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the FWS 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 which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not

intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

Amount or Extent of Take Anticipated

Given the limited information available at this time, the FWS concludes that incidental take of spikedace is not reasonably certain to occur within Arizona during the lifetime of the proposed action. We find this for the following reasons: spikedace currently do not occur within the external boundaries of the Coronado NF, and it is unlikely that indirect effects of the proposed action will affect the population located downstream of the Forest in Aravaipa Creek. Secondly, if the species is present but not detected, uncertainties on their location and abundance precludes our ability to estimate the method, timing, or location of adverse effects incurred either directly or indirectly from the proposed action. If the species is detected on the NFS within the life of the current LRMP, reinitiation will be necessary.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA 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. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. Design and implement projects on NFS lands and within the range of spikedace consistent with the recovery plan. That is, the focus shall be on projects designed specifically for spikedace recovery and not on incidental take minimization within other projects.

2. Manage streams to create additional habitat for spikedace.

3. Cooperate with state conservation agencies, FWS, and universities to determine range of natural variation in absolute abundance and age-class structure pursuant to Recovery Task 2.4.

4. In cooperation with FWS, state conservation agencies, and universities conduct field studies and in-stream experiments to qualitatively and quantitatively describe indirect interactions among spikedace and non-native fishes.

5. In cooperation with FWS and state conservation agencies plan and conduct investigations on captive holdings, propagation, and rearing.

6. Work to secure funding for studies and habitat improvement projects.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effect or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

YAQUI CATFISH

STATUS OF THE SPECIES

Description

The Yaqui catfish (*Ictalurus pricei*) is a medium to large fish of the family Ictaluridae (Minckley 1973). The body is slender and streamlined with older (larger) fish appearing more thick bodied. The caudal fin is shallowly forked and the anal fin has a broadly rounded distal margin with 23-25 rays. The body is profusely speckled in young fish, while adults are more unicolored, dark gray to black dorsally, white to grayish beneath. Barbels are jet-black except on immediate chin where they are gray to whitish.

The Yaqui catfish was originally described as *Villarius pricei* by Rutter (1896) from the Rio San Bernardino, Northwestern Sonora. The name *pricei* was transferred among a number of genera before being settled in *Ictalurus* (see Hendrickson et al. 1980). *Ictalurus meeki* (Regan 1906), described from the upper Rio Papigochic, may be a synonym of *I. pricei.*

The taxonomic status of Mexican catfishes in basins other than the Rios Yaqui-Casas Grandes basin remains unclear, although Hendrickson (1984) also referred to catfish from Rio San Lorenzo, Sinaloa, as this species and anticipated other localities from more southern Mexican rivers as collections become available. An undescribed catfish resembling *I. pricei* has been introduced and is established in the Gila River drainage, but its morphology, status, and overall distribution have yet to be determined (FWS 1994). See Lundberg (1992) for a synthesis of recent work on the systematic relationships of Ictalurid catfishes.

Legal Status: On August 31, 1984, the FWS listed the Yaqui catfish as a threatened species and designated CH (FWS 1984). A final Recovery Plan for the species was signed on March 29, 1995.

Distribution and Abundance

The distribution and abundance information has not changed since the 2005 BO/CO so we hereby incorporate that information by reference and provide a narrative summary below.

As described in the 2011 BA, Yaqui catfish were extirpated from the U.S. in the 1950s and reintroduced into the Rio Yaqui basin within the San Bernardino National Wildlife Refuge (NWR) in Cochise County, Arizona in 1997 (FWS 2010, AGFD 2001) and on El Coronado Ranch in 1999 (USFS 2004). Although Yaqui catfish were reintroduced into Twin Pond on the San Bernardino NWR using progeny of captive stocks held at Dexter National Fish Hatchery and Technology Center (NFHTC), the species has not been observed there since 2005. Due to reestablishment efforts in Arizona, however, Yaqui catfish are currently present only in House Pond on the Slaughter Ranch next to the NWR and on the El Coronado Ranch where they were stocked under a Habitat Conservation Plan (FWS 1998b).El Coronado Ranch borders lands managed by the Douglas RD of the Coronado NF and lies within the West Turkey Creek watershed. Yaqui catfish are not believed to occur on NFS lands, although escape from the ponds on the El Coronado Ranch is possible (USFS 2004).

In Mexico, the Yaqui catfish is currently believed to be extirpated from the Rio Casa Grandes (Smith and Miller 1986, Propst and Stefferud 1994). The range of the Yaqui catfish is confined to the Rio Yaqui basin in Mexico, though taxonomic uncertainties make it unclear whether the range extends to other basins.

Habitat

The following information is reiterated from the 2005 BO/CO. The Yaqui catfish's historical range throughout the Yaqui River Basin consists of intermediate to low elevation warm-water creeks, cienegas, and moderate- to large-sized rivers. In the Rio Yaqui basin, the Yaqui catfish has been found in medium to large creeks and rivers with medium to slow current over sand or rock substrates (Hendrickson et al. 1980). In small streams they prefer clear quiet pools. Creeks typically have alternating riffles and pools in which heterogeneity is enhanced by undercut banks, boulders, and wood debris. Gravel bottoms in swift areas are vegetated with algae. Cienegas, streams and associated marshlands with low, emergent aquatic plants and hydric-adapted trees, were historically common but have suffered severe degradation since the arrival of Europeans (Hendrickson and Minckley 1985). Rivers vary from pool-riffle types with boulder and gravel bottoms to long, strongly flowing reaches over gravel and sand (Campoy-Favela et al. 1989). During the dry season, Yaqui catfish seek refuge in permanent spring-fed pools (Haynes and Schuetze 1997). Elevations in Arizona range from 3,730 to 4,620 ft (1138 to 1409 m).

Critical Habitat: Critical habitat for the Yaqui catfish includes all aquatic habitats of San Bernardino NWR, Cochise County, Arizona. These areas provide habitat for one of the two existing populations of Yaqui catfish. Additionally, the aquatic habitats on San Bernardino NWR may provide expansion habitat for the Yaqui catfish. No CH is designated on the Coronado NF or any USFS lands. PCEs include:

1. Clean, small permanent streams and spring pools without any exotic fishes.
2. The streams should have deep pool areas separated by riffles and flowing areas of moderate current.
3. Backwater areas of stream and springs with overgrown cut banks and accumulations of detritus are necessary for feeding and shelter.

Life History
As stated in the 2005 BO/CO, little is known of the Yaqui catfish's ecology and life history. Minckley (1985) suggested that the ecology of the Yaqui catfish and channel catfish (*Ictalurus punctatus*) are similar. Most commonly, the Yaqui catfish is caught in larger rivers in areas of medium to slow current over gravel/sand substrates (Hendrickson et al. 1980). The species grows rapidly and achieves large sizes in ponds at Dexter National Fish Hatchery & Technology Center (NFHTC) (Jensen 1992, 1993). Yaqui catfish are bottom feeding omnivores that feed on other fish, insects, larvae, crustaceans, plant matter, and detritus (Haynes and Schuetze 1997). Reilly and Lochmann (2000) conducted comparative diet analysis between Yaqui catfish and channel catfish and found that weight gain, protein efficiency ratio, specific growth, and feed conversion were lower for Yaqui catfish than channel catfish for the 12 week study.

Reasons for Listing
As stated above, the Yaqui catfish was listed as a threatened species with CH on August 31, 1984 (FWS 1984). The factors contributing to the listing of the Yaqui catfish include habitat destruction or modification, predation, inadequacy of existing regulatory mechanisms, and other factors (FWS 1984).

The following discussion is reiterated from the 2011 BA. Water development and pumping of underground aquifers constitute the greatest threat to the survival of Yaqui fishes, followed closely by introduction of non-native organisms. The range of this species has been significantly reduced, primarily due to habitat destruction and genetic introgression. Remaining populations are in danger of being subjected to intense competition and genetic swamping through the indiscriminate release of closely related non-native fishes.

The Yaqui catfish is seriously affected by a variety of habitat modifications. This species existed in San Bernardino Creek, Arizona, until the spring flows supporting the creek diminished and the remaining aquatic habitat was destroyed by cattle. Arroyo cutting, diverting stream headwaters, construction of impoundments, and excessive pumping of underground aquifers are responsible for the reduction of permanent stream habitat and for failing springs. Many river systems in Mexico, especially in lowland areas, have been highly modified into canal systems for irrigation agriculture. These alterations destroy pool habitats and have adverse impacts on fish populations.

The San Bernardino Valley is known to have potential geothermal energy resources (Hahman 1979), although the area is not a Known Geothermal Resource Area. The BLM has issued leases for geothermal resources on some of their lands adjacent to the San Bernardino NWR. Exploration and development of these leases could potentially cause depletion or pollution of the underground aquifers that supply water to the springs of the San Bernardino NWR, and could

thereby result in loss or pollution of the flows of those springs. However, if exploration and development are properly designed and regulated, such effects are not expected (Cheremisinoff and Morresi 1976).

Introduced predatory fishes, such as largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), black bullhead (*Ameirus melas*), channel catfish (*Ictalurus punctatus*), and green sunfish (*Lepomis cyanellus*) are present in some portions of the remaining range of the Yaqui catfish, and prey on them. The threat of such predation is likely to increase in the remaining habitats of the Yaqui catfish in Mexico. This threat is minor at present in U.S. habitats, and steps are already being taken to alleviate it.

Extant populations of the Yaqui catfish are seriously threatened by the introduction of closely related non-native species. Already established and expanding populations of channel catfish and blue catfish (*Ictalurus furcatus*) may reduce Yaqui catfish populations through competition or by genetic swamping. The introduction of non-native species has been shown to be detrimental to other native fishes, as illustrated by the rapid elimination of native Yaqui topminnow (listed as endangered and found in the same drainage) populations after introduction of the closely related western mosquito fish (*Gambusiu affinis*) as documented by Minckley (1973), Schoenherr (1973), and others.

Most of the U.S.-Mexico borderlands (Gehlbach 1981, Humphrey 1986), including all of southeastern Arizona and southwestern New Mexico have been heavily used for cattle grazing and local farming. Mining and other activities also resulted in some detrimental habitat or landscape changes. Diversity of natural landscapes quickly diminished under grazing pressure, especially when ranges were overstocked (Wagoner 1960). Chihuahuan Desert scrub expanded, grasslands deteriorated or locally disappeared, and riparian and aquatic habitats were destroyed or reduced to disturbed, disjunct remnants (FWS 1994). Today's regional vegetation nonetheless remains a desert grassland, closely intermingled with Chihuahuan desert scrub on drier sites (Lanning 1981). Mesquite (*Prosopis glandulosa*) bosques are the predominant lowland communities, along with pockets of riparian broad-leafed woodlands and cienega habitats where water persists at or near the surface (Marrs-Smith 1983)

Physical and other impacts associated with watershed use and misuse led to dramatic reductions in aquatic habitats and biota. In the past, as today, water was a scarce and sought-after commodity. Relatively abundant supplies in the upper Rio Yaqui basin, especially after artesian wells were built in the later 1800's, led to large-scale cattle grazing and concentrated farming in the area. Severe grazing pressure (including trampling) also led to incision of stream channels that drained and desiccated cienegas, diversion and modification of stream channels themselves, and excessive exploitation of underground aquifers; all reduced the quantity and quality of natural surface waters.

Climate Change

Potential effects of climate change throughout Arizona and New Mexico are discussed in the Introduction section of this BO. Climate forecasts project not only temperature increases but also an increase in the frequency of hot extremes, heat waves, and heavy precipitation events. Ultimately, this may result in drier future conditions for the Southwest and an increasing

probability of drought. Due to these projections, we anticipate that fish species including the Yaqui catfish will face the following conditions as a result of climate change:

1. Increased water temperature;
2. Decreased stream flow;
3. A change in the hydrograph; and
4. An increased occurrence of extreme events (such as fire, drought, and floods)

Temperature is a key factor defining the gradients of performance and the absolute bounds of life for most aquatic organisms. It also affects rates of growth and timing of key life history events or transitions (Rieman and Isaak 2010). Increased temperature, due to climate change, is likely to lead to increased water temperature, which would allow other warm-water fishes (native and nonnative) to expand their range into the limited habitat occupied by Yaqui catfish.

Despite the current limits of climate change effects analysis, the 2011 BA also states that the USFS Southwestern Region has developed guidance for addressing climate change in NF LRMP revisions, which are broad and general in scope and which rely on adaptive management as climate change science evolves. Therefore, as we better understand the potential effects of climate change on Yaqui catfish distribution, FWS expects that this increased knowledge will be incorporated into revisions of the Coronado NF LRMP.

Recovery Actions

Yaqui catfish are not found on the Coronado NF and no CH is designated on NFS lands (FWS 2005). Therefore, direct actions to pursue recovery of Yaqui catfish on NFS lands do not exist; however, indirect effects may be considered through impacts to the aquifer and surface waters of the San Bernardino Valley, Sulphur Springs Valley, and Whitewater Draw (USFS 2004).

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, 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 which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

As stated in the 2011 BA and 2005 BO/CO, there are no known populations of Yaqui catfish within the Coronado NF boundaries; however, the species was released in ponds on the El Coronado Ranch in 1999 (USFS 2004), which borders the west boundary of the Chiricahua Mountains unit of the Douglas RD. The ponds on the El Coronado Ranch are within the West Turkey Creek watershed (FWS 2005).

For ease of future consultations, in the event the Yaqui catfish becomes established on the Coronado NF, the S&Gs were analyzed as if this were already the case. In the 2009-2010 annual monitoring of LRMP implementation, Yaqui catfish were captured in two of the three known

sites/ impoundments, House Pond at the Slaughter Ranch and Big Tank at El Coronado Ranch. None were captured on San Bernardino NWR.

Critical Habitat
Critical habitat does not occur on the Coronado NF, but CH does exist on the San Bernardino NWR approximately 16 km (10 mi) downstream. Critical habitat on the NWR provides habitat for one of the two existing population of Yaqui catfish and may provide expansion habitat for the Yaqui catfish. The CH on the NWR is separated from the Coronado NF by 10-15 miles of intermittent stream channels.

Factors Affecting the Species within the Action Area
The following factors affecting the Yaqui catfish are reiterated from the 2005 BO/CO. Any effects to the Yaqui catfish as a result of USFS activities would likely be due to watershed manipulation which would alter habitat that could be occupied by the species.

It was anticipated that the severe 2011 fire season may have had some adverse effect to the Yaqui catfish. As it turns out, this species is only found in private ponds on El Coronado Ranch and no suppression effects or wildfire impacts were identified while the ponds remain intact (Coronado National Forest, pers. comm., 2011).

EFFECTS OF THE ACTION

The S&Gs listed in the Coronado NF LRMP and 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs are related to the Yaqui catfish and its habitat. The S&Gs, if applied to project-level activities, may result in both indirect and direct effects to the species and its CH. Designated CH for the Yaqui catfish does not occur within the action area but does exist approximately 10 miles downstream on the San Bernadino NWR where indirect effects may occur.

The 2005 BO/CO included tables showing the S&Gs considered for each species' analysis and a ranking table summarizing the types of effects to species (lethal, sublethal, etc.) expected to result from the S&Gs. Because there have been no changes in Forest policy or programs that would change the 2004 BA (USFS) and 2005 BO/CO (FWS) effects determination for this species, we hereby incorporate by reference the ranking tables and effects analysis presented in the 2005 BO/CO and provide a narrative summary below.

As outlined in the 2005 BO/CO, Yaqui catfish currently do not occur on the Coronado NF. However, we analyzed the effects of the proposed action at the request of the USFS because they may occur on or downstream of the Forest in the future. The majority of the applicable S&Gs are likely to result in beneficial effects to the Yaqui catfish; however, we found several S&Gs that are likely to result in a lethal, sublethal, or negative behavioral response in this species. The S&Gs with the potential for negative effects to the catfish result from the Forestry and Forest Health, Rangeland Management, and Watershed Management Programs.

Standard and Guideline 697 within the Forestry and Forest Health Program allows for the use of chemical agents in recreation areas. Yaqui catfish could be present in these areas in the future

(particularly in riparian camping and boating areas) and, thus, may be affected by chemical use. If chemical agents are transferred to water sources, purposefully or incidentally, the watershed would experience decreased water quality over time, thus decreasing the feeding and breeding success of Yaqui catfish. Activities conducted under this S&G are also potentially lethal to the species within occupied areas or areas adjacent to the species where pollutants could enter occupied habitat. Standard and Guideline 696, however, may offset some of these potential impacts as it requires the Coronado NF to conform to Department of Agriculture standards in the use of all pesticides and to promote development of alternative methods of control.

Within the Rangeland Management Program, there are many S&Gs that allow for a range of grazing levels across MAs. These S&Gs (792 and 805) could result in negative effects to the Yaqui catfish as a result of watershed degradation, such as reduced breeding and feeding success. In addition, S&G 829 allows for grazing in MA 9, but only if the riparian area can achieve and be maintained in satisfactory condition. In general, the emphasis of the range management program on the Forest is to improve watershed condition and wildlife habitat.

The Watershed Management Program contains one S&G that may have a direct negative effect on the Yaqui catfish. Standard and Guideline 678 provides some goals for watershed management including the maintenance of 80 percent of natural shade over water surfaces, 80 percent of natural bank protection, and composition of sand, silt, and clay within 20 percent of natural levels. The FWS recognizes these S&Gs as positive, but these habitat characteristics represent desired future conditions in many areas. Working towards these goals should benefit the catfish in the long-term; however, until these goals are achieved, the habitat of the Yaqui catfish is still limited and may result in the catfish avoiding some areas. Standards and Guidelines 677, 711, 782, and 784 all allow for some riparian and watershed improvement that should result in increased habitat quantity and quality for the Yaqui catfish despite some short-term effects due to project impacts. These impacts could include temporarily decreased water quality and quantity potentially leading to decreased breeding and feeding success and mortality of individuals due to crushing by humans, tools, or machinery.

A number of S&Gs in the Wildlife Program may benefit the Yaqui catfish by providing for actions which work towards delisting of listing species. If properly implemented, these S&Gs should not only minimize the adverse effects of other projects but would also result in increased population numbers and sizes. These S&Gs are particularly useful in consideration of the actual status of the Yaqui catfish on the landscape.

In summary, four percent of the applicable S&Gs have the potential to cause adverse effects of Yaqui catfish, while just over 75 percent of the S&Gs have positive effects to the species. The remaining 21 percent of the applicable S&Gs have no effect to the Yaqui catfish or are subject to interpretation and are difficult to analyze.

1996 Regional Amendment

The management direction provided by the S&Gs in the 1996 Regional Amendment relates to the conservation of MSOs and northern goshawks. The S&Gs promote healthy forest ecosystems; functioning watersheds; and riparian and aquatic systems (USFS 2004). Watersheds occupied by the Yaqui catfish co-occur with MSO restricted and protected areas, as well as the

nesting and post-fledgling family areas of northern goshawks. As a result, the S&Gs associated with the 1996 Regional Amendment are applicable to the Yaqui catfish and its habitats. However, we found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

Effects to Critical Habitat

As repeated throughout this species section, CH for the Yaqui catfish occurs 10 to 15 miles down intermittent channels from the NFS boundaries. FWS concurs with the findings of USFS that any potential effects to CH would likely be insignificant or discountable due to the linear separation and intermittency of draws between NFS lands and CH for the Yaqui catfish. Indirect effects associated with activities should also be avoided by implementation of S&G 676, which allows other resource activities to occur only to the extent that they benefit or do not adversely affect Yaqui catfish. This includes effects to CH and PCEs. Our concurrence for a “not likely to adversely affect” call can be found in Appendix A of this BO.

Summary of Effects

As summarized in the 2005 BO/CO, the applicable S&Gs within the Coronado NF LRMP and 1996 Regional Amendment allow for a variety of effects to the Yaqui catfish. Take of Yaqui catfish would be reasonably certain to occur as a result of implementation of the Coronado NF LRMP and 1996 Regional Amendment if it were to become established on Coronado NF lands. As it stands, any effects to the Yaqui catfish on El Coronado Ranch due to the implementation of the Coronado NF LRMP and 1996 Regional Amendment would likely be insignificant or discountable. Additionally, any effects to CH would also likely be insignificant or discountable due to the linear separation and intermittency of draws between USFS lands and CH for the Yaqui catfish.

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.

As stated in the 2005 BO/CO, ponds associated with mining operations on private property within the action area may contain non-native fish. Natural events such as floods may spread non-native species. Water development and pumping of underground aquifers could also occur on private land. Because ground water pumping was cited as a reason for listing, this could have appreciable negative affects to the species.

CONCLUSION

After reviewing the current status of the Yaqui catfish, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Yaqui catfish. Pursuant to 50 CFR 402.02, to "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the

reproduction, numbers, or distribution of that species. Designated CH for the Yaqui catfish does not occur within the action area; thus, the USFS found that the continued implementation of the Coronado NF LRMP may affect, but is not likely to adversely affect the designated CH for the Yaqui catfish. FWS concurs with this finding as any effects to CH would likely be insignificant or discountable due to the linear separation and intermittency of draws between NFS lands and CH for the Yaqui catfish. Further, S&G 676 will prevent adverse impacts on CH as it allows other resource activities to occur only to the extent that they benefit or do not adversely affect Yaqui catfish.

The Yaqui catfish is not currently found on the Coronado NF; thus, at this time, no direct impact to the species should occur as a result of the proposed action. In addition, the LRMP includes S&Gs which direct the Coronado NF to prioritize T&E species over other species, work towards recovery, and to help delist listed species, which may benefit the Yaqui catfish directly and indirectly as a result of conservation of the Yaqui chub. Beyond the S&Gs specific to listed species concerns, the LRMP also includes S&Gs which direct range and watershed conditions to improve. As a result, the availability and quality of Yaqui catfish habitat on the Coronado NF should only increase. Therefore, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of the Yaqui catfish. Furthermore, the FWS concludes that the proposed action is not likely to adversely affect Yaqui catfish designated CH as discussed in Appendix A of this BO.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species 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 FWS 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 FWS 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 ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Amount or Extent of Take Anticipated

No take is anticipated to occur as a result of the proposed action because the species is currently not found on the NFS lands and the potential adverse indirect effects that were analyzed in the opinion, do not rise to the level of take. If the species becomes established on the NFS within the life of the current LRMP, reinitiation will be necessary.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA direct federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information on listed species. The FWS recommends the following conservation activities:

1. Ameliorate effects of non-native fishes within Yaqui catfish management streams.
2. Other actions occurring in the West Turkey Creek watershed need to be analyzed for potential impacts to the Yaqui catfish. Impacts from the different forms of recreation occurring in the watershed are probably more detrimental to the Yaqui catfish and the watershed than actions previously consulted on. A watershed plan may be an appropriate means of addressing the issues. The USFS should cooperatively work with the FWS and interested parties to address these issues (Recovery plan task 2.0, FWS 1994c:23).
3. Designate reestablishment areas within the species' historical range on the Coronado NF and develop appropriate protective management measures.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

YAQUI CHUB

STATUS OF THE SPECIES

Description

The Yaqui chub (*Gila purpurea*) is a medium-sized minnow of the family Cyprinidae, with adults rarely exceeding 15 cm (6 in) in length (Minckley 1973). The body is generally dark over all, but usually somewhat lighter below. Some breeding males have a distinctive bluish sheen over the body while reproductive females are a straw yellow to light brown. Lateral bands are absent or scarcely developed. A vertically elongate, diffuse triangle-shaped caudal spot is usually present (Minckley 1973). Head and anterior body are thickened, thinning posteriorly. Scales are large and broadly imbricate with radii on all fields.

The Yaqui chub was first collected and described from San Bernardino Creek (Black Draw), just south of the U.S.-Mexico border, in the latter half of the 19th century (Girard 1857, Rutter 1896). The Yaqui chub was originally described as *Tigoma purpurea* (Girard 1857). Initially, *Gila purpurea* was thought to occur in the basins of the Río Sonora, Rio Matape, and Rio Yaqui in Arizona and Sonora, Mexico (Hendrickson et al. 1980). However, in 1991, it was recognized that the chub in the Ríos Sonora and Matape and the Río Yaqui system downstream from San Bernardino Creek is a different species, *Gila eremica* (DeMarais 1991).

Legal Status: On August 31, 1984, the FWS listed the Yaqui chub as an endangered species with designated CH (FWS 1984). A final Recovery Plan for the species was signed on March 29, 1995.

Distribution and Abundance

As described in the 2011 BA, the historical range of Yaqui chub includes the western Rio Yaqui basin, which occurs in the USA and in Mexico. The Rio Yaqui basin drains western Sonora and portions of eastern Chihuahua in Mexico and the San Bernardino Valley in southeastern Arizona, U.S. (Minckley 1980, Minckley and Brown 1994). The drainage in the USA includes parts of Cochise County, Arizona, and Hidalgo County, New Mexico (FWS 1995). Yaqui chub historical distribution included West Turkey Creek in the Chiricahua Mountains and its terminus, the Sulphur Springs Valley; both are immediately adjacent to the Coronado NF and, thus, are within the Action Area.

The Yaqui chub has been extirpated from its historical habitat; however, populations have been introduced in Leslie Canyon in the Swisshelm Mountains, in San Bernardino NWR, and in ponds and the mainstream of West Turkey Creek in the Chiricahua Mountains, Arizona (FWS 2010). . Waterbodies include Leslie Creek, House, Twin, North, and Mesquite Ponds, and El Coronado Ranch, including Turkey Creek and ponds (AGFD 2001). Reintroductions into West Turkey Creek on the Coronado NF have taken place in recent years; however, the habitat on the Forest is ephemeral and no fish have been found in follow-up monitoring. As explained in the Recovery Actions section below, no Yaqui chub have been documented in West Turkey Creek on the Coronado NF since 2003 despite these reintroduction efforts. The mainstream of West Turkey Creek is, however, occupied by Yaqui chub just downstream from the NF. Since the LRMP consultation in 2005, it appears that Yaqui chub have not become established on the Coronado NF but still persist in West Turkey Creek just downstream. In Mexico, Yaqui chub historically and currently occupy only a short perennial reach of Rio San Bernardino (Black Draw) in Sonora (Varela-Romero *et al.* 1992).

Habitat

The following information is reiterated from the 2005 BO/CO. The Yaqui chub's historical range throughout the Yaqui River Basin consists of intermediate to low elevation warm-water creeks, cienegas, and moderate- to large-sized rivers. Creeks typically have alternating riffles and pools in which heterogeneity is enhanced by undercut banks, boulders, and wood debris. Gravel bottoms in swift areas are vegetated with algae. Cienegas, streams and associated marshlands with low, emergent aquatic plants and hydric-adapted trees, were historically common but have suffered severe degradation since the arrival of Europeans (Hendrickson and Minckley 1985). Rivers vary from pool-riffle types with boulder and gravel bottoms to long, strongly flowing reaches over gravel and sand (Campoy-Favela et al. 1989). Elevations in Arizona range from 3,730 to 4,620 feet (1138 to 1409 m).

Adult Yaqui chub live in deep freshwater pools in creeks, scoured areas of cienegas, and other stream associated quiet waters. They seek cover in daylight, especially undercut banks and in areas of accumulated debris often associated with higher aquatic plants (Lee et al. 1980). In artificial ponds, adults tend to occupy the lower part of the water column and seek shade. Young

occupy near-shore zones, often near the lower ends of riffles. Maes (1995) observed a vertical stratification of age classes in both lentic and lotic environments with younger fish occupying the areas higher in the water column regardless of depth. Adult Yaqui chub avoided waters with detectable water velocity, but younger fish occasionally were found in flowing water (Maes 1995).

Critical Habitat: Critical habitat for the Yaqui chub includes all aquatic habitats of San Bernardino NWR, Cochise County, Arizona, excluding the Leslie Canyon complex. These areas provide habitat for one of the two existing populations of Yaqui chub. Additionally, the aquatic habitats on San Bernardino NWR may provide expansion habitat for the Yaqui chub. There is no CH for the Yaqui chub on the Coronado NF.

Critical habitat is described by PCEs, which are the physical and biological features the FWS has determined are essential to the conservation of the species. For the Yaqui chub, the PCEs are:

1. Clean, small, permanent streams and spring pools without any exotic fishes.
2. The streams should have deep pool areas separated by riffles and flowing areas with moderate current; and
3. Backwater areas of streams and springs with overgrown cut banks and accumulations of detritus are necessary for feeding and shelter.

Life History

For a detailed discussion of Yaqui chub life history, please refer to the 2005 BO/CO. The Yaqui chub is a small to medium sized cyprinid fish. Males in breeding condition are bluish and females and non-reproducing males are brownish-grey. Breeding occurs from March to September. Yaqui chub are omnivores. Yaqui chub exposed to Asian tapeworm have considerably lower growth rates than those not exposed. The population-level effect of this lower growth rate is unknown, and field observations show no pattern.

In the original listing, chubs from other areas of the Rio Yaqui were assumed to be Yaqui chub; however, recent taxonomic information has separated the chubs in the western portion of the range to be a different species.

Reasons for Listing

The FWS listed the Yaqui chub as an endangered species on August 31, 1984. As stated in the 2005 BO/CO, the range of this species has been significantly reduced, primarily due to habitat degradation and destruction. The remaining populations are in danger of being subjected to intense competition through the indiscriminate release of non-native fish. Threats to the Yaqui chub come from surface water development and groundwater pumping that reduces or eliminates spring flows or surface water in small streams. Introduced nonnative fish are predators or competitors on Yaqui chub and have been eliminated from the San Bernardino NWR; however, nonnative bullfrogs remain and are predators on this small fish. Nonnative fish and bullfrogs are also present in some portions of the range in Mexico.

The Yaqui chub is seriously affected by a variety of habitat modifications. This species existed in San Bernardino Creek (Astin Spring), Arizona, until the spring flows supporting the creek diminished and the remaining aquatic habitat was destroyed by cattle. Arroyo cutting, diverting

stream headwaters, construction of impoundments, and excessive pumping of underground aquifers are responsible for the reduction of permanent stream habitat and for failing springs. As explained above, the remaining U.S. populations of Yaqui chub are limited to a few springs and ponds on the San Bernardino NWR, Leslie Creek on the Leslie Canyon NWR, West Turkey Creek and ponds within the Coronado NF, and the El Coronado Ranch (Silvey 1975; FWS 1995, 1999). Both NWR populations are threatened by a gradually dwindling spring flow.

The San Bernardino Valley is known to have potential geothermal energy resources (Hahman 1979), although the area is not a Known Geothermal Resource Area. The BLM has issued leases for geothermal resources on some of their lands adjacent to the San Bernardino NWR. Exploration and development of these leases could potentially cause depletion or pollution of the underground aquifers that supply water to the springs of the San Bernardino NWR, and could thereby result in loss or pollution of the flows of those springs.

Introduced predatory fishes such as largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), black bullhead (*Ameirus melas*), channel catfish (*Ictalurus punctatus*), and green sunfish (*Lepomis cyanellus*) are present in some portions of the remaining range of the Yaqui chub, and probably prey opportunistically on them. The introduction of non-native species has been shown to be detrimental to other native fishes, as illustrated by the rapid elimination of the native Yaqui topminnow populations (listed as endangered and found in the same drainage as the Yaqui chub) after introduction of the closely related western mosquitofish (*Gambusia affinis*), documented by Minckley (1973), Schoenherr (1973), and others. This threat to the Yaqui chub is minor at present in U.S. habitats, and steps are being taken to alleviate it. The threat of such predation will continue to increase in the remaining habitats of the Yaqui chub in Mexico.

Most of the U.S.-Mexico borderlands (Gehlbach 1981, Humphrey 1986), including all of southeastern Arizona and southwestern New Mexico, has been heavily used for cattle grazing and local farming. Mining and other activities also resulted in some detrimental habitat or landscape changes. Diversity of natural landscapes quickly diminished under grazing pressure, especially when ranges were overstocked (Wagoner 1960). Chihuahuan Desert scrub expanded, grasslands deteriorated or locally disappeared, and riparian and aquatic habitats were destroyed or reduced to disturbed, disjunct remnants (FWS 1994). Today's regional vegetation nonetheless remains desert grassland, closely intermingled with Chihuahuan desert scrub on drier sites (Lanning 1981). Mesquite (*Prosopis glandulosa*) bosques are the predominant lowland communities, along with pockets of riparian broad-leafed woodlands and cienega habitats where water persists at or near the surface (Marrs-Smith 1983)

Climate Change

Potential effects of climate change throughout Arizona and New Mexico are discussed in the Introduction section of this BO. Climate forecasts project not only temperature increases but also an increase in the frequency of hot extremes, heat waves, and heavy precipitation events. Temperature is a key factor defining the gradients of performance and the absolute bounds of life for most aquatic organisms. It also affects rates of growth and timing of key life history events or transitions (Rieman and Isaak 2010). Increased temperature may also lead to an increase in water temperature, which would allow other warm-water fishes (native and non-native) to expand their range into the limited habitat occupied by Yaqui chub. This would be detrimental

to the Yaqui chub. Due to climate change projections, we anticipate that fish species including the Yaqui chub will face the following conditions as a result of climate change:

1. Increased water temperature;
2. Decreased stream flow;
3. A change in the hydrograph; and
4. An increased occurrence of extreme events (such as fire, drought, and floods)

Despite the current limits of climate change effects analysis, the 2011 BA also states that the USFS Southwestern Region has developed guidance for addressing climate change in NF LRMP revisions, which are broad and general in scope and which rely on adaptive management as climate change science evolves. Therefore, as we better understand the potential effects of climate change on Yaqui chub distribution, FWS expects that this increased knowledge will be incorporated into revisions of the Coronado NF LRMP.

Recovery Actions

The following information is reiterated from the 2011 BA. In 2005, 60 Yaqui chub were collected from West Turkey Creek using minnow traps and immediately trucked up the canyon for release into three historically perennial pool habitats within the Coronado NF. Twenty adult chub were released into each pool (USFS 2005). Follow-up monitoring at each of the pools returned no fish in one of the pools, a few fry at another release site, and a few adults in two of the pools. In 2006, four Yaqui chub (and 80 longfin dace) were collected via electroshocking from an adjacent private land site and immediately transported up canyon for release into the three perennial pools on the Forest. Yaqui chub from previous introductions were not observed. Follow-up monitoring for the 2006 stocking revealed no fish in the lower two pools, and a few dead/dying longfin dace along with one chub in the upper pool. Low water conditions were suspected as the reason for poor survival (USFS 2006). Surveys on the Coronado NF were conducted with assistance from AGFD and FWS in conjunction with the translocation efforts, as part of an on-going project to re-introduce a population of Yaqui chub (and associated fish species) into West Turkey Creek on the Douglas RD.

The Forest completed three surveys in 2007, and six surveys in 2008, both on and off the Forest. Private land below the Forest has an extant population. However, no Yaqui chub have been found in West Turkey Creek on the Forest since 2003. The probable reason for the loss of this population is most likely drought (USFS 2008). Pool habitats within the Coronado NF have likely diminished in quantity and quality due to drought and sediment flows following wildfires, although this has not been documented using a standardized habitat assessment methodology.

In 2009, three sites on West Turkey Creek within the Coronado NF boundary were surveyed, but no fish were found due to low water levels. Habitats on the Forest are ephemeral, but healthy populations persist in private ponds and in perennial stream reaches at El Coronado Ranch downstream of the Forest monitoring sites. Riparian areas are largely ungrazed and in good condition (USFS 2010).

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, 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 which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

At the time of the 2005 consultation, it was believed that Yaqui chub occurred within the El Coronado Ranch, West Turkey Creek, and the Coronado NF. Roughly 4 miles (6.4 km) of potential Yaqui chub habitat exists within West Turkey Creek. Of this, about 2.5 miles (4 km) are within the Turkey Creek Allotment on the Coronado NF. These areas coincide with MAs 3, 4, 7 and 9. However, Yaqui chub have not been found in West Turkey Creek since 2003 (USFS 2008) largely due to the ephemeral nature of the habitat and an ongoing drought. Further, pool habitats within the Coronado NF have likely diminished in quantity and quality due to drought and sediment flows following wildfires, although this has not been documented using a standardized habitat assessment methodology. Downstream of the Coronado NF, however, healthy populations persist in private ponds and in perennial stream reaches at El Coronado Ranch.

Critical Habitat

There is no Yaqui chub CH designated on the Forest. Critical habitat does exist about 10 miles (16 km) away on the San Bernardino NWR.

On the San Bernardino/Leslie Canyon NWR, annual monitoring in 2009 showed that the percent habitat occupied for Yaqui chub was 50.8 percent for all impoundments, up from 35 percent in 2008, and at the Bar Boot Ranch, where Yaqui chub were stocked through implementation of a Safe Harbor Agreement, 58 percent of the habitat was occupied with many juveniles present (FWS 2010).

Factors Affecting the Species within the Action Area

The following factors affecting the Yaqui chub are reiterated from the 2005 BO/CO. A Section 10(a)(1)(B) permit was issued in 1998 approving the Habitat Conservation Plan (HCP) for the El Coronado Ranch in Cochise County, Arizona (FWS 1998). The HCP is effective for 25 years and covers 15,204 acres of the Turkey Creek basin occurring on the private lands of the El Coronado Ranch and several grazing allotments on the Coronado NF. The goals of the HCP include watershed management, improved riparian condition, continued operation of the ranch, and conservation and recovery of native species. The Section 10(a)(1)(B) permit covers incidental take of Yaqui chub, Yaqui catfish, and the Yaqui form of longfin dace, should it ever be listed. Implementation of the HCP should lead to improved watershed and habitat conditions for native fish in the watershed.

Forest Road 41 more or less parallels Turkey Creek and ends in a trailhead at the Wilderness boundary. This is one of four trailheads that accesses wilderness recreation trails from West

Turkey Creek. Also, along with the El Coronado Ranch, there are 14 recreational summer homes, two semi-developed campgrounds, and several dispersed camping sites in use within the canyon on the Coronado NF. The West Turkey Creek Native Fish Habitat Renovation Project underwent formal consultation on February 4, 1999 (FWS 1999). The goal of this project was to maintain West Turkey Creek as a native fishery and remove non-native fishes. Two treatments have been conducted so far and appear to have been successful.

In 1994, because of the Rattlesnake Fire, significant quantities of ash and other debris were transported downstream into West Turkey Creek. Nevertheless, the resident non-native rainbow trout, native longfin dace, and Yaqui chub survived. However, the event did not impact the watershed equally. The majority of the debris flows affected the lower reaches of West Turkey Creek via Saulsbury and Ward Canyons. The watershed is still continuing to heal and recover.

In 2011, the Horseshoe 2 wildfire burned a total of 222,954 acres, including 192,647 acres of NFS lands (Coronado National Forest, pers. comm. 2011). Suppression activities associated with this wildfire likely did not result in adverse effects to the Yaqui chub; however, it is likely that habitat and individuals were affected by ash and sediment flow following the wildfire. During the wildfire and before any flooding, fish were salvaged from West Turkey Creek and placed in private ponds on El Coronado Ranch. No effects to the ponds or individuals in the ponds were identified from either the suppression activities or the wildfire.

Critical Habitat

Within this consultation the analysis of effects to Yaqui chub CH considers only indirect effects of USFS actions to San Bernardino NWR (10 miles downstream) because designated CH does not occur within the Coronado NF. Any activity which would lower the ground water level to the extent that the water flow from springs on San Bernardino NWR would be reduced could adversely impact the CH. Such activities include, but are not limited to, pumping of ground water for agricultural purposes and drilling activities associated with geothermal exploration. Any activity which would significantly alter the water chemistry of springs on San Bernardino NWR could adversely impact the CH. Such activities include, but are not limited to, release of chemical or biological pollutants into surface or underground waters at a point source or by dispersal release.

EFFECTS OF THE ACTION

The S&Gs listed in the Coronado NF LRMP and 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs are related to the Yaqui chub and its habitat. The S&Gs, if applied to project-level activities, may result in both indirect and direct effects to the species. Designated CH for the Yaqui chub does not occur within the action area, but it does occur approximately 10 miles from the NF where indirect effects could occur.

The 2005 BO/CO included tables showing the S&Gs considered for each species' analysis and a ranking table summarizing the types of effects to species (lethal, sublethal, etc.) expected to result from the S&Gs. Because there have been no changes in Forest policy or programs that would change the 2004 BA (USFS) and 2005 BO/CO (FWS) effects determination for this species, we hereby incorporate by reference the ranking tables and effects analysis presented in

the 2005 BO/CO and provide a narrative summary below. As stated above, it should be noted that Yaqui chub have not been documented in West Turkey Creek on the Coronado NF since 2003, but this analysis is conducted to evaluate how the NF's LRMP will impacts the population of Yaqui chub located just downstream from the Forest.

Although no CH for the Yaqui chub occurs on USFS lands, the species was documented (prior to 2003) on the Coronado NF in MAs 3, 4, 7, and 9. The majority of the applicable S&Gs are likely to result in beneficial effects to the Yaqui chub; however, we found several S&Gs that are likely to result in a lethal, sublethal, or negative behavioral response in this species. Standards and Guidelines with the potential to cause adverse effects to the Yaqui chub occur within the Forestry and Forest Health, Rangeland Management, and Watershed Management Programs.

Within the Forestry and Forest Health Program, S&G 697 allows for the use of chemical agents in recreation areas. Yaqui chub could be present in these areas if it becomes established on the Forest, particularly riparian camping and boating areas, and thus may be affected by chemical use. If chemical agents are transferred to water sources, purposefully or incidentally, the watershed would experience decreased water quality, thus decreasing the feeding and breeding success of Yaqui chub. Activities conducted under this S&G are also potentially lethal to the species within areas occupied by the species or in areas adjacent to the species where pollutants could enter occupied habitat. Standard and Guideline 696 may provide some protection in that it requires the Coronado NF to conform to U.S. Department of Agriculture standards in the use of all pesticides and to promote development of alternative methods of control. This S&G helps to limit usage, but may not completely protect the Yaqui chub as the U.S. Department of Agriculture standards are set up to protect humans rather than fish.

There are potential effects to the Yaqui chub as a result of the Rangeland Management Program because many of the S&Gs call for a range of grazing levels across MAs. Standards and Guidelines 792 and 805 allow for Level D grazing in MAs 7A and 7B, or Level A if Level D cannot be achieved. These S&Gs could result in some negative effects to the Yaqui chub, if established, in the form of watershed degradation resulting in reduced breeding and feeding success. Level D grazing also allows for a great deal of fencing and water developments, allowing the riparian to be protected. Standard and Guideline 829 allows for grazing in MA 9, but only if the riparian can achieve and be maintained in satisfactory condition. The manner in which the effects of livestock grazing are manifested, and the magnitude of the effects in the watershed, are dependent on local site conditions. The emphasis of the rangeland management program on the Forest is to improve watershed condition and wildlife habitat.

Only one S&G in the Watershed Management Program has a direct negative effect on the Yaqui chub. Standard and Guideline 678 provides some goals for watershed management including the maintenance of 80 percent of natural shade over water surfaces, 80 percent of natural bank protection, and composition of sand, silt, and clay within 20 percent of natural levels. The FWS recognizes these S&Gs as being positive. These habitat characteristics represent desired future conditions in many areas. Working towards these goals should benefit the Yaqui chub in the long-term; however, until these goals are achieved, the Yaqui chub may still be experiencing adverse effects from poor habitat quality.

In summary, four percent of the applicable S&Gs are likely to cause mortality of Yaqui chub, while over 76 percent of the S&Gs have positive effects to the species. Those S&Gs which may result in adverse effects are related to the Forestry and Forest Health, Rangeland Management, and Watershed Management Programs. The remaining 20 percent of the applicable S&Gs have no effect to the Yaqui chub or are subject to interpretation and are therefore difficult analyze. For a detailed analysis of the effects to Yaqui chub resulting from the Coronado NF S&Gs, please refer to the 2005 BO/CO.

1996 Regional Amendment

All of the S&Gs analyzed for the 1996 Regional Amendment fall under the Wildlife Program. The management direction provided by the S&Gs in the 1996 Regional Amendment relates to the conservation of MSOs and northern goshawks. These S&Gs promote healthy forest ecosystems; functioning watersheds; and riparian and aquatic systems (USFS 2004). Yaqui chub sites co-occur with MSO restricted and protected areas, as well as the nesting and post-fledgling family areas of northern goshawks. As a result, the S&Gs associated with the 1996 Regional Amendment are applicable to the Yaqui chub and its habitats. However, we found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

Effects to Critical Habitat

As repeated throughout this species section, CH for the Yaqui chub occurs 10 to 15 miles down intermittent channels from the NFS boundaries. FWS concurs with the findings of USFS that any potential effects to CH would likely be insignificant or discountable due to the linear separation and intermittency of draws between NFS lands and CH for the Yaqui chub. Indirect effects associated with activities should also be avoided by implementation of S&G 676, which allows other resource activities to occur only to the extent that they benefit or do not adversely affect Yaqui chub. This includes effects to CH and PCEs.

Summary of Effects

As described in the 2005 BO/CO, the applicable S&Gs within the Coronado NF LRMP and 1996 Regional Amendment will result in a variety of effects to the Yaqui chub. To a large extent, activities conducted under the positive S&Gs should benefit the Yaqui chub. However, the positive S&Gs do not eliminate the possibility of adverse effects. Although there is the potential for adverse effects to the species to result from the S&Gs included in the LRMP, we do not believe that take is reasonably certain to occur as a result of implementation of the Coronado NF LRMP and 1996 Regional Amendment. Additionally, any effects to CH would also likely be insignificant or discountable due to the linear separation and intermittency of draws between USFS lands and CH for the Yaqui chub. Our concurrence with this effect call to CH can be found in Appendix A of this document.

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.

As stated in the 2005 BO/CO, along these lines, most future actions in the watershed will be on federal lands, and thus would be subject to Section 7. Actions on the El Coronado Ranch within the El Coronado Ranch's HCP have been identified for a 25-year period. The illegal transplanting of non-native fish and amphibians will probably continue and will require periodic monitoring.

CONCLUSION

We analyzed Yaqui chub as if it occurred on the Coronado NF due to the fact that it has occurred there in the past and reintroduction attempt may occur during the life of the LRMP. However, we are not issuing an incidental take statement because the species does not currently occur on the Coronado NF. After reviewing the current status of the Yaqui chub, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Yaqui chub. Pursuant to 50 CFR 402.02, to "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. Designated CH for the Yaqui chub does not occur within the action area; thus, the USFS found that the continued implementation of the Coronado NF LRMP may affect, but is not likely to adversely affect the designated CH for the Yaqui chub. FWS concurs with this finding as any effects to CH would likely be insignificant or discountable due to the linear separation and intermittency of draws between NFS lands and CH for the Yaqui chub. Further, S&G 676 will prevent adverse impacts to CH by allowing other resource activities to occur only to the extent that they benefit or do not adversely affect Yaqui chub.

The Yaqui chub is currently found downstream of the Coronado NF and was last documented in West Turkey Creek of the NF in 2003. As discussed above, the FWS anticipates incidental take of the Yaqui chub is not reasonably certain to occur as a result of activities authorized under the Coronado NF LRMP and 1996 Regional Amendment because the species only occurs downstream. If the Yaqui chub were established on the Coronado NF, the FWS anticipates adverse effects to the species resulting from the implementation of the Coronado NF LRMP. The FWS does not believe that such activities will rise to the level of jeopardy for this species for the following reasons:

- The Coronado NF LRMP includes S&Gs that direct the Coronado NF to prioritize listed species over other species, work towards recovery, and to help delist species.

- Beyond the S&Gs specific to listed species concerns, the LRMP includes S&Gs which direct range and watershed conditions to improve. As a result, the availability and quality of Yaqui chub habitat on the Coronado NF should only increase.

- Yaqui chub have only occurred sporadically on the Coronado NF. In the case that the species becomes established on the NF, reinitiation would be necessary.

In summary, although the evaluation of the numeric effects analysis does not involve balancing or averaging the rankings, the full suite of S&Gs in the Coronado NF LRMP and 1996 Regional Amendment creates a decision-making framework within which the Coronado NF can continue to implement their LRMP without appreciably reducing the likelihood of the survival or recovery of the Yaqui chub in the wild. Therefore, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of the Yaqui chub.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species 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 FWS 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 FWS 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 of 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 ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

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

Amount or Extent of Take

Although we found that the S&Gs under the Coronado NF LRMP may adversely affect the Yaqui chub, we do not believe that incidental take is reasonably certain to occur from the implementation of the Coronado NF LRMP and the 1996 Regional Amendment. Yaqui chub are not currently present on the Coronado NF, but the species does exist on lands within 10 miles of the Forest. Standards and Guidelines within the Forestry and Forest Health, Rangeland Management, and Watershed Management Programs have the potential to affect the species through actions associated with prescribed fire, mechanical fuels treatments, chemical use, rangeland management, recreation, and impacts of surface disturbing projects. These indirect effects, however, are not likely to result in measurable impacts to the Yaqui chub at this time,

and, thus, do not rise to the level of take. If the species becomes established on NFS lands, reinitiation will be necessary and FWS will prepare an incidental take statement at that time.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA direct federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information on listed species.

1. Ameliorate effects of nonnative fishes within Yaqui chub management streams.
2. Other actions occurring in the West Turkey Creek watershed need to be analyzed for their potential impacts Yaqui chub. Impacts from the different forms of recreation occurring in the watershed are probably more detrimental to the Yaqui chub and the watershed than actions previously consulted on. A watershed plan may be an appropriate means of addressing the issues. The USFS should cooperatively work with the FWS, AGFD, and interested parties to address these issues (Recovery Plan task 2.0, U.S. Fish and Wildlife Service 1994c:23).
3. Designate reestablishment areas within the species' historical range on the Coronado NF and develop appropriate protective management measures.
4. Minimize or eliminate adverse effects from site-specific projects to Yaqui chub near the Coronado NF. This can be accomplished by managing riparian areas adjacent to and upstream of Yaqui chub populations for conditions that will eliminate direct effects and minimize indirect effects to Yaqui chub and its habitat. Also, the Coronado NF should design fire use, chemical use, range management, and recreational projects to minimize or eliminate adverse effects to the Yaqui chub.
5. Design projects in potential Yaqui chub habitat to incorporate important characteristics of pool habitats with the goal of implementing projects that will have beneficial, insignificant, and discountable effects to the Yaqui chub and its habitat.
6. Retain pool habitat in its current frequency and retain physical characteristics of the pools themselves. Important characteristics include: length, width, depth, residual depth, bank shape, bed material, instream cover type, presence of submergent or emergent vegetation, and absence of non-native fish or amphibians.
7. Cooperate with state conservation agencies to eliminate the introduction and continued presence of nonnative fish species within Yaqui chub habitat.
8. In cooperation with state conservation agencies, USFS research stations, FWS, and ongoing research efforts, develop a multi-agency monitoring plan focused on non-acts of God habitat risks to Yaqui chub and Yaqui chub pool habitat on the Coronado NF.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

CHIRICAHUA LEOPARD FROG

STATUS OF THE SPECIES

The Chiricahua leopard frog (*Lithobates [=Rana] chiricahuensis*) was listed as a threatened species without CH in a Federal Register notice dated June 13, 2002. Included was a special rule to exempt operation and maintenance of livestock tanks on non-Federal lands from the section 9 take prohibitions of the Act. Critical habitat was proposed in 2011 (U.S. Fish and Wildlife Service 2011a, 2011b) and includes 43 CH units in Arizona and New Mexico. The Chiricahua Leopard Frog Final Recovery Plan (Recovery Plan) was finalized in April 2007 (U.S. Fish and Wildlife Service 2007).

The frog is distinguished from other members of the *Lithobates 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 are 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 (Platz and Mecham 1979, Davidson 1996). Snout-vent lengths of adults range from approximately 2.1 to 5.4 inches (Platz and Mecham 1979, Stebbins 2003). The Ramsey Canyon leopard frog (*Lithobates* "*subaquavocali*s"), found on the eastern slopes of the Huachuca Mountains, Cochise County, Arizona, has recently been subsumed into *Lithobates chiricahuensis* (Crother 2008) and recognized by the FWS as part of the listed entity (U.S. Fish and Wildlife Service 2009).

The range of the Chiricahua leopard frog includes central and southeastern Arizona; west-central and southwestern New Mexico; and, in Mexico, northeastern Sonora, the Sierra Madre Occidental of northwestern and west-central Chihuahua, and possibly as far south as northern Durango (Platz and Mecham 1984, Degenhardt et al. 1996, Lemos-Espinal and Smith 2007, Rorabaugh 2008) (Figure 2). Reports of the species from the State of Aguascalientes (Diaz and Diaz 1997) are questionable. The distribution 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 (see further discussion below).

The Chiricahua leopard frog is an inhabitant of montane and river valley cienegas, springs, pools, cattle (stock) tanks, lakes, reservoirs, streams, and rivers. The species requires permanent or semi-permanent pools for breeding and water characterized by low levels of contaminants and moderate pH, and may be excluded or exhibit periodic die-offs where *Batrachochytrium dendrobatidis (Bd)*, a pathogenic chytridiomycete fungus, is present (see further discussion of this in the threats section below and in U.S. Fish and Wildlife Service 2011). The diet of the Chiricahua leopard frog includes primarily invertebrates such as beetles, true bugs, and flies, but fish and snails are also eaten (Christman and Cummer 2006).

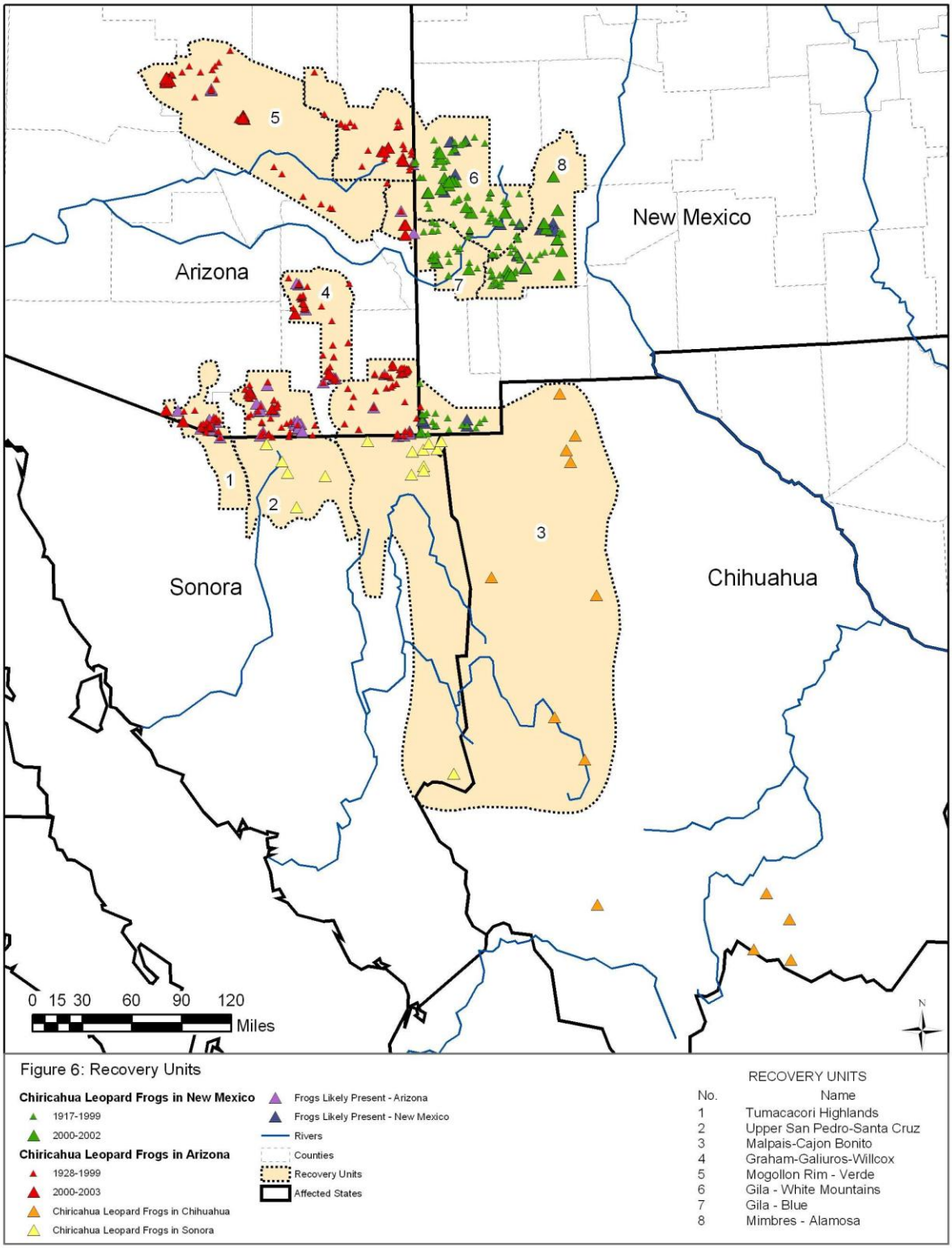

Figure 2. Map of the known range of the Chiricahua leopard frog as of 2007. The map covers areas in Arizona, New Mexico, and Mexico. All eight recovery units (RUs) are delineated by number.

Prior to the invasion of perennial waters by predatory, non-native species (American bullfrog, crayfish, fish species), the frog was historically found in a variety of aquatic habitat types. Today, leopard frogs in the Southwest are so strongly impacted by harmful nonnative species, which are most prevalent in perennial waters, that their occupied niche is increasingly restricted to the uncommon environments that do not contain these nonnative predators, and these now tend to be ephemeral and unpredictable. This increasingly narrow realized niche is a primary reason for the threatened status of the Chiricahua leopard frog.

The life history of the Chiricahua leopard frog can be characterized as a complex life cycle, consisting of eggs and larvae that are entirely aquatic and adults that are primarily aquatic, making the species a habitat specialist (U.S. Fish and Wildlife Service 2007). The species has a distinctive call and males can be temporarily territorial (U.S. Fish and Wildlife Service 2007). Amplexus is axillary and the male fertilizes the eggs as the female attaches a spherical mass to submerged vegetation. Eggs are laid from February into October, with most masses found in the warmer months (U.S. Fish and Wildlife Service 2007). Numbers of eggs in a mass range from 300 to 1,485 (Jennings and Scott 1991) and may be correlated with female body size. The hatching time of egg masses in the wild ranges between 8-14 days, depending on water temperature (U.S. Fish and Wildlife Service 2007). Upon hatching, tadpoles are mainly herbivorous and remain in the water, where they feed and grow, with growth rates faster in warmer conditions. Tadpoles have a long larval period, from three to nine months, and may overwinter. After metamorphosis, Chiricahua leopard frogs eat an array of invertebrates and small vertebrates and are generally inactive between November and February (U.S. Fish and Wildlife Service 2007). Males reach sexual maturity at 2.1-2.2 in (5.3-5.6 cm), a size they can attain in less than a year (Sredl and Jennings 2005). Under ideal conditions, Chiricahua leopard frogs may live as long as 10 years in the wild (Platz et al. 1997, p. 553).

Chiricahua leopard frogs can be found active both day and night, but adults tend to be active more at night than juveniles (Sredl and Jennings 2005). Chiricahua leopard frogs presumably experience very high mortality (greater than 90 percent) in the egg and early tadpole stages, high mortality when the tadpole turns into a juvenile frog, and then relatively low mortality when the frogs are adults (Zug et al. 2001, U.S. Fish and Wildlife Service 2007). Adult and juvenile Chiricahua leopard frogs avoid predation by hopping to water (Frost and Bagnara 1977). They also possess an unusual ability among members of the Rana pipiens complex; they can also darken their ventral skin under conditions of low reflectance and low temperature (Fernandez and Bagnara 1991; Fernandez and Bagnara 1993), a trait believed to enhance camouflage and escape predation (U.S. Fish and Wildlife Service 2007).

Males have larger home range sizes than females, with the largest home range for a male documented at 251,769 ft2 (7,674 by 32 ft, or 23,390.2 m2 [2,339 by 9.8 m]) (U.S. Fish and Wildlife Service 2007). The maximum distance moved by a radio-telemetered Chiricahua leopard frog in New Mexico was 2.2 miles (3.5 km) in one direction (preliminary findings of telemetry study by R. Jennings and C. Painter, Technical Subgroup, 2004). In 1974, Frost and Bagnara (1977) noted passive or active movement of Chiricahua and Plains (*Lithobates blairi*) leopard frogs for five miles or more along West Turkey Creek in the Chiricahua Mountains. In August 1996, Rosen and Schwalbe (1998) found up to 25 young adult and subadult Chiricahua leopard frogs at a roadside puddle in the San Bernardino Valley, Arizona. They believed that the

only possible origin of these frogs was stock tank located 3.4 miles away. Although amphibians are known to have limited dispersal and colonization abilities due to physiological constraints, limited movements, and high site fidelity (Blaustein et al. 1994), Chiricahua leopard frogs can disperse to avoid competition, predation, or unfavorable conditions (Stebbins and Cohen 1995). Dispersal most likely occurs within favorable habitat, making the maintenance of corridors that connect disjunct populations possibly critical to preserve populations of frogs. Active or passive dispersal (while carried along stream courses) of juveniles or adults to discrete aquatic habitats facilitates the creation and maintenance of metapopulations (U.S. Fish and Wildlife Service 2007), an important option for a water-dependent frog in an unpredictable environment like the arid Southwest.

For far more detailed information on this species, please refer to the Recovery Plan (U.S. Fish and Wildlife Service 2007), which is the baseline in regard to the current status, biology, and threats to the Chiricahua leopard frog.

Population Status in Arizona, New Mexico, and Mexico

Evidence indicates that since the time of listing, the species has probably made at least modest population gains in Arizona, but is apparently declining in New Mexico. Overall in the U.S., the status of the Chiricahua leopard frog is either static or, more likely, improving, with much of the increase attributable to an aggressive recovery program that is showing considerable results on the ground through the reestablishment of populations (mainly in Arizona), captive rearing programs, creation of refugial populations, and enhancement and development of habitat have helped stabilize or improve the status of the species in some areas (U.S. Fish and Wildlife Service 2011). In Arizona and New Mexico, there are currently two main captive breeding facilities – the Phoenix Zoo and the Ladder Ranch. In Arizona, a captive breeding program was established with the Phoenix Zoo in 2005 and the Ladder Ranch (a private 155,553 acre ranch in Sierra County, New Mexico) began captive propagation-headstarting-release in 2011. These programs, in concert with habitat restoration activities occurring across both states, are contributing to range-wide recovery of the frog. Population status and trends in Mexico are unknown.

Arizona

In Arizona, the frog still occurs in seven of eight major drainages of historical occurrence (Salt, Verde, Coronado, San Pedro, Santa Cruz, Yaqui/Bavispe, and Magdalena river drainages), but appears to be extirpated from the Little Colorado River drainage on the northern edge of the species' range. Within the drainages where the species occurs, it was not found recently in some major tributaries and/or in river mainstems. For instance, the species has not been reported since 1995 from the following drainages or river mainstems where it historically occurred: White River, West Clear Creek, Tonto Creek, Verde River mainstem, 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 areas: Pinaleno Mountains, Peloncillo Mountains, and Sulphur Springs Valley. Moreover, the species is now absent from all but one of the southeastern Arizona valley bottom cienega complexes. Large valley bottom cienega complexes may have

once supported the largest populations in southeastern Arizona, but non-native predators are now so abundant that the cienegas do not presently support the frog in viable numbers (U.S. Fish and Wildlife Service 2002).

A review of the status of the species in Arizona from 2002, when the species was listed, to 2009 was conducted by Rorabaugh (2010). A comparison of survey results during 2005-2009 versus 1999-2002 revealed increasing numbers of sites occupied by Chiricahua leopard frogs from 2002-2008. The total number of occupied sites increased from 49 in 2002 to 80 in 2008 and 90 in 2009, while the number of robust breeding populations increased from 5 in 2002 to 13 in 2008, and then declined slightly to 11 in 2009. The total number of breeding populations increased from 26 in 2002 to 34 in 2008 and then declined by 1 for a total of 33 sites in 2009. These trends were also generally reflected at the RU level of analysis. Exceptions included a reduction in number of breeding populations in RU 3 from three to two and in RU 6 from three to zero. Recovery Unit 5 also exhibited a reduction in the number of robust breeding populations from two to zero. Overall, the data suggest that there has been an increase in the number of occupied sites from 2002-2009. However, the increase in sites may only represent a positive response to temporarily favorable environmental conditions (i.e., such as adequate summer rains in rare years that allow for limited dispersal, rather than an intrinsic improvement that will endure over time due to factors such as long-term drought) and/or it could be a result of our underestimating the number of sites in 2002 due to lack of surveys in areas the frog actually occurred in at that time.

The above data suggest substantial gains in the number of known locations of Chiricahua leopard frogs since the time of listing. However, basing status and trends on differences in numbers of occupied sites from 2002-2009 can be problematic for several reasons. First, if increasing trends are accurate, they may represent population response to temporarily favorable environmental conditions, such as adequate summer rains that allow dispersal, rather than an intrinsic improvement that will endure over time. Second, there are sources of bias that affect the conclusions. For instance, both data sets likely underestimate the number of occupied sites existing at the time, because some sites were unknown or surveys had not been conducted within the last three years to categorize all sites as occupied or unoccupied. But there is further bias in the survey data in that the 2009 data set benefits from recent discoveries of populations that could have existed in 2002, but we did not know of them at the time.

The latter type of bias can be eliminated by adding to the 2002 total all of the occupied sites that were discovered after 2002, except for those for which we are reasonably certain were unoccupied in 2002. If analyzed in this way, the total number of occupied sites, in 2002, increases from 49 to 83. This is roughly the same number of occupied sites as in 2008 (85). Based on this, the total number of occupied sites was fairly stable or increasing slightly in Arizona from 2002 (83) to 2008 (85) and 2009 (92). However, this correction inserts yet another type of bias into the sample – analyzed in this way, the 2002 total is based not only on what was found during 1999 to 2002, but also surveys during period 2003 to 2009. Yet the 2008 and 2009 totals are only based on surveys during 2005-2008 and 2006-2009 respectively. The number of occupied sites in 2009 would no doubt increase if we could add in new sites during the equivalent future period (through 2016). Though we cannot provide an exact number of expected new sites that may be established by 2016, each RU stakeholder group has identified

locations for potential new sites, so we potentially could work towards establishing four to eight new sites per year (though not all of these site are guaranteed to be successful).

As a result, concluding there were 83 extant sites in 2002, 85 in 2008, and 92 in 2009, is likely the worst case scenario, in that this analysis is most likely to show any declines, if they occurred from 2002-2009. The actual trend is probably somewhere between that (roughly stable) to what was concluded in the previous analysis (substantial increases). In conclusion, there is no evidence of decline in Arizona; rather, the data suggest at least modest increases.

New Mexico

In New Mexico, the frog historically occurs in west-central and southwestern New Mexico in Catron, Grant, Hidalgo, Luna, Socorro, and Sierra Counties and has been collected or observed at 182 localities over time (Painter 2000). In 1995, Jennings reported that frogs still occurred at only eleven sites in New Mexico. Based on additional work, Painter (2000) listed forty-one localities at which frogs were found from 1994-1999. Thirty-three of these are north of Interstate 10 and eight are in the southwestern corner of the state. Thirty-one of the 41 populations were verified extant during 1998-1999 (Painter 2000). However, during May-August 2000, the frog was found at only eight of 34 sites (U.S. Fish and Wildlife Service 2002). Three populations east of Hurley in Grant County declined or were extirpated during 1999 to 2000, and preliminary data indicate another population on the Mimbres River, also in Grant County, has experienced a significant die-off (U.S. Fish and Wildlife Service 2002). Survey results from the 2004 field season indicate that there are 31 locations where the frog can be considered as likely to occur in New Mexico (R. Williams, FWS, 2004, unpubl. data; R. Jennings, Western New Mexico University, 2005, unpubl. data).

A similar analysis as was done for Arizona populations (see above) was not possible in New Mexico because all sites have not been monitored annually and much of the reported survey information is reported as presence or absence. Due to the evolving nature of Chiricahua leopard frog monitoring since the early 1990s and the ability of frogs to move up to 5 miles (8 km), survey information has resulted in different definitions of “sites” and “populations” over time. Often site boundaries are indistinct making some connected areas a single site, and other connected areas several sites. Thus it is difficult to assess the frog’s status by enumerating sites and often comparisons among sites are not equivalent. However, based upon the data available, we can conclude that the frog has continued to decline annually in New Mexico since listing.

As background, the final rule listing the species indicated the frog had been found at 41 sites from 1994-1999, and 31 of these 41 sites were verified as extant during 1998-1999. The rule explains that frogs were found at only 8 of 34 surveyed sites (of the original 41 sites) in 2000. The Recovery Plan indicated that 30-35 populations of Chiricahua leopard frogs were likely extant in New Mexico at the time of writing (2006-7). The tally of these 30-35 populations included dispersal sites, which indicates that not all of these populations were robust, breeding sites. Starting with the 41 sites from 1994-1999, 27 of those sites are now extirpated, four of them are considered unstable with low population numbers or are possibly extirpated, two are considered dispersal observations with no reproduction, one has an unknown status due to inaccessibility, and seven sites support reproduction and no significant die-off or population loss

has been observed.

Based on the above data, collected from 2002 to 2010, 27 of the 41 sites are considered extirpated, representing a 66 percent drop in the known Chiricahua leopard frog sites in New Mexico during this 5-year period (U.S. Fish and Wildlife Service 2011). Since listing in 2002, an additional 30 new sites have been identified. To date, of these 30 new sites, 15 have become extirpated, six are unstable with low population numbers or are possibly extirpated, four are considered dispersal observations with no reproduction, one site is on private property with an unknown population status, and at four sites reproduction is occurring and no significant die-off or population loss has been observed. New sites have been found due to increased surveying efforts in remote areas and growing access to private lands through partnership activities. Although undiscovered occupied sites may still exist, the rate and likelihood of finding new sites will diminish, as the area of unsurveyed habitat is reduced each year. Furthermore, while the frog has a large capacity for dispersal, because of the many of the new observations were not near known occupied sites, we assume that most of the new observations were existing locations and not newly colonized locations. Thus in the past eight years, these newer sites have reflected a similar trend of decline, with half of the sites no longer occupied.

Disease, particularly infection caused by *Bd*, has accounted for the majority of Chiricahua leopard frog declines. This disease seems to present more of a threat the frog in New Mexico than it does in Arizona, perhaps due to the higher elevations and cooler conditions found at sites in New Mexico. However, non-native species (bullfrogs, crayfish, and non-native fish) also continue to significantly impact extant populations and threaten the frog in New Mexico. All remaining frog populations in New Mexico are extremely vulnerable to extirpation from disease, non-native species, small population sizes, habitat drying, and lack of connectivity between other suitable habitats or populations.

In recent years, New Mexico Chiricahua leopard frog partners have gained momentum in conservation actions. In an effort to stave off permanent genetic losses, much of the recovery activities in New Mexico have been focused on creating off-site refugia populations. This entails collecting wild eggs, tadpoles, or metamorphs and bringing them into captivity for rearing and disease testing and treatment if needed, and releasing them into confined steel rim tanks. Currently, the New Mexico Ecological Services Field Office and the BLM have the capacity to rear, hold, and treat animals; the USFS has set up a quarantine holding facility (for first use in Spring 2011); and the Ladder Ranch has outdoor holding pens for adult frogs (for captive reproduction). For the Chiricahua leopard frog in New Mexico, our hope is that not only will the refugia sites serve as a back-up if there is a die-off at the source population, but that with time, they will also serve as a source for additional repatriation efforts. The facilities that are contributing to these efforts will also serve to produce animals for repatriation projects once extant populations have been boosted. As of 2010, we have attempted to establish eight refugia populations.

Mexico: Sonora and Chihuahua

Based on published and unpublished reports and perusal of Sonora, Mexico collection data from 23 museums, the Chiricahua leopard frog is known from about 26 localities in Chihuahua,

Mexico and 19 localities in Sonora (Lemos-Espinal and Smith 2007). *Lithobates* [*Rana*] *chiricahuensis* have been reported as far south as the Mexican state of Aguascalientes, but frogs south of central Chihuahua are of questionable identification (U.S. Fish and Wildlife Service 2007). Based on limited surveys, populations of leopard frogs, gartersnakes, and other native aquatic herpetofauna are generally more intact and non-native predators are much less widely distributed in Sonora and at least parts of Chihuahua (Rosen and Melendez 2010, Lemos-Espinal and Smith 2007, Rorabaugh 2008). However, specifically for the Chiricahua leopard frog, data are insufficient to determine status or trends in Mexico. None of the Chiricahua leopard frog localities in Sonora have been revisited recently, with the exception of one in the Sierra Los Ajos. No frogs were found at that site (L. Portillo, pers. comm. 2009). Chiricahua leopard frogs have been observed recently at several sites in Chihuahua (R. Jennings, pers. comm. 2007), but not enough is known to assess status or trends.

Summary of Population Status

In conclusion, the data suggest the status of the Chiricahua leopard frog is at least stable and probably improving in Arizona, declining in New Mexico, and unknown in Mexico. In pooled data for the U.S., a worst case analysis shows essentially no change in the number of occupied sites from 2002 to 2009 (133 versus 131, respectively); however, as discussed above, this likely underestimates the status of the species in Arizona, overestimates the status of the species in New Mexico, and includes data that are not standardized to be truly comparable. The actual situation is probably that the status of the species is stable in the U.S overall, but the different conditions between Arizona and New Mexico indicate that improvement is occurring only in Arizona at this time, while in New Mexico, frog numbers continue to decline. Continued and new aggressive recovery actions are needed to address threats to the species rangewide, to maintain positive trends in Arizona, to stabilize population losses in New Mexico, and to assist partners in Mexico with their conservation efforts. If on-going recovery actions are interrupted, drought worsens, or other threats intensify, the status of the species across its range could easily deteriorate.

<u>Threats</u>

The primary threats to this species are predation by nonnative organisms and die-offs caused by a fungal skin disease – chytridiomycosis. The chytridiomycete skin fungus, (*Bd* is the organism that causes chytridiomycosis) is responsible for global declines of frogs, toads, and salamanders (Berger et al. 1998, Longcore et al. 1999, Speare and Berger 2000, Hale 2001). Additional threats include: drought, floods, degradation and loss of habitat as a result of water diversions and groundwater pumping, poor livestock management, altered fire regimes, mining, development, and other human activities; disruption of metapopulation dynamics, resulting from an increased chance of extirpation or extinction resulting from small numbers of populations and individuals, and environmental contamination (U.S. Fish and Wildlife Service 2007). Loss of Chiricahua leopard frog populations is part of a pattern of global amphibian decline, suggesting other regional or global causes of decline may be important as well (Carey et al. 2001). Witte et al. (2008) analyzed risk factors associated with disappearances of ranid frogs in Arizona and found that population loss was more common at higher elevations and in areas where other ranid population disappearances occurred. Disappearances were also more likely where introduced

crayfish occur, but were less likely in areas close to a source population of frogs.

The goal of the Recovery Plan (U.S. Fish and Wildlife Service 2007) is to improve the status of the species to the point that it no longer needs the protection of the Endangered Species Act. The recovery strategy calls for reducing threats to existing populations; maintaining, restoring, and creating habitat that will be managed in the long term; translocation of frogs to establish, reestablish, or augment populations; building support for the recovery effort through outreach and education; monitoring; conducting research needed to provide effective conservation and recovery; and application of research and monitoring through adaptive management. Recovery actions are recommended in each of eight RUs throughout the range of the species. MAs are also identified within RUs where the potential for successful recovery actions is greatest.

The Recovery Plan identifies eight RUs in Arizona and New Mexico (Figure 2, Table 5). Focus areas, referred to as MAs are identified within each RU. Management Areas are areas with the greatest potential for successful recovery actions and threat alleviation. Hydrologic units and mountain ranges are used as MA boundaries. Within MAs, sites where metapopulations and robust, isolated populations occur or will be established are referred to herein as "recovery sites." MAs have been delineated to include all habitats of known extant Chiricahua leopard frog populations as well as other sites with the highest potential for recovery, including sites where habitat restoration or creation, and establishment or re-establishment of Chiricahua leopard frog populations will likely occur or has already occurred. We include all known extant populations within MA boundaries because of the high value of those populations for recovery.

For the Chiricahua leopard frog to be recovered, conservation must occur in each RU (Table 5). Successful conservation is not necessary in every MA and recovery does not depend upon an even distribution of recovery efforts across an RU. Rather, we anticipate that recovery efforts will be focused in those MAs and portions of RUs in which opportunities are best. Recovery criteria to delist the Chiricahua leopard frog includes: 1) at least two metapopulations located in different drainages, plus at least one isolated and robust population in each RU, 2) protection of these populations and metapopulations, 3) connectivity and dispersal habitat protection, and 4) reduction or elimination of threats and long-term protection. As noted in the FWS's 1998 Consultation Handbook, RUs are population units that have been documented as necessary to both the survival and recovery of the species. Avoiding loss of populations or other serious adverse effects in a RU will ensure continued contribution of that RU to the recovery of the species.

Existing populations and suitable habitat in MAs will be protected through management. Management will include maintaining or improving watershed conditions both upstream and downstream of Chiricahua leopard frog habitats to reduce physical threats to aquatic sites and allow for Chiricahua leopard frog dispersal, reducing or eliminating non-native species, preventing and managing disease, and other actions. Suitable or potentially suitable unoccupied habitat with high potential for supporting Chiricahua leopard frog populations or metapopulations (referred to here as recovery sites) will be protected, and restored or created as needed, within MAs. These habitats will include aquatic breeding habitats and uplands or ephemeral aquatic sites needed for movement among local populations in a metapopulation. Activities to achieve this include habitat management, removal of non-native species (e.g.

American bullfrogs, non-native fishes, and crayfish), enhancing water quality conditions, and reducing sedimentation. Populations of Chiricahua leopard frogs will be established or reestablished in these MAs.

Table 5. The eight RUs as identified in the Recovery Plan and the current status of the delisting criteria for the Chiricahua leopard frog in each RU.

Recovery Unit	**RU#**	**Recovery Criteria 1**	**Recovery Criteria 2**	**Recovery Criteria 3**	**Recovery Criteria 4**
Tumacacori-Atascosa-Pajarito Mountains, Arizona and Mexico	1	Met	Not met	Not met	Not met
Santa Rita-Huachuca-Ajos Bavispe, Arizona and Mexico	2	Not met	Not met	Not met	Not met
Chiricahua Mountains-Malpai Borderlands-Sierra Madre, Arizona, New Mexico, and Mexico	3	Not met	Not met	Not met	Not met
Pinaleno-Galiuro-Dragoon Mountains, Arizona	4	Not met	Not met	Not met	Not met
Mogollon Rim-Verde River, Arizona	5	Not met	Not met	Not met	Not met
White Mountains-Upper Gila, Arizona and New Mexico	6	Not met	Not met	Not met	Not met
Upper Gila-Blue River, Arizona and New Mexico	7	Not met	Not met	Not met	Not met
Black-Mimbres-Rio Grande, New Mexico	8	Not met	Not met	Not met	Not met

Critical Habitat

The 2012 final rule for the designation of CH includes 39 CHUs across the range of the species in Arizona and New Mexico (U.S. Fish and Wildlife Service 2012). Through the CH designation process, the FWS determined the PCEs for the Chiricahua leopard frog. We consider the PCEs to be the elements of the physical or biological features (PBFs) that provide for a species' life-history processes and are essential to the conservation of the species.

Based on the above needs and our current knowledge of the life history, biology, and ecology of the species, and the habitat requirements for sustaining the essential life-history functions of the species, we have determined that the PCEs essential to the conservation of the Chiricahua leopard frog are:

1. Aquatic breeding habitat and immediately adjacent uplands exhibiting the following characteristics:
    a. Standing bodies of fresh water (with salinities less than 5 parts per thousand, pH greater than or equal to 5.6, and pollutants absent or minimally present), including natural and manmade (e.g., stock) ponds, slow-moving streams or pools within streams, off-channel pools, and other ephemeral or permanent water bodies that

typically hold water or rarely dry for more than a month. During periods of drought, or less than average rainfall, these breeding sites may not hold water long enough for individuals to complete metamorphosis, but they would still be considered essential breeding habitat in non-drought years.

b. Emergent and or submerged vegetation, root masses, undercut banks, fractured rock substrates, or some combination thereof, but emergent vegetation does not completely cover the surface of water bodies.
c. Nonnative predators (e.g., crayfish (*Orconectes virilis*), American bullfrogs (*Lithobates catesbeiana*), nonnative predatory fishes) absent or occurring at levels that do not preclude presence of the Chiricahua leopard frog.
d. Absence of chytridiomycosis, or if present, then environmental, physiological, and genetic conditions are such that allow persistence of Chiricahua leopard frogs.
e. Upland areas that provide opportunities for foraging and basking that are immediately adjacent to or surrounding breeding aquatic and riparian habitat.

2. Dispersal and non-breeding habitat, consisting of areas with ephemeral (present for only a short time), intermittent, or perennial water that are generally not suitable for breeding, and associated upland or riparian habitat that provides corridors (overland movement or along wetted drainages) for frogs among breeding sites in a metapopulation with the following characteristics:
    a. Are not more than 1.0 mile (1.6 kilometers) overland, 3.0 miles (4.8 kilometers) along ephemeral or intermittent drainages, 5.0 miles (8.0 kilometers) along perennial drainages, or some combination thereof not to exceed 5.0 miles (8.0 kilometers).
    b. In overland and non-wetted corridors, provides some vegetation cover or structural features (e.g., boulders, rocks, organic debris such as downed trees or logs, small mammal burrows, or leaf litter) for shelter, forage, and protection from predators; in wetted corridors, provides some ephemeral, intermittent, or perennial aquatic habitat.
    c. Are free of barriers that block movement by Chiricahua leopard frogs, including, but not limited to, urban, industrial, or agricultural development; reservoirs that are 50 acres (20 hectares) or more in size and contain predatory nonnative fishes, bullfrogs, or crayfish; highways that do not include frog fencing and culverts; and walls, major dams, or other structures that physically block movement.

With the exception of impoundments, livestock tanks, and other constructed waters, CH does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries.

The purpose of the designation of CH is to conserve the PCEs essential to the conservation of the species through the identification of the appropriate quantity and spatial arrangement of the PCEs sufficient to support the life-history functions of the species. Because not all life-history functions require both PCEs, not all areas designated as CH contain both PCEs. Each of the areas designated as CH have been determined to contain sufficient PCEs, or with reasonable effort, PCEs can be restored to provide for one or more of the life-history functions of the Chiricahua leopard frog.

All areas designated as CH will require some level of management to address the current and future threats to the Chiricahua leopard frog and to maintain or restore the PCEs. Special management in aquatic breeding sites will be needed to ensure that these sites provide water quantity, quality, and permanence or near permanence; cover; and absence of extraordinary predation and disease that can affect population persistence. In dispersal habitat, special management will be needed to ensure frogs can move through those sites with reasonable success.

Approximately 31 percent of all CH for the Chiricahua leopard frog is located on five NFs in Region 3 (the Coronado, Gila, Tonto, Coconino, and Apache-Sitgreaves NFs). In total, approximately 3,265 acres of CH occurs on these five NFs and the majority of these CHUs are represented by populations occupying cattle tanks. The Coronado NF, which is the subject of this BO, includes approximately 1,688 acres of the CH.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions within the action area. All proposed federal actions within the action area that have undergone formal or early section 7 consultation are included in the environmental baseline discussion. The environmental baseline discussion defines the current status of the frog, its habitat, and designated CH within the Coronado NF. This discussion serves as a platform to assess the effects of the action to the flycatcher now under consultation.

Status of the Chiricahua leopard frog and within the Action Area

The Coronado NF occurs in four RUs identified in the Chiricahua leopard frog recovery plan. Three breeding populations exist in RU 1 (Tumacacori-Atascosa-Pajarito Mountains, Arizona and Mexico) on the Coronado NF. Sycamore Canyon is the only significant site with moving water in RU 1 to support breeding frogs. Most other sites are livestock tanks or impounded springs. The Sycamore Canyon site which includes the Bear Valley Ranch Tank, Rattlesnake Tank, and Atascosa Canyon downstream of Bear Valley Ranch were all occupied by frogs at the time of listing. Within Sycamore Canyon occupied tanks include the following: Yank Tank, North Mesa Tank, South Mesa Tank, and Bear Valley Ranch Tank. Bonita Tank and Mojonera Tank are considered occupied breeding sites. In wet years, Upper Turner Tank has been known to be occupied. Pena Blanca Lake/Spring and Associated Tanks is the third population area that includes Pena Blanca Lake, Pena Blanca Spring, Summit Reservoir, Tinker Tank, Thumb Butte Tank, and Coyote Tank. These sites were all occupied in 2009. Adult frogs and tadpoles were found in Pena Blanca Lake in 2009 and 2010, after the lake had been drained and then refilled, which eliminated the nonnative predators. However, early in 2010, rainbow trout (*Oncorhynchus mykiss*) were restocked back into the lake, by AGFD and they plan to reestablish a variety of warm water fishes, as well. Three additional waters including Sierra Tank East, Sierra Tank West, and Sierra Well may have the potential to support breeding with habitat work.

Recovery Unit 2 (Santa Rita-Huachuca- Ajos Bavispe, Arizona and Mexico) also contains several population sites on the Coronado NF. The Florida Canyon site was augmented with

frogs from elsewhere in the Santa Rita Mountains in 2009. The site was enhanced in 2010, with the addition of a steel tank for breeding. The eastern slope of the Santa Rita Mountains is another population site which includes two metal troughs in Louisiana Gulch, Greaterville Tank, Los Posos Gulch Tank, and Granite Mountain Tank complex. The Granite Mountain Tank complex includes two impoundments and a well. All but Los Posos Gulch Tank are currently occupied breeding sites. More than 60 frogs were observed at Los Posos Gulch Tank in 2008 which was once thought to be a robust breeding site; however, it dried, and the frogs disappeared in 2009. Scotia Canyon is another population area where breeding habitat occurs at Peterson Ranch Pond and possibly at other perennial or nearly perennial pools. Frogs were reestablished in this canyon via a translocation in 2009; the last record of a frog in the canyon before that was 1986. A population of the Ramsey Canyon leopard frog was located at Carr Barn Pond. The Coronado NF created and now maintains Carr Barn Pond consistent with the Ramsey Canyon (=Chiricahua) leopard frog conservation agreement, to which they are a signatory. This site was occupied in 2009, but the population has since been eliminated, probably by *Bd*. Brown and Ramsey Canyons have been intensively managed for the Ramsey Canyon (=Chiricahua) leopard frog since 1995. Places where frogs have bred and that still retain habitat needed for the leopard frog include Ramsey Canyon, Trout and Meadow Ponds on private lands owned by The Nature Conservancy, and the Ramsey Canyon Box; and in Brown Canyon, the Wild Duck Pond, House Pond, and the Brown Canyon Box.

Recovery Unit 3 (Chiricahua Mountains- Malpai Borderlands-Sierra Madre, Arizona, New Mexico, and Mexico) includes the Peloncillo Mountains. Areas where frog populations occur or have occurred include Geronimo, Javelina, State Line, and Canoncito Ranch Tanks; Maverick Spring; and pools or ponds in the Cloverdale Cienega and along Cloverdale Creek below Canoncito Ranch Tank. Breeding occurs in State Line and Canoncito Ranch Tanks, and possibly other aquatic sites. In the Chiricahua Mountains, John Hands Pond (the type locality for the CLF) and a spring-fed pond at the Southwest Research Station are managed for frog recovery however, no frogs have been observed at the site since 1977.

Recovery Unit 4 (Pinaleno-Galiuro-Dragoon Mountains, Arizona) includes populations in Oak Spring and Oak Creek (Glaiuro Mountains) Shaw Tank, Tunnel Spring and until recently Halfmoon (Dragoon Mountains). The Galiuro and Dragoon mountains have been surveyed relatively well over the last decade or more.

Table 6. Known breeding sites for Chiricahua leopard frogs on Coronado National Forest.

***L. chiricahuensis* Breeding Sites on Coronado NF Lands**			
Breeding Site	**General Area**	**Ranger District**	**Recovery Unit**
Shaw Tank	Dragoon Mtns	Douglas	RU 4
Middlemarch Canyon Mine Shaft	Dragoon Mtns	Douglas	RU 4
Tunnel Spring	Dragoon Mtns	Douglas	RU 4
State Line Tank	Peloncillo Mtns	Douglas	RU 3
Clifford's Tank	Galiuro Mtns	Safford	RU 4
Home Ranch Tank	Galiuro Mtns	Safford	RU 4
Oak Creek	Galiuro Mtns	Safford	RU 4
Vermont Tank	Galiuro Mtns	Safford	RU 4
Rudy Ronquillo Pond	Pajarito Mtns	Nogales	RU 1

Pena Blanca Lake	Pajarito Mtns	Nogales	RU 1
Sycamore Canyon	Pajarito Mtns	Nogales	RU 1
Summit Reservoir Tank	Pajarito Mtns	Nogales	RU 1
Thumb Tank	Pajarito Mtns	Nogales	RU 1
Bonita Tank	Pajarito Mtns	Nogales	RU 1
Mojonera Tank	Pajarito Mtns	Nogales	RU 1
Greaterville Tank	Santa Rita Mtns	Nogales	RU 2
Granite Mountain Tank	Santa Rita Mtns	Nogales	RU 2
Louisiana Gulch Corral	Santa Rita Mtns	Nogales	RU 2
Cave Creek/Gardner Canyon Confluence	Santa Rita Mtns	Nogales	RU 2
West Tank	Santa Rita Mtns	Nogales	RU 2
Scotia Canyon	Huachuca Mtns	Sierra Vista	RU 2
Brown Canyon Box	Huachuca Mtns	Sierra Vista	RU 2

# Coronado NF Breeding Sites by Recovery Unit		**# Coronado NF Breeding Sites by Ranger District**	
Recovery Unit 1	7	Douglas	4
Recovery Unit 2	7	Safford	4
Recovery Unit 3	1	Nogales	12
Recovery Unit 4	7	Sierra Vista	2
Total Number Coronado NF Breeding Sites			**22**

Wildland Fires

Recent wildfires may have affected the PCEs of designated CH for the frog. Areas containing designated CHUs may have experienced a range of burn severities and fire could have removed all or a portion of the surrounding vegetation component (including trees, shrubs, grasses, and forbs). Post-fire storm water runoff may have carried ash or sediment into the streams, resulting in poor water quality and sedimentation events that reduced or eliminated particular habitat features. The extent of damage to the PCEs of designated CHUs is not well known at this time.

Horseshoe 2 Wildfire

The Horseshoe 2 wildfire started in the Chiricahua Mountains on May 8, 2011 and was declared contained on June 25, 2011. The fire burned a total of 222,954 acres of which included 192,647 acres of NFS lands, 12,163 acres of National Park Service lands, 1,336 acres of BLM land, 2,874 acres of State of Arizona lands and 13,934 acres of private land. No wild populations of Chiricahua leopard frog are extant in the Chiricahua Mountains, but one captive population is found in man-made ponds at the Southwest Research Station in Cave Creek. These ponds were not significantly affected by suppression activities, the wildfire, or floods. Critical Habitat has been designated in Cave Creek. The creek itself underwent significant flooding following the fire, but the stream channel is expected to recover as the watershed stabilizes. No suppression effects have been identified, but CH may be affected by ash flow and sedimentation, at least for the next year or two. The effects of fire and suppression actions would not be expected to change the baseline for this species in the Chiricahua Mountains.

Murphy Wildfire

The Murphy Wildfire started on May 30, 2011 on the Nogales RD and was contained on 6/14/2011. Less than three percent of the fire area burned at high severity. Several tanks serve as habitat for Chiricahua and lowland leopard frogs: Summit, Thumb Butte, Ronquillo Pond (Pena Blanca Spring) and Pena Blanca Lake are designated CH for the Chiricahua leopard frog. Yank, Summit, Lookout, Bear Valley Ranch, Tinker, Bellota, and Mesa Tanks; as well as

Waterfall Spring, Ronquillo Pond, Sycamore Canyon and Pena Blanca Lake are occupied by Chiricahua and/or lowland leopard frogs. All of these may be affected to some degree by ash flow or sedimentation. Sycamore Canyon may be affected by ash and sediment, but only a portion of this watershed burned. Two designated CHUs (Sycamore Canyon and Pena Blanca Lake and Spring and Associated Unit Tanks) fall within the perimeter of the fire.

Monument Fire

The Monument Fire began on June 12, 2011 and was contained on July 5, 2011. A total of 32,074 acres burned during the fire. One breeding site (also known as Beatty's Guest Ranch) in Miller Canyon on private land was lost to post-fire flooding. Frogs were salvaged from this site by the AGFD prior to the floods and are being housed off site. Although individuals were lost as a result of post-fire flooding, a remnant population persists in a small pond and in the stream in Miller Canyon. The Carr Barn Pond CHU also burned but was not occupied by frogs at the time of the fire.

Status of Critical Habitat within the Action Area

The information provided below describes the status of CH on the Coronado NF within RU and CHU.

Recovery Unit 1 (Tumacacori-Atascosa-Pajarito Mountains, Arizona and Mexico)

Bonita, Upper Turner, and Mojonera Tanks CHU

This unit includes 201 acres (81 ha) of Coronado NF lands in the Pajarito and Atascosa Mountains, Santa Cruz County, Arizona. Two breeding sites (Bonita Tank and Mojonera Tank), combined with a dispersal site or site where breeding and recruitment may occur in wet years (Upper Turner Tank), form the center of a future metapopulation. Three additional waters—Sierra Tank East, Sierra Tank West, and Sierra Well—may have the potential to support breeding with habitat work. Frogs currently occupy Bonita and Mojonera Tanks. Frogs were last found at Upper Turner Tank in 2004.

In this unit, bullfrogs are a continuing threat, and illegal border activity and associated law enforcement have resulted in watershed damage. A road on the berm of Upper Turner Tank is scheduled for improvement to access a surveillance tower operated by U.S. Customs and Border Protection. Frogs in this region have tested positive for *Bd*, but the disease appears to have little effect on population persistence.

Sycamore Canyon CHU

This unit includes 262 acres (106 ha) of Coronado NF land and 7 acres (3 ha) of private lands along Atascosa Canyon through Bear Valley Ranch in the Pajarito and Atascosa Mountains, Santa Cruz County, Arizona Sycamore Canyon, Yank Tank, North Mesa tank, South Mesa Tank, and Bear Valley Ranch Tank are currently occupied. The current occupancy status of Rattlesnake Tank and Atascosa Canyon downstream of Bear Valley Ranch Tank is unknown. Sycamore Canyon from Ruby Road to the international border supports frogs and breeding, but in the driest months (May and June) the stream dries to pools.

Bullfrogs have been a continuing problem in this unit, although recent control efforts seem to have eliminated them from Sycamore Canyon. Nonnative green sunfish (*Lepomis cyanellus*)

have occasionally been found in Sycamore Canyon, as well. Pools critical to survival of frogs and tadpoles through the dry season, are sensitive to sedimentation and erosion upstream in the watershed of Sycamore Canyon. The earliest records of *Bd* in Arizona are from Sycamore Canyon (1972). A robust population of Chiricahua leopard frogs persists at this site despite the disease and periodic die-offs. Illegal border activity and associated law enforcement have resulted in many trails and new vehicle routes in the area, as well as trampling in the canyon.

Peña Blanca Lake and Spring and Associated Tanks CHU
This unit includes 202 acres (82 ha) and is all on Coronado NF lands, Santa Cruz County, Arizona. This unit is a metapopulation that includes Peña Blanca Lake, Peña Blanca Spring, Summit Reservoir, Tinker Tank, Thumb Butte Tank, and Coyote Tank. These sites were all occupied in 2009.

Chiricahua leopard frogs and tadpoles were found in Peña Blanca Lake in 2009 and 2010, after the lake had been drained and then refilled, which eliminated the nonnative predators. However, early in 2010, rainbow trout (*Oncorhynchus mykiss*) were stocked back into the lake, and plans are underway to reestablish a variety of warm water fishes in the spring of 2012. Despite the stocking of rainbow trout, Peña Blanca Lake now boasts a robust population of Chiricahua leopard frogs; the largest single population throughout its range. Surveys of the lake in April 2011, confirmed that Chiricahua leopard frogs remained extant. Surveys of the lake in September 2011, estimated the Chiricahua leopard frog population to number between 300-500 individuals which is likely a low estimate because only a single night survey was performed and the shoreline habitat was complex making observations difficult. During that survey, Chiricahua leopard frogs were calling, indicating that fall breeding may have been occurring.

Nonnative introduced predators, particularly bullfrogs and sportfish, remain a serious threat in this region. A concerted effort began in 2008 to clear the area of bullfrogs. The effort appears to be successful, and Chiricahua leopard frogs have clearly benefited. However, there is a continuing threat of recolonization or purposeful introduction of bullfrogs, and management of this area will continue to concentrate on preventing bullfrogs from decolonizing the area and eliminating those that do. As discussed, warmwater sportfish at Peña Blanca Lake are scheduled to be stocked in the spring of 2012 which will affect the suitability of the lake as Chiricahua leopard frog habitat. However, given the number of CMs which included managing against bullfrogs and ensuring the persistence of dense shoreline vegetation, the proposed stocking of warmwater fish would not result in adverse modification of this CH unit. Frogs in this region have tested positive for *Bd*; however, the disease appears to have little effect on population persistence.

Recovery Unit 2 (Santa Rita-Huachuca-Ajos Bavispe, Arizona and Mexico)
The requisite number of metapopulations (two) and isolated, robust populations (one) have not been met (Criterion 1), although we are working toward metapopulations meeting the definition in the recovery plan on the eastern slope of the Santa Rita Mountains and on the southeastern slopes of the Huachuca Mountains. An isolated, robust population occurs at Beatty's Guest Ranch in the Huachuca Mountains and is the most stable, robust population in this RU. Several other isolated populations also occur scattered across the RU, and we are currently working with partners to build a metapopulation in the Las Cienegas area.

The appropriate protection and management of habitats for persistence of two metapopulations and connectivity have not been met (Criteria 2 and 3). However, dispersal sites and corridors for connectivity have been established in the Huachuca Mountains (e.g. Ramsey Canyon), and various conservation plans and Safe Harbor Agreements have been developed or are in development in this RU. Threats have not been eliminated (Criterion 4). American bullfrogs, crayfish, *Bd*, non-native fishes, illegal border activities and law enforcement response, and wildfire continue to threaten Chiricahua leopard frogs in this RU.

An isolated, robust population occurs at Beatty's Guest Ranch in the Huachuca Mountains and is the most stable, robust population in this RU. Several other isolated populations also occur scattered across the RU. American bullfrogs, crayfish, *Bd*, non-native fishes, illegal border activities and law enforcement response, and wildfire continue to threaten Chiricahua leopard frogs in this RU. The status of the Chiricahua leopard frog is relatively stable and threats are increasing.

Florida Canyon CHU
Florida Canyon includes 4 acres (2 ha) and is all on the Coronado NF in the Santa Rita Mountains, Pima County, Arizona. Included in the proposal is approximately 1,521 feet (463 m) of Florida Canyon from a silted-in dam to the downstream end of the Florida Workstation property. PCE 1 is present and was enhanced in 2010, with the addition of a steel tank for breeding. Chiricahua leopard frogs currently occupy this site. This is considered an isolated population.

Water is a limiting factor in this system, particularly during drought. Fire in the watershed could result in scouring and sedimentation in the pools important as habitat for the frog. The addition of a steel tank will provide dependable water for breeding that is safe from erosion or sedimentation events. Introduced predators and *Bd* are potential threats, but neither has been recorded at this site.

Eastern Slope of the Santa Rita Mountains CHU
This unit includes 172 acres (70 ha) of Coronado NF lands and 14 ac (6 ha) of private lands in the Greaterville area in Pima County, Arizona. PCEs 1 and 2 are present. Included in the CH designation are two metal troughs in Louisiana Gulch, Greaterville Tank, Los Posos Gulch Tank, and Granite Mountain Tank complex. The Granite Mountain Tank complex includes two impoundments and a well. All but Los Posos Gulch Tank are currently occupied breeding sites. More than 60 frogs were observed at Los Posos Gulch Tank in 2008. It was once thought to be a robust breeding site; however, it dried, and the frogs disappeared in 2009. These four sites collectively form a metapopulation.

Surface water is a primary limiting factor in this unit. The breeding habitat at Louisiana Gulch, although limited to two 6.0-ft (1.8-m) diameter steel tanks, is dependable because it is fed by a well. The other tanks are filled by runoff and susceptible to drying during drought. Nonnative predators and *Bd* are not known to be imminent threats in this area.

Scotia Canyon CHU
This unit includes 70 acres (29 ha) in Scotia Canyon, Huachuca Mountain, Cochise County, Arizona, and is entirely on Coronado NF lands. Breeding habitat occurs at Peterson Ranch Pond and possibly at other perennial or nearly perennial pools. Chiricahua leopard frogs were reestablished in this canyon via a translocation in 2009; the last record of a Chiricahua leopard frog in the canyon before that was 1986. PCEs 1 and 2 are present. This site is managed as an isolated population, but there is some potential for creating connectivity to the metapopulation in Ramsey and Brown Canyons via population reestablishment in Garden Canyon at Fort Huachuca. Scotia Canyon, with its pond and stream habitats, has the potential to be a robust population.

Intensive bullfrog eradication and habitat enhancement work has been done in preparation for reestablishing the Chiricahua leopard frog. However, bullfrog reinvasion is a significant, continuing threat, and other nonnative predators could potentially reach Scotia Canyon via natural or human assisted releases. In addition, barred tiger salamanders from the Peterson Ranch Pond tested positive for *Bd*, but the frogs appeared to be persisting in that same pond. Further, heavy fuel loads could result in a catastrophic wildfire, which would have significant detrimental effects on the frog and its aquatic habitats. Finally, a road through the canyon is eroded in places and contributes sediment to the stream; it receives much use by recreationists and U.S. Customs and Border Protection.

Carr Barn Pond CHU
This unit includes 0.6 acres (0.3 ha) of Coronado NF lands in the Huachuca Mountains, Cochise County, Arizona. This population is considered isolated. We believe PCE 1 is present. Carr Barn Pond is an impoundment with a small, lined pond with water provided from a well. During runoff events, the size of the pond expands considerably and then gradually shrinks back to the lined section. The population has since been eliminated, probably by *Bd*. The unit has a history of nonnative predator problems and disease. The population has been eliminated after *Bd* die-offs three times; twice the population has subsequently been reestablished through translocations. Largemouth bass (*Micropterus salmoides*) have been introduced illegally into the pond and then removed, and bullfrogs periodically invade the site but are promptly removed before they breed.

Ramsey and Brown Canyons CHU
This unit includes 49 acres (20 ha) of private lands in Ramsey Canyon and 58 ac (24 ha) of Coronado NF in Brown and Ramsey Canyons, Huachuca Mountains, Cochise County, Arizona. PCEs 1 and 2 are present within this unit. This unit is managed as a metapopulation. Places where Chiricahua leopard frogs have bred and that still retain PCE 1 include Ramsey Canyon, Trout and Meadow Ponds on private lands owned by The Nature Conservancy, and the Ramsey Canyon Box; and in Brown Canyon, the Wild Duck Pond, House Pond, and the Brown Canyon Box (on Coronado NF lands).

Ramsey Canyon and Brown Canyon are considered currently occupied, but although frogs have bred at the Box in Brown Canyon, the site is too small to support more than just a few frogs. In addition, recent die-offs associated with *Bd* have significantly reduced populations in both canyons. The House and Wild Duck ponds as well as Ramsey Canyon have a history of *Bd* outbreaks. The Ramsey Canyon population has been eliminated twice and then reestablished;

the Wild Duck and House Ponds have also undergone repeated disease-related declines and extirpations followed by reestablishments. The populations tend to persist for months or years after reestablishment only to experience epizootic (an outbreak of disease affecting many animals of one kind at the same time) *Bd* outbreaks followed by declines or extirpation.

Additional threats in this unit include nonnative species, drying, sedimentation, and fire. Nonnative predators threaten populations at the House and Wild Duck Ponds, where bullfrogs have been found periodically and goldfish (*Carassius auratus auratus*) were once introduced. Those two ponds are buffered against drought and drying by a pipeline from a spring and a windmill. However, the Box in Brown Canyon is subject to low water and drying during drought. That latter population depends upon immigration or active reestablishment for long-term persistence. The Trout and Meadow Ponds in Ramsey Canyon are fed by pipelines; thus the water supply is dependable. The Trout Pond could however be filled in with sediment during a flood. Further, a fire in the watershed could threaten aquatic breeding sites in both canyons.

Recovery Unit 3 (Chiricahua Mountains-Malpai Borderlands-Sierra Madre, Arizona, New Mexico, and Mexico)

Cave Creek CHU

This unit includes 234 acres (95 ha) of Coronado NF lands in the Chiricahua Mountains, Cochise County, Arizona. Chiricahua leopard frogs and tadpoles were released during the fall of 2011 into a pond on the Southwestern Research Station where they were initially reared in an on-site ranarium. Included in this unit is Cave Creek and associated ponds in or near the channel, from Herb Martyr Pond downstream to the eastern USFS boundary. PCEs 1 and 2 are present. This site will be managed as a metapopulation.

Herb Martyr Pond is the type locality for the Chiricahua leopard frog; however, no frogs have been observed at the site since 1977. The pool behind the dam is entirely silted in, and pools at the base of the dam are probably not adequate for Chiricahua leopard frog survival or reproduction. However, with restoration this site could once again support Chiricahua leopard frogs. The pond below the dam at John Hands appears suitable for occupancy, but Chiricahua leopard frogs have not been recorded there since 1966. Chiricahua leopard frogs were occasionally seen in Cave Creek through 2002.

Scarcity of water can occur in drought years and bullfrogs occur to the east but have never been recorded in the unit. The current status and past history of *Bd* in this unit are unknown. Rainbow trout were present and occurred concurrently with Chiricahua leopard frogs at Herb Martyr Pond, but no trout are currently known in the unit.

Peloncillo Mountains CHU

This unit includes 366 acres (148 ha) of Coronado NF lands in Hidalgo County, New Mexico. This unit is designated as critical habitat because it was occupied at the time of listing and currently contains PCEs 1 and 2 to support life-history functions essential for the conservation of the species. Cloverdale Cienega within this CHU is an ephemeral site that can be utilized as a dispersal corridor for Chiricahua leopard frogs in the Peloncillo Mountains. This does not contribute to the number of reproductive sites on the Coronado NF that are described within this BO in Table 6.

Aquatic habitats in the Peloncillo Mountains CHU include Geronimo, Javelina, State Line Tanks; Maverick Spring; and pools or ponds in the Cloverdale Cienega and along Cloverdale Creek below Canoncito Ranch Tank. Breeding has occurred in State Line Tank, and possibly other aquatic sites in this unit. These tanks and Maverick Spring have recent records of Chiricahua leopard frogs (2007 to the present) and are considered currently occupied, with the exception of State Line Tank. State Line Tank was reported as dry in 2011 with no available habitat or refuge for Chiricahua leopard frogs and no Chiricahua leopard frogs observed. It is not known at this time if damage to the tank or drought condition caused it to dry in 2011. However, because Chiricahua leopard frogs disperse from Canoncito Ranch Tank into Cloverdale Cienega, Cloverdale Creek, and surrounding tanks when water is present, State Line Tank still contains PCEs 2. This unit is managed as a metapopulation.

Periodic drought dries most of the aquatic sites completely or to small pools, which limits population growth potential. Nonnative sportfish are present at Geronimo Tank and may preclude successful recruitment. Occurrence of *Bd* in this area has not been investigated, but may also be a limiting factor.

Recovery Unit 4 (Pinaleno-Galiuro-Dragoon Mountains, Arizona)

Deer Creek CHU

This unit consists of 17 acres (7 ha) of Coronado NF, 69 ac (28 ha) of Arizona State Land Department lands, and 34 acres (14 ha) of private lands in the Galiuro Mountains, Graham County, Arizona. Included in designated CH are Home Ranch, Clifford's, Vermont, and Middle Tanks, a series of 10 impoundments on the Penney Mine lease, and intervening drainages, primarily Deer Creek, and associated uplands and ephemeral tanks that provide corridors for movement among these tanks. Breeding has been confirmed on Deer Creek above Clifford's Tank, and in Home Ranch and Vermont Tanks, and is suspected in the other three sites named above when water is present long enough for tadpoles to metamorphose into adults (3 to 9 months). Home Ranch Tank supports a large population of Chiricahua leopard frogs. This unit functions as a metapopulation.

The primary threat to Chiricahua leopard frogs and their habitats in this unit is periodic drought that results in breeding sites drying. During a severe drought in 2002, all but one of the waters in the unit dried. Frogs reportedly died for unknown reasons in the 1980s (Goforth 2005, p. 2), possibly indicative of *Bd*; however, no Chiricahua leopard frogs have tested positive for the disease from this unit. The only nonnative aquatic predator recorded in this unit is the barred tiger salamander.

Recovery work has occurred in this unit, including head-starting of egg masses and reestablishment and augmentation of populations. The FWS, AGFD, Arizona State Land Department, and an agate miner (Penney Mine Tanks) have drafted a conservation plan for managing habitats on the mine lease, but funds are lacking to implement that plan.

Oak Spring and Oak Creek CHU

This unit consists of 27 acres (11 ha) of Coronado NF lands in the Galiuro Mountains, Graham County, Arizona. The unit is currently occupied. This site is isolated and does not support

enough frogs to be considered a robust population. The largest pool, Cattail Pool, typically contains water and supports several breeding Chiricahua leopard frogs. The stream reach designated for CH includes the area where Chiricahua leopard frogs occur.

The primary threat in this unit is extended drought during which all of the pools are subject to reduction or drying. Cattail Pool is spring-fed, and is likely the last pool to dry. Oak Spring is also used for water developments, which may limit the capability of the site to support frogs. Chiricahua leopard frogs have been headstarted and released at this site to augment the population.

Dragoon Mountains CHU
This unit includes 74 acres (30 ha) of Coronado NF lands in Cochise County, Arizona. Shaw Tank and Tunnel Spring in Middlemarch Canyon are designated as CH in this unit and are currently occupied breeding sites. The latter is a robust population that was occupied at the time of listing. Shaw Tank is a reestablishment site that was not known to be occupied in 2002. This is considered an isolated population. Also included is Halfmoon Tank, which supported a robust population of Chiricahua leopard frogs until 2002. Siltation and recent drought affect the amount and persistence of water. The tank is in need of renovation so that it may again dependably hold water and support breeding.

Threats to the Chiricahua leopard frog and its habitat are primarily scarcity of suitable breeding habitat and loss of that habitat during drought. Tunnel Spring is spring-fed and thus buffered against drought; however, Shaw and Halfmoon Tanks are filled with runoff. Neither nonnative predators nor *Bd* have been noted in these populations and habitats, although if introduced they would constitute additional threats.

Recovery work, including headstarting of eggs collected from Tunnel Spring and establishment of a new population at Shaw Tank with reared tadpoles and frogs, has been accomplished in this unit, and the USFS's livestock permittee has been a participant in those recovery activities.

Factors Affecting the Chiricahua leopard frog and Designated Critical Habitat within the Action Area

The factors affecting the Chiricahua leopard frog and its designated CH within the action area are discussed in this section. Projects associated with formal consultations that evaluated adverse effects to the frog that occurred from 2005 (i.e., the year of the original LRMP BO/CO) to the present are summarized in Table 7.

Table 7. Formal consultations and incidental take anticipated for the Chiricahua leopard frog on the Coronado National Forest from 2005 to 2011.

Consultation #	Date of Final BO	Project	Anticipated Take	Locations	Form of Take
02-21-05-F-0847	5/11/2005	10-year allotment management plans for the HQ, Campini and Blacktail	No take anticipated	n/a	n/a

		allotments			
22410-2008-F-0053	5/14/2008	Clanton/Cloverdale, Geronimo, Guadalupe, Maverick, Robertson, and Walnut allotments	As specified in October 24, 2002 opinion	unknown	Harm and harass
22410-2008-F-0029	6/13/2008	Redrock Canyon fish barrier	20 frogs	Redrock Canyon drainage and Oak Tank	Harm
22410-F-2010-0495	12/23/2010	Cloverdale Ciénega restoration project	100% loss of frogs*	Middle and lower reaches of Cloverdale Creek	Harm and harass
*22410-2008-F-0149-R001***	*12/6/2011*	*Effects to Listed Species from U.S. USFS Aerial Application of Fire Retardants on NFS Lands*	*Six drops in occupied frog habitat on the Coronado National Forest affecting 32.7 miles or 3 acres of non-fluvial, standing water.*	*Coronado NF*	*Direct mortality, harm, and harass*

* Cloverdale Cienega is an ephemeral site that can be utilized as a dispersal corridor for Chiricahua leopard frogs in the Peloncillo Mountains. This does not contribute to the number of reproductive sites on the Coronado NF that are described within this BO in Table 6.
**Projects in italics are fire suppression activities that are not included in the proposed action for this consultation.

During the 2005 consultation for all 11 NF LRMPs, the FWS and USFS jointly developed a set of CMs for the Chiricahua leopard frog which became part of the proposed action. The five CMs are listed below and the Forest's accomplishments are described in the "Effects of the Action on the Role of Designated Critical Habitat in Recovery" section below. The environmental baseline for Chiricahua leopard frog within the action area, i.e., the Coronado NF appears to be stable. Factoring in the three large wildfires in 2011, data do not show a declining population. The greatest threats to Chiricahua leopard frogs on the Coronado NF are nonnative species, drought, and disease. The Coronado NF is actively participating in recovery actions that are benefiting the frog (U.S. Fish and Wildlife Service 2011c).

This BO is now covering the projects that were evaluated in prior BOs that have yet to be fully implemented or are ongoing.

EFFECTS OF THE ACTION

Effects of the action refer to the direct and indirect effects of an action on the species or CH, together with the effects of other activities that are interrelated and interdependent with that

action that will be added to the environmental baseline. Effects to the frog were evaluated in the 2005 BO/CO (see U.S. Fish and Wildlife Service 2005). The majority (67 percent) of the S&Gs within the Coronado NF LRMP were considered positive in the sense that management would maintain habitat for the frog. Adverse effects were found to occur from the Fire Management, Lands and Minerals, Forestry and Forest Health, Watershed Management Engineering, and Rangeland Management, programs and are discussed below.

Background Information regarding the Proposed Action

The proposed action being analyzed in this BO is implementation of the Coronado NF LRMP and its amendments. During the 2005 LRMP consultation, the FWS and USFS jointly developed a set of CMs for the Chiricahua leopard frog which became part of the proposed action. The five CMs are listed below.

Conservation Measure #1: Design projects in occupied Chiricahua leopard frog habitat on National Forest System lands which address the appropriate components of the Chiricahua leopard frog recovery plan, with the goal of implementing projects with beneficial, insignificant, or discountable effects to Chiricahua leopard frog.

Conservation Measure #2: Over the next five years, cooperate with state game and fish agencies, other federal agencies, Forest Service research stations, FWS, and others (universities etc.) to assess and prioritize habitat for potential Chiricahua leopard frog reintroduction. Cooperatively document the result in an annual report to the FWS and to the extent feasible within the mission and capabilities of the Forest Service assist the with any Chiricahua leopard frog reintroduction efforts.

Conservation Measure #3: Implement, as appropriate, recommendations to minimize the effects of stock pond management and maintenance identified in the final recovery plan for the Chiricahua leopard frog.

Conservation Measure #4: Continue to implement the standardized interagency monitoring protocol for Chiricahua leopard frogs.

Conservation Measure #5: The long-term benefits directly attributable to wildland fire use for resource benefits, is the reduction of catastrophic fire. This is very significant in goals and objectives vital to restoring fire-adapted systems. Their absence predisposes ecosystems to the undesirable effects associated with catastrophic fires, potentially at levels of severity and intensity outside historic ranges of variability which are highly detrimental to aquatic systems. That said, the Forest Service agrees to the following:

a. Pre-ignition Planning: Maintain current distributions of threatened, endangered, proposed, and candidate species in GIS layers on each National Forest in the Southwestern Region and these GIS layers will be provided to the Line Officer, Fire Management staff and/or incident commander for each species occurring in the watershed of the ignition as wells as surrounding watersheds.

Identify watersheds that are particularly susceptible to ash flow and sediment following high intensity fires. Use this information to guide fire use mitigation measures such as; delay, direct check and/or suppress.

b. A Forest Service biologist for the appropriate species will be assigned and consulted during fire management activities to ensure that concerns for threatened and endangered species are addressed. For example, spawning season restrictions to protect breeding activities, appropriate buffers to filter ash and sediment, avoiding mechanical and chemical measures within the riparian corridor, etc.

   During development and implementation of operational management plans, identify potential threats to listed species and designated critical habitat and develop mitigation actions to eliminate threats.

c. Develop contingency plans in cooperation with FWS, other federal agencies, state agencies, universities/colleges, and others to preserve, rescue and secure a population in imminent danger of localized extirpation due to fire use for resource benefits.

An LRMP provides guidance and direction in the context of a broad management framework. This LRMP defines the direction for managing the NFs. Direction in the LRMP is provided in the form of the S&Gs. Because it was unclear what the operational difference is between a "standard" and "guideline," we did not differentiate between the two for our analysis. While the FWS recognizes that much discretion exists on the part of Forest managers at the project level, in the implementation of the LRMP through the S&Gs, this discretion also adds to the complexity of this consultation due to the conflicting nature of some S&Gs that exist between the different operating programs within the same Forest. We provide examples of this below by USFS program.

The S&Gs are written to apply Forest-wide or to a specific MA. The Coronado NF has designated "MAs" based on such criteria as vegetation type, principal land use, and special management designations such as wilderness areas. The LRMP contains some S&Gs that apply Forest-wide and some that apply only to specific MAs. During the development of a project, each management program reviews Forest-wide and MA-specific S&Gs that either give direction to, or place constraints on, management activities (e.g., logging, grazing, recreation, mining, etc.). The S&Gs that provide direction state what will be accomplished to achieve specific resource goals.

This BO is now covering the projects that were covered by prior BOs that have yet to be fully implemented.

The LRMPs direct how current and future activities will be carried out in the following management programs: (1) Engineering, (2) Fire Management, (3) Forestry and Forest Health, (4) Lands and Minerals, (5) Rangeland Management, (6) Recreation, Heritage and Wilderness, (7) Watershed Management, and (8) Wildlife, Fish, and Rare Plants. Each of the USFS's eight resource programs were discussed in depth within the April 8, 2004, BA, the June 10, 2005, LRMP BO/CO, and the April 6, 2011, BA.

Effects to the Chiricahua leopard frog were evaluated in the 2005 BO/CO, and are included herein by reference (see U.S. Fish and Wildlife Service 2005). The majority of the S&Gs, which continue to be implemented as the proposed action within the Coronado NF LRMP, were considered positive in the sense that they would maintain habitat for the frog or provide for recovery. However, potential adverse effects were found in all of the management programs. The Fire Management Program combines elements of fire prevention, prescribed fire, wildland fire, and fire suppression. However, wildland fire, including fire suppression and wildland fire use, are not included in the proposed action and consultation on these actions will continue to be handled under emergency Section 7 consultation procedures.

Effects of the Action on the Chiricahua leopard frog

Some S&Gs presented for analysis for the Coronado NF were not assigned a Consultation Resource Program; however, some of these S&Gs were categorized as Chemical Management under the LRMP Resource Program heading. Standards and Guidelines 699 and 703 provides guidance regarding the use of pesticides. Use of these chemicals in occupied habitat could result in take of frogs if applied on or near water; however, the only authorized use of pesticides is in fish lakes which do not currently contain Chiricahua leopard frogs on the NF. Adult frogs living in the terrestrial environment could be impacted through reduced feeding success as a result of insecticide use. Additionally, this S&G does not completely eliminate the potential for transmission of chemicals into the waters. These types of chemicals are likely to result in death and deformity of multiple life stages of frogs. Also, at a minimum, any herbicide or insecticide in the waters would likely result in reduced breeding success through lack of cover and reduced feeding success through lack of prey and forage items. Amphibians in general, and ranid frogs, in particular, are quite sensitive to pesticides and other chemical insult. These chemicals have a variety of direct and indirect effects on amphibians (Sparling 2003). Airborne movement and deposition of acidic compounds, pesticides, and potentially other chemicals over long distances can affect otherwise pristine areas that do not receive direct applications (Blanchard and Stromberg 1987, Davidson et al. 2002), and some pesticides may cause sublethal effects at very low dosages (Hayes et al. 2002, Hayes 2004; but see Carr et al. 2003). Similarly, S&G 702 provides guidance regarding cyanide leaching ponds during mining operations. These ponds would likely result in lethal take of frogs that disperse into these areas; however, although cyanide leaching may be permitted forest-wide within the Coronado NF, there have been no permits for projects that use cyanide leaching in the last 20 years and there is no anticipation for any in the foreseeable future (M. Linden, 2011, pers comm. USFS; R3 RO; L&M).

Engineering Program - No applicable S&Gs in the Engineering Program are likely to result in direct negative effects to the frog. Standards and Guidelines 712, 785, 797, 811, and 818 all call for roads to be closed, drained, and revegetated. This activity should result in improved watershed condition thereby reducing the impact of degraded watersheds on frog populations; however, the act of manipulating roads is likely to result in take of individuals. Frogs of multiple life stages could be killed by tools and machinery. There is also likely to be some temporary avoidance of the project areas which could result in reduced breeding success if projects occur during these times. Additionally, there may be negative effects from this program not captured in the applicable S&Gs. The Engineering Program includes activities such as construction,

maintenance, and operation of roads. Construction and use of roads in general may have negative effects on frogs in that, at any road density, improperly placed roads may disrupt metapopulation dynamics due to habitat fragmentation if these roads serve as barriers to movement (deMaynadier 2000).

These effects would likely result in reduced feeding and breeding success due to degraded habitat and increased difficulty in dispersion and reproduction. Although not documented for Chiricahua leopard frogs, mortality of other species of leopard frogs by vehicle traffic on roadways can be considerable (Carr and Fahrig 2001). Chiricahua leopard frogs, although rarely, are sometimes found on roads (J. Rorabaugh, FWS, 2005, unpubl. data) where they could be subject to road mortality.

Fire Management Program - No applicable S&Gs in the Fire Management Program are likely to result in direct negative effects to the frog. Standards and Guidelines 695, 713, 798, 812, and 829b all allow for the use of prescribed fire. These S&Gs provide great benefit to the frog by reducing the risk of catastrophic wildfire, which given the limited number of populations in existence, could have serious impacts to population functions. However, these projects are likely to result in lethal incidental take of individuals associated with humans, tools, machinery, and burning. There is also likely to be temporary avoidance of the burned and/or cleared areas resulting in decreased breeding success. Finally, as stated above, ash flows and erosion/sedimentation in burn areas have been known to cause local extirpations of frogs in the affected areas.

Forestry and Forest Health Program - Standard and Guideline 697 provides guidance regarding the use of chemical agents in recreation areas. There is reason to believe that frogs would be present in these areas, particularly riparian camping or boating areas, thereby likely being affected by chemical use. Similarly, S&G 698 allows for the use of herbicides in fishing lakes. Any use of chemical agents could affect the frog, as discussed above; however, the frog does not currently occur in any lakes on the Coronado NF that are managed for recreational fishing, thus this S&G should not have an impact on the frog. Standard and Guideline 773a calls for vigilance for outbreak of disease or insect infestation. The control of disease and insects in the Coronado NF helps to maintain the general environment; however, the use of chemicals to control them could result in incidental take of frogs as discussed above. Standard and Guideline 704 allows for T&E habitat needs to take precedence over disease and insect control and should help to minimize the possibility of negative impacts from S&G 773a on the frog.

Land and Minerals Program - No applicable S&Gs in the Lands and Minerals Program are likely to result in negative effects to the frog. In addition, no negative impacts are anticipated from this program as a whole.

Rangeland Management Program -In the Rangeland Management Program, S&Gs 762, 792, and 805 all allow for grazing. In those areas where grazing overlaps occupied frog habitat there are likely to be negative impacts that result in reduced feeding and breeding success. In addition, there are likely to be impacts to individual frogs under any grazing regime, in the form of lethal incidental take via trampling, spread of chytrids, and livestock water maintenance. In addition, S&G 771 allows some grazing in order to reduce fuel hazard. The fuels reduction can be

important in reducing the effects of catastrophic wildfire; however, some take of individuals is likely to occur due to trampling, and grazing if at levels that significantly reduces fire frequency causing watershed degradation and changes in vegetation communities.

Livestock grazing has been identified as having adverse effects to frogs. The specific effects of livestock grazing on leopard frog population trends are not well-studied, however the literature is robust in its treatment of livestock grazing on aquatic and riparian habitat. Livestock are known to spend a disproportionate amount of their time in riparian zones and thus can adversely affect these systems in a number of ways (U.S. Fish and Wildlife Service 2007:32). Livestock grazing is nearly ubiquitous within the historical range of the frog. In Arizona, stock tanks have become important habitats for the Chiricahua leopard frog. Adverse effects to the species and its habitat may occur under certain circumstances as a result of livestock grazing activities; particularly in drought conditions or in instances where numerous stressors on frog populations act in concert.

Actual trampling of metamorphosed frogs or toads from livestock using occupied habitat has been reported in rare instances. In extreme drought conditions, the likelihood of adult or larval frogs being trampled may increase due to the decrease of standing water and increase in livestock use. However, we believe the most significant adverse effect of livestock accessing breeding habitat of the frog is trampling egg masses. Egg masses may contain over 1,000 individual eggs and with even a one percent survival rate, constitute the simultaneous mortality of 10 or more reproductive individuals. Egg masses are also particularly important for use in head-starting, specifically in circumstances with limited access to egg masses within particular genetic strains. Indirect effects from livestock grazing may include deterioration of watersheds, erosion, scouring, and/or siltation of stream course, elimination of off-channel pools that provide breeding habitat and undercut banks that provide cover for frogs, and possibly the spread of disease (i.e., *Bd*) (U.S. Fish and Wildlife Service 2007:33).

Recreation, Heritage, and Wilderness Program - No applicable S&Gs in the Recreation Program are likely to result in direct negative effects to the frog. However, there may be negative effects from this program not captured in the applicable S&Gs. The goal for this program is to "Maintain the current spectrum of developed, dispersed, and primitive recreation opportunities and increase those opportunities with the capability of the resources and the framework of this plan as needs and funds develop (Coronado NF LRMP)." This goal statement implies a multiple use recreation program which may include camping, hiking, boating, and fishing. Although these activities are not directly identified as threats to the frog, they are likely to involve some incidental take of individual frogs in the form of disturbance, avoidance of impacted recreation areas, and even mortality from direct contact with humans/vehicles. Additionally, as these recreational users move through the environment, they might contribute to the spread of chytrids, especially water users if boats and other equipment are not thoroughly dried or sterilized between sites. Some are also likely to spread non-native predators.

Watershed Management Program - No applicable S&Gs in the Watershed Management Program are likely to result in direct negative effects to the frog. Standards and Guidelines 677, 711, 764, 782, 794, and 807 all provide for watershed improvement projects. These projects should result in improved watershed condition thereby maintaining or improving habitat for the frog. However, frogs of multiple life stages could be killed by tools and machinery. There is also

likely to be some temporary avoidance of the project areas which could result in reduced breeding success if projects occur during these times.

Wildlife, Fish, and Rare Plants Program - No applicable S&Gs in the Wildlife Program are likely to have direct negative effects to the frog. Standard and Guideline 652 allows for use of wildlife escape ramps in all livestock waters. These waters can be crucial in the survival of frogs as refugia in years of drought; however, there could be lethal take of individuals due to trampling. In addition, wildlife movement between waters could contribute to the spread of chytrids and availability of these waters could facilitate the dispersal of non-native bullfrogs and salamanders. Similarly, S&Gs 666, 668, 708, 778, and 790 provide for maintenance of wildlife structures. These could include occupied wildlife waters and stock tanks resulting in lethal take of frogs during the maintenance projects. Standard and Guideline 667 allows for projects to be implemented which would improve habitat for T&E species. Some of these projects could include prescribed burning and forest thinning. These projects are likely to reduce the risk of catastrophic fire, but are likely to result in short-term effects to individuals.

A number of S&Gs in the Wildlife Program potentially provide substantial benefits to the frog. For example, S&G 634 establishes the maintenance of T&E species habitat as a priority over other species habitats forest-wide. Standards and Guidelines 629, 709, 770, 779, 791, 804, 814, 821, and 836 all provide for actions which work towards delisting of T&E species by implementing recovery plans. These S&Gs should help the Forest to minimize the effects of other projects, prioritize its projects such that negative impacts of other Forest uses could occur largely outside critical frog areas, and may also result in increased population numbers and sizes.

In summary, the applicable S&Gs within the Coronado NF LRMP have the potential to result in a variety of effects to the frog. To a large extent, activities conducted under the positive S&Gs should benefit the frog and/or help to eliminate or minimize the effects of activities conducted under the negative S&Gs. However, the positive S&Gs do not eliminate the possibility of take, thus take of frogs is reasonably certain to occur as a result of implementation of the Coronado NF LRMP.

According to the USFS's BA for this consultation, because LRMPs do not prescribe the timing or exact locations of specific land management activities, some uncertainty about the potential environmental consequences exist. Therefore, we summarized projects since the completion of the 2005 BO/CO in order to evaluate the effects to the frog from the continued implementation of the Coronado NFs LRMP (see Table 7 above). Since the 2005 consultation, the FWS anticipated that take of frogs would occur in the form of harm and harass from livestock allotment management, a restoration project, and construction of a fish barrier. Projects on the Coronado NF that were evaluated since 2005 did not result in jeopardy or adverse modification determination. This BO is now covering the projects that were consulted upon in previous BOs that have yet to be fully implemented or are ongoing.

In summary, Chiricahua leopard frog populations on the Coronado NF appear to be stable. Threats from disease on non-native species exist however on the Forest. Biologists on the Coronado have worked with multiple private landowners with regard to frog recovery activities. Further, although adverse effects are occurring, the majority of the S&Gs within the Coronado

NF's LRMP were considered positive in the sense that management would maintain habitat for the frog.

Effects of the Action on Chiricahua leopard frog Critical Habitat

In our analysis of the effects of the action on CH, we consider whether or not a proposed action will result in the destruction or adverse modification of CH. In doing so, we must determine if the proposed action will result in effects that appreciably diminish the value of CH for the recovery of a listed species. To determine this, we analyze whether the proposed action will destroy or adversely modify any of the PCEs that are the basis for proposing CH. To determine if an action results in adverse modification of CH, we must also evaluate the current condition of all CH units, and the PCEs of those CHUs, to determine the overall ability of all CH to support recovery. Further, the functional role of each of the CHUs in recovery must also be considered because, collectively, they represent the best available scientific information as to the recovery needs of the species.

The FWS designated CH in 2012. Therefore, we have not yet analyzed the effects of site-specific projects on CH. Based upon actions we have consulted on within this action area, continued implementation of the Coronado NF LRMP may result in projects with adverse effects to CH. Below the PCEs related to Chiricahua leopard frog aquatic breeding habitat (including immediately adjacent uplands) and dispersal habitat and the potential effects from implementation of the LRMP are described.

1. Aquatic breeding habitat and immediately adjacent uplands exhibiting the following characteristics:

> *PCE 1a:* Standing bodies of fresh water, including natural and manmade (e.g., stock) ponds, slow-moving streams or pools within streams, off-channel pools, and other ephemeral or permanent water bodies that typically hold water or rarely dry for more than a month. During periods of drought, or less than average rainfall, these breeding sites may not hold water long enough for individuals to complete metamorphosis, but they would still be considered essential breeding habitat in non-drought years.
>
> *Effect:* Actions implemented under the LRMP are expected to retain and recover this PCE for frogs. There are S&Gs in place to ensure that areas supporting listed species are not dewatered or impaired to the point that they cannot support frogs. Cleaning (i.e., draining and or removal of sediment) of stock tanks or piping of water from pools (spring-fed or perennial) that provide habitat for Chiricahua leopard frogs could result in the loss and/or reduction (reduced depth) of this PCE. However, occasional drying for short periods (less than one month) may be beneficial in that the frogs can survive, but nonnative predators, particularly fish, and in some cases, American bullfrogs and populations of aquatic forms of tiger salamanders, will be eliminated during the dry period (U.S. Fish and Wildlife Service 2007).

PCE 1b: Emergent and or submerged vegetation, root masses, undercut banks, fractured rock substrates, or some combination thereof, but emergent vegetation does not completely cover the surface of water bodies.

Effect: The Rangeland Management Program is expected to result in adverse effects to this PCE. Livestock can eat and/or modify emergent and submerged vegetation at sites they occupy resulting in loss of cover for frogs. However, because we have worked with the Coronado NF to fence off portions of stock tanks occupied by Chiricahua leopard frogs and designated these locations as CH, the expected effect is that vegetation inside the protective fences will be protected and will maintain sufficient vegetation at these stock tanks to support breeding frogs (e.g., vegetation to attach egg masses, provide cover and food to tadpoles, etc.).

PCE 1c: Nonnative predators absent or occurring at levels that do not preclude presence of the Chiricahua leopard frog.

Effect: The Coronado NF is implementing CMs to ensure that actions implemented under the LRMP, particularly movement of water under the Fire Management and Range Management Programs does not result in the incidental movement of nonnative species into CH. These measures include mandatory notification of USFS biologists and the FWS 60-days prior to cleaning any stock tank located within Chiricahua leopard frog areas. Efforts are also made to ensure that USFS employees are aware of what stock tanks contain frogs and nonnative species so that the potential for inadvertent transfers of nonnative species to occupied habitat is reduced.

PCE 1d: Absence of chytridiomycosis (*Bd*), or, if present, then environmental, physiological, and genetic conditions are such that allow persistence of Chiricahua leopard frogs.

Effect: There is the potential that actions carried out under the LRMP, such as the cleaning/sediment removal of stock tanks and moving machinery between stock tanks could result in the movement of *Bd*, or other diseases, to CH. However, the Coronado NF provides preventative measures to all of its livestock allotment permittees, field personnel, and others working in/near CH that require equipment be disinfected between sites. Pathogens, such as *Bd*, can easily be transferred between habitats on equipment and footwear. Disinfecting equipment between sites should significantly reduce the potential for *Bd* to be transmitted to CH.

PCE 1e: Upland areas that provide opportunities for foraging and basking that are immediately adjacent to or surrounding breeding aquatic and riparian habitat.

Effect: Rangeland management actions may result in reduced vegetative habitat immediately around and surrounding CH. However, fencing at occupied habitat will leave some areas adjacent and immediately surrounding the stock tanks vegetated by denying livestock access. Livestock will be able to eat, trample, and/or otherwise modify

vegetation outside the fenced area. This may result in some beneficial effects by providing basking habitat (e.g., open areas) for frogs.

2. Dispersal and non-breeding habitat, consisting of areas with ephemeral (present for only a short time), intermittent, or perennial water that are generally not suitable for breeding, and associated upland or riparian habitat that provide corridors (overland movement or along wetted drainages) for frogs to move among breeding sites in a metapopulation. The dispersal and non-breeding habitat need to have the following characteristics:

PCE 2a: Are not more than 1.0 mile overland, 3.0 miles along ephemeral or intermittent drainages, 5.0 miles along perennial drainages, or some combination thereof not to exceed 5.0 miles.

Effect: Actions implemented under the LRMP should not result in the loss of stock tanks within CH that would change the movement distance between stock tanks. Therefore, dispersal and non-breeding habitat should remain intact.

PCE 2b: In overland and non-wetted corridors, provides some vegetation cover or structural features (e.g., boulders, rocks, organic debris such as downed trees or logs, small mammal burrows, or leaf litter) for shelter, forage, and protection from predators; in wetted corridors, provides some ephemeral, intermittent, or perennial aquatic habitat.

Effect: Actions implemented under the LRMP should not significantly reduce or modify this PCE within CH. Though actions may result in small reductions in organic debris as a result of prescribed fire, road maintenance, or livestock grazing, these impacts are not likely to significantly modify this PCE.

PCE 2c: Are free of barriers that block movement by Chiricahua leopard frogs, including, but not limited to, urban, industrial, or agricultural development; reservoirs that are 50 acres or more in size and contain predatory nonnative fishes, bullfrogs, or crayfish; highways that do not include frog fencing and culverts; and walls, major dams, or other structures that physically block movement.

Effect: Actions implemented under the LMRP would not result in the creation of barriers to movement within CH.

Effects of the Action on the Role of Critical Habitat in Recovery

According to the 5-Year Review for the Chiricahua leopard frog, threats have not been eliminated pursuant to Criterion 4 of the Recovery Plan in RUs 1-4. The proposed action includes actions that are recommended in the Recovery Plan. These actions were identified as being necessary to recover the Chiricahua leopard frog and the Coronado NF is either implementing or assisting with implementation of these actions in CH. These actions include the following:

- The Coronado NF has and continues to design projects in occupied Chiricahua leopard frog habitat which address the appropriate components of the Recovery Plan, with the goal of implementing projects with beneficial, insignificant, or discountable effects to Chiricahua leopard frog.

- The Coronado NF has and continues to implement actions to minimize the effects of stock pond management and maintenance as identified in the Recovery Plan. As recommended by the Recovery Plan, occupied stock tanks have been partially fenced and stock-pond management guidelines are being followed.

- The Coronado NF, working with FWS and AGFD, has been monitoring potential habitat following the standardized interagency monitoring protocol for the Chiricahua leopard frog.

- The Coronado NF maintains GIS layers for the current distribution of Chiricahua leopard frogs on the forest and this information is used to guide fire management and mitigation to avoid or minimize the effect of wildland fires on the species. Fire use operational plans on each district are reviewed and updated prior to each fire season and are followed during a fire use event. USFS and FWS biologist are consulted prior to determining if a natural fire ignition may be allowed to burn in listed species habitat.

- The FWS, through the Recovery Stakeholder's Group which includes the USFS, has taken the lead in organizing and hosting Chiricahua leopard frog conservation coordination meetings. The team of agency personnel and other interested parties established several workgroups to address various aspects of protecting populations, identifying information needs, information access, seeking funding and resources, establishing partnerships, and other tasks. The Regional Office has financially supported reintroduction projects, survey training workshops, and frog propagation efforts during the reporting period. In addition, the biologists on the Coronado NF are active members of the Chiricahua leopard frog multi-organization conservation team. Further, the Coronado NF biologists have also helped with habitat improvements and re-introduction of populations.

These actions should increase the sustainability and resiliency of Chiricahua leopard frog habitat. Therefore, continued implementation of the Coronado NF's LRMP is not expected to diminish the conservation contribution of CH to the recovery of the Chiricahua leopard frog.

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 Act. Since the entire project area is within the Coronado NFs, all legal actions likely to occur are considered Federal actions.

Unregulated activities on non-Federal lands, such as trespass livestock, inappropriate use of off-highway vehicles, and illegal introduction of nonindigenous aquatic species are cumulative effects and can adversely affect the species through a variety of avenues. Illegal introductions of nonindigenous fishes and other aquatic invasive species are routinely made by the public (e.g., topminnow, red shiner, and guppies).

Cumulative effects to native aquatic animals include ongoing activities in the watersheds in which the species occurs such as livestock grazing and associated activities outside of Federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization, and recreation without a Federal nexus. Some of these activities, such as irrigated agriculture, are declining and are not expected to contribute substantially to cumulative long-term adverse effects to native aquatic animals. Other activities, such as recreation, are increasing. Increasing recreational, residential, or commercial use of the non-Federal lands near the riparian area and ciénega would likely result in increased cumulative adverse effects to occupied, as well as potentially occupied native aquatic animal habitat through increased water use, increased pollution, and increased alteration of the stream banks through riparian vegetation suppression, bank trampling, changing flow regimes, and erosion.

CONCLUSION

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the CH to satisfy essential requirements of the species" (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998:4-34).

After reviewing the current status of the Chiricahua leopard frog and its CH, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, we conclude that continued implementation of the LRMP for the Coronado NF will not jeopardize the continued existence of the frog and will not destroy or adversely modify CH. Effects analyses and conclusions in BOs from 2005 through 2010 for the Coronado NF also determined that projects implemented under the current LRMP were not likely to jeopardize the continued existence of the Chiricahua leopard frog. Further, summary of our reasoning for determining that the continued implementation of the LRMP for the Coronado NF will not jeopardize the frog and will not destroy or adversely modify CH for the species is based on the following:

- During the 2005 LRMP consultation, the FWS and USFS jointly developed a set of CMs for the Chiricahua leopard frog which became part of the proposed action. Since then, the USFS has incorporated these recommendations into individual projects consulted on under the 2005 LRMP BO/CO and provided project implementation monitoring information to the FWS indicating that these projects were implemented as proposed.

- Standards and Guidelines within the Coronado NF's LRMP have not changed since 2005, the majority of which were found to be beneficial to the Chiricahua leopard frog. The frog's environmental baseline has improved on the Coronado NF as a result of conservation actions implemented by FWS, AGFD, and the USFS. These actions, such as habitat improvements and reintroductions, have resulted in an increase in the number of stock tanks occupied since 2005 and protection of CH (e.g., fencing at occupied tanks to prevent livestock access to portions of the tank).

Projects implemented under the Coronado NF's LRMP have not lead to a jeopardy determination.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR 17.3) 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 which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered 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 undertaken by the Forest so that they become binding conditions of any grant or permit issued to the appropriate utility, 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 (1) fails to assume and implement the terms and conditions or (2) fails to require the (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, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Forest or appropriate utility must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement (see 50 CFR §402.14(i)(3)).

Amount of Take

Incidental take of the Chiricahua leopard frog is reasonably certain to occur as a result of the continued implementation of the Coronado NF LRMP. This incidental take is expected to be in the forms of harm (including direct mortality) and harassment resulting from site-specific projects implemented under the LRMP. However, it is difficult to quantify the number of individual frogs taken because: (1) dead or impaired individuals are difficult to find (and are readily consumed by predators) and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species could change over time through immigration, emigration, and loss or creation of habitat; and (3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity.

The standard Visual Encounter Surveys (VES) method is the survey protocol used to conduct Chiricahua leopard frog surveys (U.S. Fish and Wildlife Service 2007, Appendix E). The VES method will generate presence/absence data if used independently and generate information from which inferences about frog abundance and trends can be made at a specific site. However, we do not have a means of counting all individual frogs at a site. As noted above, we believe that we cannot measure the number of frogs taken as a result of this action because these frogs are difficult to find, particularly if they are dead or impaired, and the frog is difficult to see due to its size, cryptic coloring, and complex habitat. In addition, egg masses and tadpoles are frequently hidden in submerged vegetation and cannot be counted precisely. Therefore, though we can generate counts of frogs seen by surveyors, results from these surveys do not provide an accurate estimate of the number of frogs present at the site. If we are unable to know the number of frogs at a site, it follows logically that we would be unable to count the number of frogs potentially incidentally taken as a result of the proposed action.

Since we cannot estimate the number of individual frogs that will be incidentally taken for the reasons listed above, the FWS is providing a mechanism to quantify when take would be considered to be exceeded as a result of the implementing the Coronado NF LRMP. We conclude that the incidental take of Chiricahua leopard frogs will be considered exceeded if there is a net loss in the number of reproductive sites in either Ranger Districts or RUs (see Table 6) for a period of three consecutive years on Coronado NF lands as a result of the proposed action. This incidental take is in addition to any previously authorized incidental take specified in the "Factors Affecting the Species in the Action Area" section above. In other words, we have identified actions that may result in the incidental take of individual frogs (due to actions implemented under the Management Programs discussed in the Effects section above). The actions analyzed under the LRMP could take several (though we are unable to count the exact number) individual frogs of various life stages (frogs, tadpoles, and eggs) through direct mortality or harm from trampling (human, animal, or machine), and harm and/or harassment through habitat modification (e.g., as a result of roads, livestock, piping of water, and/or the movement of disease or nonnative predators through cleaning of stock tanks, or other action resulting in take authorized under the LRMP). This amount of incidental take will not prevent the population from recovering to pre-take levels because the existing occupied stock tanks are all within frog dispersal distance of one another (frogs can move up to 5 miles, see Status of the Species) and connected via CH. Therefore, if frogs cease to be present at one site, the frogs will be able to recolonize the site on their own, or we can assist them as we have done in the past. We expect the Coronado NF to continue to work with the FWS and AGFD to continue to

implement actions such as captive breeding, habitat protection (e.g., fencing, silt fences, etc.) that will result in an increase in the number and resiliency of occupied stock tanks or other suitable habitats on the NF.

Effect of the Take

In this BO, the FWS determines that this level of anticipated take is not likely to result in jeopardy to Chiricahua leopard frogs. While the proposed action, implementation of S&Gs under the seven Management Programs described in the Effects Section, may adversely affect the frog in the short-term through the loss of individual frogs of various life stages through any of the forms of incidental take described above, none of these actions as described in the BA should result in the loss of all frogs at a given stock tank.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Chiricahua leopard frogs.

1. Minimize or eliminate adverse effects to Chiricahua leopard frogs on the Coronado NF.
2. Minimize or eliminate adverse effects to Chiricahua leopard frog habitat on the Coronado NF.
3. Monitor the impacts of site-specific projects on the Chiricahua leopard frog.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the USFS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1.1 The Coronado NF shall make protection of occupied breeding sites a priority during implementation of projects, which may include partial (or in rare circumstances, total) exclusion fencing of stock tanks, if necessary.

1.2 Where feasible, all equipment that comes into contact with aquatic habitats will be cleaned and disinfected or allowed to dry completely before visiting a different aquatic site by removing all soil, mud, and debris to ensure that *Bd* or other diseases are not spread between sites.

The following terms and conditions will implement reasonable and prudent measure 2:

2.1 Live fish, crayfish, bullfrogs, leopard frogs, salamanders, or other aquatic organisms shall not be moved among earthen stock tanks or other aquatic sites by Coronado NF employees or permittees unless approved by the FWS.

2.2 Water shall not be hauled to occupied sites by Coronado NF employees, permittees, or anyone operating under USFS authorization, from other sites that support leopard frogs, bullfrogs, crayfish, or fish.

2.3 If Coronado NF employees, permittees, or anyone operating under USFS authorization observes bullfrogs, crayfish or nonnative fish at sites either occupied by Chiricahua leopard frogs or thought to be previously free of these nonnative species, the local FWS's Ecological Services Field Office shall be notified via e-mail within five business days to coordinate interagency counter-measures, if necessary.

The following terms and conditions will implement reasonable and prudent measure 3:

3.1 The Coronado NF shall monitor incidental take resulting from the proposed action and report their findings to the FWS. Incidental take (implementation) monitoring shall include information such as when or if the project was implemented, whether the project was implemented as analyzed in the site-specific BO (including CMs, and BMPs), breeding season(s) over which the project occurred, relevant frog survey information, and any other pertinent information as described in the site specific BO about the project's effects on the species.

3.2 Annual reports, which will include this species, shall be sent to the local FWS's Ecological Services Field Office by March 1 of each year.

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. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information.

1. We recommend that the USFS implement Forest-specific actions within the Chiricahua Leopard Frog Recovery Plan.
2. We recommend that the USFS support research on the forest to study how *Bd* is spread throughout frog populations.
3. We recommend the Forest pursue opportunities for Safe Harbor Agreements with private landowners with inholdings surrounded by Forest land to create opportunities for additional refugium populations of Chiricahua leopard frogs.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

NEW MEXICO RIDGE-NOSED RATTLESNAKE

STATUS OF THE SPECIES

The New Mexico ridge-nosed rattlesnake (NMRR) was federally listed as threatened with CH on August 4, 1978 (43 FR 34479). Critical habitat for the NMRR was designated in Bear, Spring, and Indian Canyons in the Animas Mountains between 6,048 ft (1,844 m) and 8,320 ft (2,536 m), but is not within the action area of this BO. Our June 10, 2005, Programmatic BO/COs for the Continued Implementation of the Land and Resource Management Plans for the Eleven NFs and NGs of the Southwestern Region (FWS 2005a) and our October 24, 2002, BO on the Continuation of Livestock Grazing on the Coronado NF (FWS 2002) include a detailed Status of the Species for the NMRR. Those BOs are available on our website at http://www.fws.gov/southwest/es/arizona/, under Document Library; Section 7 BOs. Herein, we incorporate the status discussions by reference.

There have been no notable changes in natural history knowledge or distribution since the 2005 BO/CO (FWS 2005a) except the effects of the Adobe fire in the Animas Mountains, 2007, and the Whitmire fire, 2008, in the Peloncillo Mountains (FWS 2008). High-severity fire can reduce canopy and subcanopy cover that affect microclimate parameters and potentially availability of prey species. The loss of ground cover through fire can result in increased erosion and sediment accumulation in talus piles used as denning sites of NMRRs (FWS 2008).

The Adobe wildfire burned through designated CH for this species, with much of the area in Indian Creek being subjected to high-severity fire effects. Much of the riparian and pine woodland overstory in Indian Creek was lost to this wildfire. Areas in Bear and Spring Canyons appear to have been similarly affected, but an evaluation has not occurred. Several occupied talus slides in Indian Creek were partially buried in sediment and ash during post-fire runoff events. Preliminary results from prey-base monitoring in 2007 shows no discernible difference inside and outside the burn area. Individual snakes that appeared healthy were located within the severely affected areas of Indian Creek (Charlie Painter, NMDGF, pers. comm. 2007). Based upon preliminary observations in the Sierra San Luis, where a stand replacing fire burned through an occupied canyon in 1989, there may be some long-term effects of fire on the demographics of the snake population (Matt Goode, University of Arizona, pers. comm. 2007).

A total of 3,990 acres (1,615 ha) were burned by the Whitmire fire in the Peloncillo Mountains. The fire burned through part of three polygons of core NMRR habitat identified by Holycross and Smith (2001). Preliminary analysis indicated that the fire effects were low, and the upper canopy in the core habitat polygons was not impacted. No NMRR habitat was affected by the 2011 fires.

Designated CH for the NMRR is located on private lands within the Animas Mountains, New Mexico.

Climate Change
The potential effects of climate change could include long-term drought and hotter average temperatures, which could result in a higher risk of high intensity stand-replacing fires, one of the primary risks to the NMRR. However, there are no expectations of measurable changes in climate within the time frame of this action.

Recovery Actions
The Coronado NF has implemented riparian habitat enhancement activities in pine/oak canyons of the Peloncillo Mountains (USFS 2004a). In addition, implementation of the Coronado NF's Peloncillo Programmatic Fire Management Plan reduces the risk of catastrophic fires across the landscape (USFS 2004b). Such actions aim to improve and protect habitat conditions for the NMRR.

Overall, the status of the NMRR and its designated CH has not changed significantly since the 2005 BO/CO.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, the anticipated impacts of all proposed federal actions in the action area that have undergone formal or informal section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species within the Action Area

The Peloncillo population of NMRR is one of three known populations; the Animas and Sierra San Luis Mountains contain the other two populations. The population of NMRR on the Peloncillo Mountains is the only population of the subspecies within the action area of the Coronado NF. Occupied habitat area is managed by the USFS and BLM. Specifically, occupied area managed by the USFS is found entirely within MA 4. Management Area 4 is composed of 1,128,739 acres (456,786 ha) located on the Douglas Ranger District of the Coronado NF in the New Mexico bootheal, near the border with the state of Arizona (USFS 2004a). Within the Peloncillo Mountains, a total of 27 NMRRs have been found in 13 general areas (FWS 2002). The relatively low number (27 snakes) may be attributed to the difficulty in locating this subspecies in the Peloncillo Mountains. To date, there have been no effective methods developed for surveying the NMRR. Current methods take 30-50 person days to locate a single snake, so surveying and monitoring is not cost effective. No surveying or monitoring of NMRR populations has been conducted since the 2005 BO/CO (USFS 2009, 2010). However, the Forest has monitored NMRR habitat through its rangeland vegetation condition, trend and utilization analyses.

Holycross and Smith (2001) prepared a report and mapped NMRR habitat in the Peloncillo Mountains. Habitats were mapped as: 1) habitats probably or likely supporting (the FWS equates this to reasonably certain to be occupied) a deme of NMRR (habitats 3 and 4); 2) habitats very unlikely or unlikely to have NMRR occurring there (habitats 1 and 2); and 3) potential habitats

that burned destructively in the Maverick prescribed fire and no longer contain habitat characteristics. A total of 275 habitat patches were identified in the Peloncillo Mountains; 233 patches were ranked as habitats 3 and 4, totaling 5,070 acres (2052 ha). The FWS considers this amount of acreage reasonably certain to be occupied. Holycross and Smith (2001) also provide a map of potential core habitat, based upon a comparison of the known occupied locations and the potential available habitat within the Peloncillo Mountains. This map does not include all habitats used by NMRR, but only core habitats found in canyon woodlands that are typically used during the active season. Designated CH for the NMRR does not include USFS lands, nor does it occur within the action area.

Factors Affecting the Species within the Action Area

Factors affecting the NMRR and its associated habitat within the Peloncillo Mountains include illegal collection, wildfires, prescribed fires, and low to moderate levels of recreational activities. Potential threats to the NMRR include fuel wood harvest, mining, improper grazing management, and development (FWS 1985, 2002).

Collection and commercial exploitation of the NMRR has occurred in the past, and may still continue. During the 1960's and 1970's, as the taking of species in Mexico and Arizona became more difficult, the collection of NMRRs increased. Increased poaching (collection) has been known to significantly impact NMRR populations (USFS 2004a).

Catastrophic, stand-replacing fire events are a serious threat to NMRR and its woodland habitat. Altered fire regimes in the southwestern U.S. have caused woody fuel loads to build up in woodland habitats, increasing the risk for high intensity stand-replacing fires (USFS 2004b). Such catastrophic fires can destroy habitat essential to the survival of the species and pose a serious threat to the NMRR (FWS 2001). In 1997, the Maverick prescribed fire occurred in two of the 13 areas known to be occupied by NMRR in the Peloncillo Mountains. In 2003, the Baker II prescribed fire was successfully implemented. The perimeter of the burn encompassed approximately 47,000 acres (19,000 ha). Post fire evaluation of the NMRR habitat as identified by Holycross and Smith (2001) showed that about 9 percent of the type 3 and 4 habitats within the burn were affected by high-intensity fire effects (Helbing 2004).

In September of 2004, the Coronado NF completed a BA for the Peloncillo Programmatic Fire Management Plan (USFS 2004b). Objectives of the fire plan consist of reducing catastrophic fires, developing mosaic habitat patterns, and promoting natural ecological processes (USFS 2004b). Activities associated with the implementation of this plan may kill or injure NMRRs through the use of heavy equipment and fire effects from back burns and prescribed burns. These activities may also contribute to an increase in snake predation due to loss of ground cover, potentially reduce prey species numbers, and alter suitable habitat as to significantly disrupt normal behavior patterns including, but not limited to, breeding, feeding, or sheltering.

On March 18, 2005, the FWS issued a BO on the USFS's Peloncillo Programmatic Fire Management Plan (FWS 2005b). The FWS concluded that the proposed action of the fire plan was "not likely to jeopardize" the continued existence of the NMRR. However, incidental take was anticipated as a result of the fire plan. This BO quantified take by the number of individuals

for actions where it is relatively easy to detect individuals. For projects on a scale where detection of individuals is extremely unlikely, the FWS used potential core habitat ranked by Holycross and Smith (2001) as "habitats probably or likely supporting a deme of *C. w. obscurus*" (habitats 3 and 4) as a surrogate for take. The FWS anticipated the following incidental take for the NMRR as a result of the fire plan:

1. One NMRR will be killed or injured; or

2. Up to 10 percent of delineated core habitat ranked as 3 or 4 (Holycross and Smith 2001), in Fire MAs IV and V (Upper Cloverdale Creek Watershed) will be affected by high-intensity fire during the life of the fire plan. A high canopy consuming fire is one where 90 to 100 percent of the wooded overstory canopy is burned off; or

3. Up to 20 percent of delineated core habitat ranked as 3 or 4 (Holycross and Smith 2001), in the remaining Fire MAs will be affected by high-intensity fire during the life of the fire plan (FWS 2005b).

The Incidental Take Statement for the NMRR from the Peloncillo Programmatic Fire Management Plan BO covers all effects of prescribed fire and related activities for a period of 10 years. Implementation of this project and the issuance of incidental take associated with it are both ongoing and are in addition to this BO.

Recreational activities and off-highway vehicles (OHV) use have the potential to directly and indirectly affect the NMRR. In 2001, the Coronado NF had 2.7 million visitors, and the capacity at developed recreation sites is approximately 15,000 visitors (USFS 2004a). Although the Coronado NF restricts the use of motorized vehicles to existing trails and roadways, snake mortalities associated with vehicle use have been known to affect the NMRR (USFS 2004a).

The lands within MA 4 are suitable for livestock forage. The effects of livestock grazing on the NMRR are largely speculative and poorly studied. Potential impacts from livestock grazing to the NMRR may include trampling and habitat degradation. Improper livestock grazing is believed to reduce snake hiding and prey cover, and reduces available habitat (FWS 1985, 1999). Although permitted, the recent drought has limited the grazing of livestock within MA 4.

In 2002, the FWS issued a BO on the USFS's On-going and Long-term Grazing Activities on the Coronado NF (FWS 2002). The 2002 BO addressed the continued grazing of domestic livestock on 190 allotments, as well as the effects of associated roads and other range projects. The FWS concluded that the proposed action of the continued grazing was not likely to jeopardize the continued existence of the NMRR. Yet, incidental take was anticipated as a result of the proposed grazing activities. The 2002 BO authorized the taking of two NMRR as a result of direct impacts, including trampling by cattle or horses associated with grazing, snakes run over by vehicles associated with livestock grazing, snakes killed by permittees or ranch hands, and construction and maintenance of range projects. Take was also authorized for two NMRR as a result of indirect effects of livestock grazing, including reduction of vegetation cover quantity or quality, which increases predation and lowers prey availability, reducing reproductive output and/or increases snake mortality (FWS 2002). The Incidental Take Statement for the 2002 BO

covers all effects associated with livestock grazing on the Coronado NF for a period of 10 years. This consultation was originally conducted in 2002, but, since the 2005 BO/CO was issued, the Coronado NF reinitiated the grazing consultation as described below.

Since the 2005 BO/CO, one consultation has occurred that may affect the NMRR. In 2008, we consulted on the reauthorization of seven grazing allotments (FWS 2008). Our BO concluded that the action would neither jeopardize the continued existence of the NMRR, nor result in destruction or adverse modification of CH. In the 2008 BO, FWS concluded that the actual use and AUMs on all seven allotments has not changed and the management goals and objectives remain the same, and, therefore, the renewal of the 10-year grazing permits (to expire in 2018) does not significantly change the effects of the action from that described in the 2002 BO mentioned above. Thus, the 2008 BO authorized the same level of incidental take, effects of the take, reasonable and prudent measures, and terms and conditions as authorized in the 2002 BO except the take was extended for the duration of the reissued grazing permits. Implementation of this ongoing project and the issuance of incidental take are covered under this programmatic opinion since it supersedes the 2005 LRMP BO/CO. We have reviewed this site-specific project to ensure that it will not further diminish the conservation contribution of CH to the recovery of the NMRR.

Timber harvesting has been classified as unsuitable in all areas within MA 4. However, the lands within MA 4 are suitable for fuel wood harvesting (USFS 2004a). The harvesting of fuel wood has the potential to destroy or damage habitat essential to the survival of the NMRR.

Mineral operations and utility right-of-ways have the potential to directly and indirectly affect the NMRR through habitat destruction and disturbance (USFS 2004a). Access roads and the accompanying vehicle traffic are a necessary component of minerals activities. The use of heavy equipment along with surface occupancy causes direct habitat loss. In addition, human occupation increases the chances for harassment and displacement of the NMRR (USFS 2004a).

There have been no reported changes to designated CH since the 2005 BO/CO. No CH occurs on or near the Coronado NF.

EFFECTS OF THE ACTION

The S&Gs listed in the Coronado NF LRMP and 1996 Regional Amendment provides direction during the development of site-specific actions. Multiple S&Gs within the Coronado NF LRMP are applicable to the NMRR and its habitat. These S&Gs, if applied to project-level activities, may result in both indirect and direct effects to the NMRR. For a list of S&Gs considered in this consultation, please refer the 2005 BO/CO. Designated CH for the NMRR does not occur within the action area; thus, no CH for this species will be affected as a result of the proposed action.

Within the action area, the NMRR is only known to occur on the Peloncillo Mountains of the Coronado NF. Occupied sites include 13 general areas within MA 4 of the Douglas Ranger District, near the Arizona/New Mexico border. As outlined in the Coronado NF LRMP, the management emphasis for MA 4 is for a sustained harvest of livestock forage and fuelwood, while maintaining and improving game animal habitat (USFS 2004a).

The S&Gs within the Coronado NF LRMP generally emphasize the restoration and protection of T&E species' habitat. Most of the S&Gs within the Coronado NF LRMP have a positive response on the NMRR. However, some S&Gs and programs may negatively impact NMRR and their habitat.

This BO considers projects that were previously authorized in separate consultations but are ongoing or have yet to be implemented. The USFS is implementing two ongoing projects including the 2008 implementation of on-going grazing on seven allotments and the 2005 Peloncillo Programmatic Fire Management Plan. These were previously consulted on under site-specific BOs. The BOs issued for those projects noted adverse effects to the NMRR, as described in the Factors Affecting the Species within the Action Area above.

Engineering Program

The Engineering Program of the Coronado NF LRMP includes the construction, maintenance and operation of roads. Although such activities could potentially result in snake mortality, habitat modification and destruction, no applicable S&Gs within the Engineering Program have a negative effect upon NMRRs. General guidelines provided for the Engineering Program focus on road construction, use, maintenance, and closures with regards to natural resource protection. In particular, management direction of S&G 785 involves the closure and revegetation of roads and trails that are not needed for further use. Such direction has a positive effect on NMRR by reducing road density and minimizing threats to the subspecies.

Additional guidelines within the Coronado NF LRMP relate to activities conducted under the Engineering Program. The LRMP directs management to ensure public access to various parts of the Forest via state, county, or permanent USFS roads (USFS 1986). Potential effects on the NMRR may include direct road mortality and an increase in illegal collection by increased public access. However, the LRMP also provides direction for minimizing the transportation system to adequately meet management, protection, and utilization needs; but in locations that will minimize damage and maximize the values of all resources (USFS 1986). Implementation of this guidance, along with S&G 785 helps minimize but does not eliminate potential negative effects that the transportation system may have on the NMRR.

Fire Management Program

Fire management on the Coronado NF includes fire prevention, fire suppression, and fire use. Wildfires in the Southwest are getting larger and more intense, primarily due to the density of trees and accumulated dead woody debris on NFS lands (USFS 2004a). Such catastrophic fire has been identified as a natural stochastic threat to the NMRR and habitat (Smith et al. 2001).

No applicable S&Gs within the Coronado NF LRMP were associated with the Fire Management Program. However, the Coronado NF LRMP directs the use of prescribed fire to reduce fuel hazard and enhance and improve wildlife habitat, livestock forage, watershed values, and visual resources values (USFS 1986). Fuel treatments may consist of chipping, broadcast burning, piling and burning, or lopping and scattering (USFS 1986).

Prescribed fire activities may directly affect NMRRs. The NMRR may be caught and burned by these fires. Snakes may also be killed or injured during the surface disturbing activities

associated with prescribed fire actions. The potential exists for an increase in snake predation due to loss of ground cover and longer periods of surface exposure as more time and energy is devoted to foraging (BLM 2004). Additional indirect effects include reduction in prey availability, changes in reproductive patterns, and long-term alteration of suitable habitat. Combined with the disjunct distribution of the NMRR, the loss of individual snakes and habitat disturbance may also affect the ability of individuals to find suitable mates.

Interdependent effects from fire prevention activities may have a long-term positive impact to the NMRR. Fire prevention activities reduce the chances of injury and mortality, as well as destruction of habitat from catastrophic fires. The Coronado NF has developed a Peloncillo Programmatic Fire Management Plan, which includes the use of prescribed fire and management of fire ignitions that may occur on the Peloncillo Mountain Range over a 10-year period (USFS 2004b). The goal of the fire plan is to maintain a mosaic of woodlands, shrub lands, and grasslands, while reducing woody plant encroachment (USFS 2004b). The effects of prescribed fire and associated activities have been identified and addressed in the Peloncillo Programmatic Fire Management Plan BO (FWS 2005b). The FWS does not foresee any additional impacts to the NMRR from the effects of prescribed fire activities than those outlined in the Peloncillo Programmatic Fire Management Plan BO.

Forestry and Forest Health Program

The Forestry and Forest Health program includes guidance on chemical applications for a variety of purposes. In particular, S&Gs 697 addresses rodenticide, insecticide, and herbicide applications that could have the potential to negatively affect NMRR. The use of insecticides may indirectly affect the NMRR by reducing prey availability. However, the use of insecticides is limited to applications at administrative and recreation areas (S&G 697) that do not occur within NMRR core habitat. Snakes may also be affected by the use of herbicides applied for land treatments, which could contribute to the loss of habitat structure. Authority for herbicide application on the Coronado NF is currently limited to small scale applications to control invasive exotic plants; no large scale land treatments have been authorized or are planned.

The Coronado NF LRMP also provides S&Gs for the use of chemicals related to mining operations. Specifically, S&G 702 guides the use of chemicals involved with cyanide leaching activities. Cyanide leaching ponds could have lethal and sublethal effects on NMRRs through direct mortality and reduced prey availability. Although cyanide leaching may be permitted forest-wide within the Coronado NF, there have been no permits for projects that use cyanide leaching in the last 20 years and there is no anticipation for any in the foreseeable future (M. Linden, 2011, pers comm. USFS; R3 RO; L&M). S&G 702 is not included in the new draft LRMP for the Coronado NF. Although there have been no permits for projects that use cyanide leaching on the CNF in at least 20 years (pers. comm. w/M. Linden; USFS; R3 RO) and none are expected to occur, if a proposed project did include the use of outdoor cyanide leaching, there are other S&Gs and policies that would provide for the protection of the NMRR. Mitigation or protection measures would likely include a fully contained or covered leaching system, thus excluding the NMRR from contact with the leaching agent (R. Gerhardt, 2011, pers. comm. USFS CNF, 1/21/11). As such, it is unlikely there will be negative effects to the NMRR from this S&G.

Land and Minerals Program

The Lands and Minerals Program manages purchases, withdrawals, land exchanges, mining, oil, gas, geothermal leases, and the issuance of nonrecreational special use authorizations. The management and administration of minerals includes surface disturbances associated with underground mining operations, such as exploration drill holes, road construction, and active mining. Impacts associated with these activities could include increased traffic mortality, limited protection, and habitat loss and degradation from activities related to mineral extraction permits.

The USFS has limited discretion on the authorization and management of land and minerals permits. Furthermore, no S&Gs within the Lands and Minerals Program are applicable to the MA 4, where NMRR are known to occur. As a result, no S&Gs within the Land and Minerals Program have been given a negative exposure/response ranking for the NMRR.

Rangeland Management Program

The Rangeland Management Program provides for grazing of domestic livestock on NFS lands (USFS 2004a). As stated earlier, the management emphasis for MA 4 includes a sustained harvest of livestock forage. Grazing within the Peloncillo Mountains, and specifically within MA 4, where the NMRR is currently known to occur, is primarily managed at grazing Levels C and D. Grazing Levels of C and D are designed to manage for higher forage use levels and require higher density water developments and interior fencing. The S&Gs within the Rangeland Management Program emphasize the improvement of range conditions, including the construction and maintenance of water developments.

The effects of grazing activities within the range of the NMRR have been identified and addressed in the 2002 BO (FWS 2002). The FWS does not foresee any additional impacts to the NMRR than those outlined in the 2002 BO and the seven grazing allotments reauthorized in the 2008 BO (FWS 2008).

Recreation, Heritage, and Wilderness Program

The Recreation Program oversees the management of recreation and heritage sites within the NFs and NGs of the Southwestern Region. The majority of recreational use on the Coronado NF is day use and dispersed use recreation. Low to moderate levels of recreational activities have the potential to directly affect NMRRs through increased poaching (collection) and motor vehicle related mortality.

Although OHV use has increased on all NFS lands in the Southwestern Region, the Coronado NF has restricted OHV use to designated roads, unless posted otherwise. No off-road OHV use is permitted on the Coronado NF. In addition, the Coronado NF LRMP only permits dispersed recreation activities that do not adversely affect the productivity of the land or resources. Specifically, S&Gs 612 and 613 determine use capacities and develop operational plans for managing use capacity at less than standard or standard. This management direction would limit and minimize the effects of recreation upon the NMRR. Implementation of these S&Gs, as well as additional guidance for the Recreation Program, provides for the protection of natural resources from recreational activities. Thus, implementation of S&Gs 612 and 613 minimizes the threats of recreation on NMRR within the action area.

Wildlife, Fish, and Rare Plants Program

The Wildlife Program involves a variety of activities for managing habitats of all existing native and desired non-native wildlife, fish, and plant species in order to maintain viable populations (USFS 2004a). Much of the guidance under the Wildlife Program applicable to the NMRR has a positive effect on the subspecies.

Multiple S&Gs direct the development of general activity plans to guide habitat management on the Coronado NF, specifically to improve T&E species habitat conditions. Forest-wide S&Gs 629 and 633 provide direction for delisting T&E species in accordance with approved recovery plans. Guidance includes determining essential habitat for T&E species; recommending appropriate CMs to meet the protection and management needs of these species; and prioritizing completion of recovery plans. Thus, S&Gs 629 and 633 have a positive effect on the NMRR. Specific to MA 4, S&G 774 directs the management of wildlife to maintain and improve T&E species' habitats. Also, MA 4 S&G 779 guides structural and nonstructural habitat improvement projects for the benefit of T&E species in accordance with approved recovery plans. As a result, management guidance for S&Gs 774 and 779 have a positive effect on the NMRR.

Forest-wide management guidance for the Wildlife Program provides direction for minimizing adverse effects to the NMRR. Multiple S&Gs allow for the identification of T&E species habitat, and include site-specific restrictions to protect such habitat. S&G 638 lists management practices for minimizing the effects of mineral extraction on T&E species, which includes the NMRR. S&G 648 allows for modification of fuelwood harvest practices in areas of T&E species habitat. In addition, S&Gs 649 and 651 limit road construction and maintenance in accordance to tolerance levels of federally listed T&E species. S&G 653 includes direction on range and watershed rehabilitation projects, which restore and protect NMRR habitat. These S&Gs have a positive effect on the NMRR and help maintain habitat and provide for recovery of the subspecies.

S&Gs within this program may direct management activities to improve T&E species habitat conditions, yet short-term negative impacts may occur. Forest-wide S&G 652 directs that wildlife consideration be given when developing allotment management plans. These plans aim to maintain both livestock and wildlife utilization. Such management direction helps maintain NMRR habitat, providing prey and foraging cover. However, S&G 652 directs the use of structural improvements to maintain wildlife and livestock utilization of vegetation. Structural improvements may have an adverse effect on individuals depending on the timing and techniques used in construction, but most likely will destroy or modify habitat features essential to the NMRR. The management direction of S&G 652 has the potential for short-term effects on the NMRR, while providing for long-term habitat conditions needed for the subspecies' recovery.

Structural and nonstructural improvement guidelines are provided to meet the specific wildlife habitat objectives for each MA. Habitat improvement activities, while working to maintain and improve wildlife habitat, may have a short-term negative effect on T&E species, including the NMRR. For MA 4, guidelines are provided to manage for a sustained harvest of livestock forage and fuelwood, while maintaining and improving game animal habitat. S&G 667 directs the use of nonstructural wildlife improvements, which include prescribed burns, seeding of suitable wildlife forage species, thinning, and the transplanting of listed T&E species and other identified species into suitable habitat. These improvement actions have a positive impact on NMRRs by providing

adequate habitat characteristics. However, the NMRR experience short-term negative effects during the implementation of habitat improvement projects.

In summary, adverse effects to the NMRR resulting from the implementation of the Coronado NF LRMP are likely to occur in response to activities conducted under the Engineering, Rangeland Management, and Fire Management Programs. The FWS does not anticipate any additional take of NMRR from prescribed fire effects and associated activities beyond that issued in the Peloncillo Programmatic Fire Management Plan BO (FWS 2005b). We also do not anticipate any additional incidental take of NMRR from the effects of livestock grazing beyond that issued in the 2002 BO and 2008 BO (FWS 2002, 2008). The only incidental take that the FWS anticipates in addition to these ongoing projects is expected to occur in the form of harm from vehicle traffic for various uses.

1996 Regional Amendment

The management direction provided by the S&Gs in the 1996 Regional Amendment relates to the conservation of MSOs and northern goshawks. The S&Gs promote healthy forest ecosystems; functioning watersheds; and riparian and aquatic systems (USFS 2004a). Occupied MSO habitats, along with restricted and protected areas for the MSO do not overlap the range of the NMRR. Yet, three northern goshawk MAs coincide with the NMRR's range. However, we found that the S&Gs used by the USFS for the northern goshawk do not appreciably affect the NMRR. There was no change in the 1996 Regional Amendment S&Gs analysis from the 2005 BO/CO.

All of the S&Gs in the 1996 Regional Amendment lie under the Wildlife Program; yet the content of the S&Gs apply to several program activities. The majority of the S&Gs provide management direction for maintaining MSO and northern goshawk habitat, and provide for recovery of these species. While not a focus of the LRMP, S&Gs have the potential to affect other T&E species. In the case of the NMRR, approximately 67 percent of the S&Gs within the 1996 Regional Amendment have no effect, or have no application to the subspecies, mainly due to the lack of MSO and NMRR habitat overlap. Of the S&Gs that did apply to NMRR and were rankable, 100 percent were ranked as positive.

A few S&Gs pertain to forest and woodland types outside protected and restricted MSO areas. S&G 1476 promotes habitat management for landscape diversity. This guideline applies an ecosystem approach to managing habitat by incorporating natural variation in stand conditions and retaining snags and large trees, which are used by NMRR for concealment. By managing for habitat diversity and healthy watersheds, S&G 1476 has a positive effect on the NMRR.

S&Gs within the 1996 Regional Amendment also pertain to northern goshawk habitat. Management direction provided in S&G 1509 focuses on limiting road densities and the use of small skid trails in lieu of roads. This S&G minimizes the effects of road-related activities on the NMRR. Guidance provided in S&G 1508 directs the use of prescribed fires within goshawk nesting areas. Prescribed fires aim to reduce fuels and minimize the potential for catastrophic fires, which pose a threat to the NMRR. Thus, S&G 1508 has a long-term positive effect on the NMRR.

A few S&Gs within the 1996 Regional Amendment include Grazing Management Standards. S&G 1510 allows for the identification of key ungulate forage monitoring areas, in order to monitor and maintain forage use at levels that assure recovery and continued existence of T&E species. Management guidance under S&G 1510 has a positive effect on the NMRR.

The combined effects of the S&Gs will have minimal impacts on the NMRR and not preclude recovery of the species. Because there is no CH in the action area, there are no effects to designated CH.

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.

All known NMRR sites within the action area are located on USFS lands. Small, privately owned lands are intermixed with federally-administered lands in the lower elevations of the Peloncillo Mountains (BLM 2004). Snake injury or mortality, along with habitat fragmentation, degradation, or destruction from grazing and recreation activities on these small, privately owned parcels could affect disjunct NMRR populations within the action area (BLM 2004). Cumulative effects to the NMRR may also include the spread of catastrophic wildfires from private to Federal lands. The recent closure of a private section of the access road to Skeleton Canyon has restricted public access to several known occupied sites within the action area. This road closure should reduce the amount of incidental recreation effects, the potential for poaching, and human-caused fire.

CONCLUSION

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the CH to satisfy essential requirements of the species" (FWS and National Marine Fisheries Service 1998:4-34). Designated CH does not occur within the action area; thus, no destruction or adverse modification of CH is anticipated.

After reviewing the current status of the NMRR, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the Coronado NF LRMP and the 1996 Regional Amendment, as proposed, will not jeopardize the continued existence of the NMRR or its recovery. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

The population of NMRR on the Peloncillo Mountains, which occurs on lands administered by the Coronado NF, is the only population of the subspecies within the action area. Two other populations of the NMRR occur outside of the action area. The Peloncillo Mountains populations of NMRR are vulnerable to illegal collection, wildfires, prescribed fires, and low to moderate levels of recreational activities. Although adverse effects to the NMRR may occur from the implementation of the Coronado NF LRMP and 1996 Regional Amendment, the FWS does not believe the impacts of the proposed action will rise to the level of jeopardy for the following reasons:

- The action area includes only one of the three mountain ranges in which the NMRR is known to occur.

- S&Gs within the Coronado NF LRMP minimize impacts of existing forest infrastructure or ongoing activities to maintain and improve current habitat for federally listed species, including the NMRR.

- Forest-wide guidelines in the Coronado NF LRMP provide direction for delisting T&E species in accordance with approved recovery plans.

- The Coronado NF LRMP provides direction for limiting the transportation system to minimize damage and protect natural resources, thus reducing potential impacts from recreation activities.

- The Coronado NF LRMP requires the determination of recreational use capacities and manages dispersed recreation activities to protect the natural resource base, including habitat of T&E species.

- The Coronado NF Programmatic Fire Management Plan directs the use of prescribed fire to develop mosaic habitat patterns to enhance and improve wildlife habitat, and reduce fuel hazards contributing to risk of catastrophic fires.

With the implementation of these management S&Gs outlined above, the FWS concludes that the proposed action will not jeopardize the continued existence of the NMRR or its recovery.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the FWS 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 which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

Amount or Extent of Take Anticipated

As previously stated, the FWS has formerly anticipated take of NMRRs from the effects of prescribed fire and related activities in the Peloncillo Programmatic Fire Management Plan BO (2005), and from continued grazing of domestic livestock (2008). The incidental take anticipated in these two programmatic BOs is incorporated here by reference (see Environmental Baseline). The FWS anticipates incidental take of one NMRR per year in the form of harm due to vehicle traffic over the life of the Plan.

Effect of the Take

We do not anticipate that this level of incidental take will result in jeopardy to the NMRR.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Coronado NF must comply with the following terms and conditions, which implement the reasonable and prudent measures described below and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of NMRR.

1. Minimize or eliminate road related take of NMRR on the Coronado NF.
2. Monitor the impacts of the proposed action on the NMRR.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the Coronado NF must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1.1 The Coronado NF shall take steps to reduce the risk of road kills along all roads within NMRR habitat.

The following terms and conditions will implement reasonable and prudent measure 2:

2.1 The Coronado NF shall document any known incidental take resulting from vehicle traffic and report their findings to the FWS.

2.2 Annual reports, which will include this species, shall be sent to the appropriate local FWS Ecological Services field office by March 1st of each year.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the Coronado NF implement the following conservation activities:

1. Actively participate in the recovery of the NMRR through the implementation of the recovery plan.

2. Work in coordination with the BLM, Natural Resource Conservation Service, FWS, the Malpai Borderlands Group, and others to develop an Ecosystem Management Plan for the Peloncillo Mountains and surrounding areas.

3. Work in coordination with AGFD, NMDGF, BLM, FWS, and the Malpai Borderlands Group to obtain funds for research designed to clarify the life history and ecology of the NMRR in order to quantify the effects of livestock grazing on the subspecies.

4. Adopt conservative utilization rates to maintain or improve range conditions and vegetation communities within occupied habitats on the Peloncillo Mountains.

5. Use traffic counters to monitor and manage levels of vehicular use on USFS roads to minimize threats to NMRRs.

6. Follow the FWS's regional guidance criteria for the use of pesticides.

7. Post signs to educate visitors of the laws restricting the collection of NMRRs in general information kiosks and brochures. Signs and other information should not identify location of suitable habitat.

8. Monitor areas where core habitat has been altered or destroyed to determine regeneration times after various disturbances.

9. Provide the FWS's Arizona Ecological Services Office with an annual report of all survey and monitoring activities.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

SONORA TIGER SALAMANDER

STATUS OF THE SPECIES

Description

Sonora tiger salamanders (*Ambystoma tigrinum stebbinsi*) are large salamanders with a dark venter and light-colored blotches, bars, or reticulation on a dark background. Metamorphosed terrestrial Sonora tiger salamanders have a color pattern ranging from a reticulate pattern with an irregular network of light coloration, often coupled with light spots, on a dark background color to a pattern of large, well-defined light or yellow spots or transverse bars, some of which encroach on the dark venter (Jones et al. 1988). Metamorphosed Sonora tiger salamanders measure from about 6.6 to 12.4 cm (2.6 to 4.9 inches) snout to vent length (SVL) (Lowe 1954, Jones et al. 1988). Male and female adult Sonora tiger salamanders can be distinguished by the presence of two black folds of tissue (cloacal folds) on the caudal side of a male's vent.

Branchiate adults are gray to olive on the dorsum, head, and tail, and off-white to yellow on the ventral surface. They have three external gills on each side of their head, and measure between 6.5 and 16.5 cm (2.6 to 6.5 inches) SVL. Larvae are aquatic with external plume-like gills and well-developed tail fins (Behler and King 1980). At this stage, they are gray on the dorsum, head, and tail, with little pigment on the ventral surface. They hatch without legs, but grow hind and forelimbs early in development.

Sonora tiger salamanders are one of three subspecies of tiger salamanders found in Arizona; the other two subspecies are Arizona tiger salamanders (*A. t. nebulosum*) and barred tiger salamanders (*A. t. mavortium*). The barred salamander is an introduced species in the San Rafael Valley and elsewhere in southern Arizona. The Sonora tiger salamander was discovered in 1949 at the J.F. Jones Ranch stock tank in Parker Canyon, San Rafael Valley, Arizona (Reed 1951).

The eggs, larvae, and branchiate adults of the three subspecies appear similar, except that larval and branchiate adult Arizona and barred tiger salamanders sometimes develop into a cannibalistic morph that has a wider head, enlarged vomerine teeth, and feeds preferentially on smaller conspecifics. Metamorphosed Arizona tiger salamanders have 11-50 irregularly shaped, yellow to olive spots and blotches, often with indistinct edges (Stebbins 2003), on a dark dorsal ground, with a similar pattern on the head and tail. Metamorphosed barred tiger salamanders have large, distinct, yellowish bars, spots, or transverse bars on a darkly grounded dorsum. Some of the spots or bars encroach on the dark venter. The reticulate pattern that can be seen in Sonora tiger salamanders is not seen in Arizona or barred tiger salamanders, however, many metamorphosed Sonora tiger salamanders do not have the reticulate pattern and are visually indistinguishable from barred tiger salamanders.

The rosy salamander occurs from Durango, Chihuahua, to Sonora, Mexico, including the southern portion of the San Rafael Valley in Mexico (Shannon 1951, Jones et al. 1995). Rosy salamander larvae are pinkish in color with dark patterning on the sides and back (Taylor 1941) and fewer gill rakers (9-15) than tiger salamanders found in Arizona and Mexico (15-24) (Collins 1979). Metamorphed rosy salamanders are uniformly dark brown on the sides and back and lighter ventrally (Anderson 1961). Allozyme data suggest that interbreeding between tiger salamanders and rosy salamanders is rare or non-existent, even when their distributions overlap (Shaffer 1983).

Genetic analysis was conducted between the gene loci of Sonora tiger salamanders and the gene loci of rosy salamanders (*Ambystoma rosaceum*), barred tiger salamander, and Arizona tiger salamanders (Jones et al. 1988). Based on this analysis, distinctive reticulate color patterns, low heterozygosity, and apparent geographic isolation, subspecific designation of Sonora tiger salamander was considered warranted by Collins and Jones (1987) and Jones et al. (1988). Further analysis of mitochondrial DNA reaffirmed subspecific designation (Collins et al. 1988).

Legal Status: In 1997, the FWS listed the Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) as an endangered species (U.S. Fish and Wildlife Service 1997a). A final Recovery Plan for the species was signed on September 24, 2002. The Sonora tiger salamander has a recovery priority number of 3. Recovery priority numbers range from 1 to 18, with 1 having the highest priority. No CH has been designated for the Sonora tiger salamander. The species is not protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which regulates international trade.

Distribution and Abundance

Because so few sites were sampled prior to the 1980's, it is impossible to determine the historical distribution of Sonora tiger salamanders. However, based on collections and observations of salamanders and the distribution of plains grassland and adjacent Madrean evergreen woodlands

(Brown 1994) in which the salamander has been found, the range of the subspecies and its occupied and potentially occupied habitat is thought to extend from the crest of the Huachuca Mountains west to the crest of the Patagonia Mountains, including the San Rafael Valley and adjacent foothills from its origins in Sonora north to the Canelo Hills.

It is speculated that historically the Sonora tiger salamander probably inhabited springs, cienegas, and possibly backwater pools of the Santa Cruz River and streams in the San Rafael Valley that were extant long enough to support breeding and metamorphosis (at least two months), but ideally were permanent or nearly permanent, allowing survival of mature branchiates. The grassland community of the San Rafael Valley and adjacent montane slopes, where all extant populations of Sonora tiger salamander occur, may represent a relictual grassland and a refugium for grassland species.

All confirmed historic and extant aquatic populations are found in tanks, ponds, or impounded cienegas within 31 km (19 mi) of Lochiel, Arizona. This region lies between the Patagonia and Huachuca Mountains, is bordered on the north end by the Canelo Hills, and stretches from Santa Cruz County in Arizona south into Sonora, Mexico. Cattle ponds or tanks are the primary habitat for Sonora tiger salamanders, but there are several observations of unidentified salamanders away from cattle ponds.

Surveys for the Sonora tiger salamander have been conducted on public lands throughout the Arizona portion of the San Rafael Valley. Dr. James P. Collins began surveying ponds with tiger salamanders in the San Rafael Valley in 1979. The Sonora tiger salamander has been found at approximately 58 breeding localities, although not all are currently occupied (Collins and Jones 1987, Collins 1996, Abbate 1998, U.S. Fish and Wildlife Service 2002a and files). During intensive surveys in 1997, from one to 150 Sonora tiger salamanders were found at 25 stock tanks (Abbate 1998). Populations and habitats are dynamic, thus the number and location of extant aquatic populations change over time, as exhibited by the differences between survey results in 1985 and 1993-1996 (Collins and Jones 1987, Collins 1996, U.S. Fish and Wildlife Service 1997a). In 1999, the lab of Dr. James Collins, Arizona State University, found Sonora tiger salamanders at 17 localities (Collins 1999). Recent genetic analysis confirmed that barred salamanders (*A. m. mavortium*) or hybrids between barred salamanders and STS are present at seven stock tanks along Highway 83 and near Parker Canyon Lake in the San Rafael Valley

A single terrestrial Sonora tiger salamander was found near Oak Spring in Copper Canyon of the Huachuca Mountains (U.S. Fish and Wildlife Service 1997a). Tiger salamanders have also been reported from a cave, a vertical mining shaft at the northwestern edge of the San Rafael Valley, and one spring-fed well, which have yet to be confirmed (Ziemba et al. 1998). In the past, salamanders were collected from a ciénega at Rancho Los Fresnos in the San Rafael Valley, Sonora, and they were likely A. m. stebbinsi. However, surveys during 2006 and 2007 failed to locate additional salamanders, and most waters on the ranch were occupied by non-native bullfrogs, crayfish, green sunfish, and/or black bullhead (FWS 2009).

More data are needed to make definitive statements about the long-term viability of Sonora tiger salamanders in the San Rafael Valley. About half of the 58 Sonora tiger salamander populations have been discovered within the last five years, and only within the last five years were ponds

with salamanders sampled consistently, making it difficult to determine long-term trends in the proportion of ponds occupied by salamanders and suitability of those ponds for salamander breeding habitat. Also, more data on the ecology of Sonora tiger salamanders (*e.g*., life-span, proportion of adults breeding each year, frequency and distance of dispersal events) are required to develop a suitable population viability analysis.

Tiger salamanders have also been found in areas just outside the San Rafael Valley, such as Fort Huachuca, Harshaw Canyon, Copper Canyon, and the Coronado Memorial. Of these localities, genetic testing has only been performed on salamanders from Fort Huachuca, and with the exception of one pond within a kilometer of the San Rafael Valley, salamanders on the Fort Huachuca appear to be barred tiger salamanders (U.S. Fish and Wildlife Service 2002a). A salamander population in Garden Canyon, Fort Huachuca, near the crest of the Huachuca Mountains, also contained hybrids, but this population has apparently disappeared. Barred salamanders are likely present due to their use as fish bait in and around Parker Canyon Lake (2009).

Genetic testing has been performed on salamanders from a number of San Rafael Valley ponds to determine their identity. This testing has showed that some San Rafael Valley ponds contain salamanders with genetic characteristics similar to barred tiger salamanders. Salamanders with these *"mavortium*-like" sequences are more common on the outskirts of the San Rafael Valley and ponds close to Parker Canyon Lake, which, because of prior use of imported waterdogs as fish bait, is where we expect to find introduced barred tiger salamanders (Ziemba et al. 1998).

Habitat

Historically, the Sonora tiger salamander probably inhabited springs, cienegas, and possibly backwater pools of the Santa Cruz River and streams in the San Rafael Valley where permanent or nearly permanent water allowed survival of mature branchiates. Erosion and arroyo cutting in the late 19th and early 20th centuries caused the San Rafael Valley to dry and natural standing water habitats to disappear (Hendrickson and Minckley 1984, Hadley and Sheridan 1995). The Sonora tiger salamanders are no longer found in these rare habitats. The state of Arizona (1990) estimated that up to 90 percent of the riparian habitat along Arizona's major desert watercourses has been lost, degraded, or altered. The Sonora tiger salamander apparently has opportunistically taken advantage of available stock tank habitats as natural habitats disappeared (Hendrickson and Minckley 1984) or were invaded by non-native predators with which the salamander cannot coexist (U.S. Fish and Wildlife Service 2002a).

The San Rafael Valley is a broad, open valley that forms the headwaters of the Santa Cruz and San Pedro rivers. The dominant terrestrial plant community in the San Rafael Valley is plains grassland (Brown 1994). Typical grasses include, among others, plains lovegrass (*Eragrostis intermedia*), side-oats grama (*Bouteloua curtipendula*), and curly mesquite (*Hilaria belangeri*). Within the grasslands, stringers or groves of cottonwoods and other wetland plants grow along some drainages and at ponds and springs. Upslope, at the edges of the San Rafael Valley, juniper and several species of oak form patchy woodlands or savannas that gradually give way to pine-oak woodlands at higher elevation (Brown 1994).

The most important habitat requirement for Sonora tiger salamanders is the availability of standing water for breeding from January through June. This gives the salamanders enough time to breed, grow as larvae, and metamorphose before the pond dries. Permanent bodies of water can be good breeding sites, except they often contain introduced fish and bullfrogs (Snyder 1998). As a result, ponds created by ranchers for watering their cattle are now almost the only suitable breeding sites remaining. However, there are still some springs on the San Rafael Cattle Ranch (U.S. Fish and Wildlife Service 2002a), and possibly elsewhere, such as in Scotia Canyon, that may be suitable breeding sites.

Sonora tiger salamanders are tolerant of a wide range of temperatures, with temperatures in ponds varying from less than 5ºC (41ºF) at the beginning of the year up to 30ºC (86ºF) during summer. Temperatures in the terrestrial environment range from below freezing to over 35ºC (95ºF). Mammal burrows or loosened soils outside the pond likely provide refugia for metamorphosed salamanders in the terrestrial environment, enabling them to burrow underground to avoid extreme environmental conditions.

Life History

Sonora tiger salamanders begin their life as jelly-coated eggs laid in water. They hatch and grow as aquatic larvae with gills, and then either mature as gilled aquatic adults called branchiate adults, neotenes, or paedomorphs; or metamorphose into terrestrial Sonora tiger salamanders without gills. Branchiate adults are reproductively mature but have not undergone metamorphosis and spend their entire lives in water. Terrestrial adults are those that have undergone metamorphosis and spend most of their lives out of the water but return to ponds to breed. Populations and habitats are dynamic, thus the number and location of extant aquatic populations changes over time, as exhibited by the differences between survey results in 1985 and 1993 to 1997 (Collins and Jones 1987, Collins 1996, Abbate 1998, Ziemba et al, 1998).

Sonora tiger salamanders begin breeding as early as January, and eggs can be found in ponds as late as early May (U.S. Fish and Wildlife Service 2002a). Breeding after monsoon rains in July and August is rare (U.S. Fish and Wildlife Service 2002a). Sonora tiger salamanders that are ready to breed have swollen, reddish vents. Terrestrial adults return to ponds to breed, and branchiate adults in the pond also breed. Although there is little data on breeding site fidelity for Sonora tiger salamanders, other *Ambystoma* species usually return to breed in the ponds where they were born (Shoop 1965, 1968; Shoop and Doty 1972; Douglas and Monroe 1981; Semlitsch 1981; Madison 1997; Madison and Farrand 1998). Courtship takes place under water, and is difficult to observe in the field.

After fertilization, female tiger salamanders lay 200 to 2000 eggs (U.S. Fish and Wildlife Service 2002a), attaching them to aquatic vegetation, sticks, rocks, or substrate either individually or in clumps of up to 50. Eggs take from 2-4 weeks to hatch; the colder the water, the longer the eggs take to develop. Sources of mortality for tiger salamander eggs include freezing, drying, trampling by livestock, and predation by adult salamanders (Holomuzki 1986) and introduced fish (Snyder 1998). Crayfish may prey upon salamander eggs as well.

Following hatching, Sonora tiger salamander larvae can develop to the minimum size necessary to metamorphose into terrestrial salamanders in as little as two months between late July to early

September. However, because many San Rafael Valley sites with salamanders hold water all year, larvae often remain in the water longer before metamorphosing or develop into branchiate adults instead of metamorphosing. In addition, larvae may not undergo metamorphoses and may overwinter in ponds (Collins and Jones 1987). Only an estimated 17 to 40 percent of Sonora tiger salamanders metamorphose annually (Collins and Jones 1987). All larvae that hatch in ephemeral waters metamorphose into the terrestrial form. Larvae must be at least 4.5 cm (1.8 in) SVL in order to make the transformation (U.S. Fish and Wildlife Service 1997a).

Small tiger salamander larvae feed primarily on zooplankton (daphnids, copepods, bosminids, ostracods, etc.), but incorporate larger aquatic macroinvertebrates (chironomids, trichopterans, molluscs, zygopterans, etc.) into their diet as they grow (Collins and Holomuzki 1984). Sources of mortality for tiger salamander larvae include pond drying, disease (Jancovich et al. 1997), and predation by wading birds, introduced fish and bullfrogs (Snyder 1998), aquatic insects (Holomuzki 1986), and adult salamanders (Holomuzki 1986). Crayfish may also prey upon larval salamanders.

Salamander larvae in permanent water often develop into branchiate adults. San Rafael Valley ponds that do not dry may support up to several hundred branchiates (U.S. Fish and Wildlife Service 2002a). Branchiate adults can sometimes metamorphose into the terrestrial form in response to stressful events such as pond drying, but are often unable to complete metamorphosis and may even die during the process (U.S. Fish and Wildlife Service 2002a). The lifespan of branchiate adults in the field is not known, but Arizona tiger salamanders have survived as branchiates for up to 8 years in captivity (U.S. Fish and Wildlife Service 2002a). The reason that branchiates have not been kept longer is that they eventually metamorphose, even after years as branchiates.

Branchiate adult tiger salamanders prey on zooplankton and a variety of macroinvertebrates, and eat salamander eggs and larvae during the breeding season (Holomuzki 1986). Although branchiate adult Sonora tiger salamanders probably eat salamander eggs and larvae, they seldom develop into a cannibalistic morph. Sources of mortality for branchiate adults include pond drying, disease (Jancovich et al. 1997), and predation by wading birds and larger introduced fish species (Snyder 1998).

When larvae are large enough (>4.5 cm (1.77 inches) SVL), they can metamorphose into terrestrial salamanders. The proportion of larvae that metamorphose depends heavily on pond permanence. In ponds that dry, all larvae that are large enough metamorphose. In ponds that do not dry, approximately 17 percent of larvae that are large enough to metamorphose actually do so (Collins et al. 1988). Metamorphs often re-populate ponds following drying or disease outbreaks that kill most branchiate adults and larvae. Metamorphs are also the only life stage that can disperse from pond to pond and establish new populations.

Outside the pond, metamorphosed tiger salamanders consume terrestrial insects and other macroinvertebrates. In the pond, metamorphosed individuals eat aquatic macroinvertebrates and terrestrial insects that fall in the water (Whiteman et al. 1994). Sources of mortality for metamorphosed adults include extreme conditions in the terrestrial environment, disease (Jancovich et al. 1997), and predation by terrestrial predators and introduced fish and bullfrogs

(Snyder 1998). The lifespan of metamorphosed Sonora tiger salamanders in the wild is not known, but metamorphosed Arizona tiger salamanders have survived 17 years in captivity (U.S. Fish and Wildlife Service 2002a). Analysis of growth rings in toe bones (skeletochronology) of 150 Arizona tiger salamanders captured in the field revealed no salamanders over 6 years old (U.S. Fish and Wildlife Service 2002a), but it remains to be seen whether the same is true for Sonora tiger salamanders.

Population Dynamics

The dispersal patterns of Sonora tiger salamanders are also unknown. The number of metamorphs in each population is difficult to estimate because most metamorphosed salamanders leave the pond after breeding, and it is unknown what fraction of salamanders in the terrestrial environment returns each year to breed. In some years, salamanders will be completely absent from a pond, only to return the following year to breed and produce many offspring. Radio tracking of other *Ambystoma* species has shown that they frequently move up to 250 m (273 feet) from their breeding ponds (Shoop 1965, 1968; Shoop and Doty 1972; Douglas and Monroe 1981; Semlitsch 1981; Madison 1997; Madison and Farrand 1998).

Although most records for Sonora tiger salamanders occur at stock tanks where breeding occurs, terrestrial metamorphs potentially wander considerable distances from these aquatic habitats, and are occasionally encountered in upland habitats. AGFD personnel captured a Sonora tiger salamander in a pit fall trap at Oak Spring in Copper Canyon, Huachuca Mountains. The nearest known breeding site is approximately 0.6 mile to the south, suggesting the salamander may have moved at least that far. Capture in a pit fall trap also confirms that the individual was surface active. In other subspecies of *Ambystoma tigrinum*, metamorphs may disperse hundreds of meters from the breeding pond, or may remain nearby (Gehlbach et al. 1969, Petranka 1998). Of hundreds of marked *Ambystoma tigrinum nebulosum* in northern Arizona, two were found to move from 0.9 to 1.2 miles to new ponds (U.S. Fish and Wildlife Service 1999a). On Fort Huachuca, Sheridan Stone reported finding terrestrial tiger salamanders (probably *A. t. mavortium*) 1.9 to 2.5 miles from the nearest known breeding pond (U.S. Fish and Wildlife Service 1999a). Referring to conservation of the California tiger salamander, *A. californiense*, Petranka (1998) finds that based on studies of movements of other *Ambystoma* species, conservation of a 650-1,650 foot radius of natural vegetation around a breeding pond would protect the habitat of most of the adult terrestrial population. Adults of western subspecies of *A. tigrinum* typically live in or about mammal burrows (Petranka 1998), although metamorphs may construct their own burrows, as well (Gruberg and Stirling 1972, Semlitsch 1983). Some species of salamanders exhibit seasonal migrations of up to several miles each way from breeding sites to upland habitats (Stebbins and Cohen 1995). If such migrations occur in the Sonora tiger salamander, we have no information about migration corridors or non-breeding habitat. Because of the arid nature of the environments in the region where the subspecies occurs, if salamanders move very far from breeding ponds, they may use wet canyon bottoms as movement corridors.

Reasons for Listing

The FWS's Final Rule (U.S. Fish and Wildlife Service 1997a) and Recovery Plan (U.S. Fish and Wildlife Service 2002a) for the Sonora tiger salamander described multiple threats or limiting factors which, when taken together, justified listing. These threats or limiting factors include the following: restricted distribution; limited number of breeding habitats; disappearance of natural

standing water habitat; predation by non-native fish, bullfrogs, and crayfish; genetic swamping by introduced, non-native barred salamanders *(A. t. mavortiu*m); disease; low genetic diversity; collection for bait or translocation by anglers; use of man-made water holding structures (e.g., impoundments, stock tanks, ponds); maintenance of impoundments; use of occupied sites as water sources for fire suppression; loss of cover around occupied sites; illegal collecting; catastrophic floods and drought; and stochastic extirpations or extinction characteristic of small populations .

Threats: Salamanders have disappeared from a few ponds since surveys began in the late 1970s, but there is little indication that there is a general decline in the number of populations in the San Rafael Valley. Furthermore, the density of ponds supporting salamander populations in the San Rafael Valley is comparable to that in other regions supporting tiger salamanders. However, the restricted distribution of Sonora tiger salamanders makes them vulnerable to relatively small-scale environmental disturbances and land-use changes. The primary threats to the Sonora tiger salamander include predation by non-native fish and bullfrogs, diseases, catastrophic floods and drought, illegal collecting, introduction of other subspecies of salamanders that could genetically swamp *A. m. stebbinsi* populations, and stochastic extirpations or extinction characteristic of small populations (FWS 2009).

Prior to the 20th century, the San Rafael Valley contained many more cienegas and vernal pools than it does today. Erosion and arroyo cutting in the late 19th and early 20th centuries caused the San Rafael Valley water table to drop and natural standing water habitats to disappear (Hendrickson and Minckley 1984, Hadley and Sheridan 1995). However, at the same time natural standing water habitats were disappearing, cattle ponds were built. Many of the remaining springs and cienegas were converted into impoundments at this time, so most of the small standing water habitats remaining in the San Rafael Valley are cattle ponds. Currently, Sonora tiger salamanders breed almost exclusively in these cattle ponds. The fact that Sonora tiger salamanders breed in human-constructed cattle ponds instead of natural habitats does not necessarily threaten persistence of the taxon. Sonora tiger salamanders have successfully bred in cattle ponds for decades, but salamanders are now dependent on humans to maintain the habitat. In particular, cattle ponds require occasional re-excavation because they fill in with silt, and pond dams also require occasional maintenance. Unfortunately, the maintenance required to maintain these ponds also adversely affects the Sonora tiger salamander. Cattle pond habitats are also vulnerable to extreme weather conditions. Long-term drought could dry many of the ponds, and if ponds remained dry for several years, lack of breeding could lead to local extirpation of the salamander population.

Illegal collection of salamanders for bait has been reported from the San Rafael Valley although there are no data on the number of Sonora tiger salamanders that are collected for bait (Collins and Jones 1987, U.S. Fish and Wildlife Service 2002a). If large numbers of salamanders are collected for bait, it could threaten the persistence of Sonora tiger salamander populations. Given the popularity of other salamanders as bait, it is reasonable to assume that illegal collection of salamanders will continue to occur.

There are reports of introduced non-native fish occurring in the San Rafael Valley as early as the 1950s, and various introduced fish species now occur in San Rafael Valley ponds, including

mosquito fish *(Gambusia affini*s), green sunfish *(Lepomis cyanellu*s), bluegill sunfish *(Lepomis macrochiru*s), black bullheads *(Ameirus mela*s), and largemouth bass *(Micropterus salmoide*s). Bullfrogs *(Rana catesbeian*a) have also been in the valley since at least the early 1970s. Laboratory and field experiments have shown that metamorphosed bullfrogs and all of the fish species listed above quickly eat salamander larvae, and even adult Sonora tiger salamanders have been found in the stomachs of adult bullfrogs (Snyder 1998). In addition, whenever non-native fish are introduced to a pond, the salamanders almost always disappear within the next few years, and do not reappear unless the fish are killed by pond drying (Snyder 1998). For some reason, adult bullfrogs have not maintained consistently high population densities in many San Rafael Valley ponds, so the potential effect of bullfrogs on Sonora tiger salamanders remains unclear (Snyder 1998). However, given the observation that bullfrogs eat salamanders and the effect of bullfrogs on other native western herpetofauna populations (Rosen and Schwalbe 1996, Kupferberg 1997, Kiesecker and Blaustein 1997), bullfrogs should be considered a threat to Sonora tiger salamanders. Occasional drying of cattle ponds due to drought or siltation has limited the number of ponds occupied by non-native fish and/or bullfrogs, because both taxa are vulnerable to drying. Crayfish are potential predators on salamanders as well, but have only been found in a few San Rafael Valley ponds, and those did not contain salamanders (U.S. Fish and Wildlife Service 2002a). Crayfish are in many San Rafael Valley streams, however, and if they are introduced to ponds with salamanders, it is likely they will harm Sonora tiger salamanders, much as they have harmed other western herpetofauna populations (Gamradt and Kats 1996, Fernandez and Rosen 1996).

Tiger salamander populations in the western U.S. and Canada, including populations of the Sonora tiger salamander, exhibit frequent epizootics (Collins et al. 2001). Sonora tiger salamander populations experience frequent disease-related die-offs (approximately eight percent of populations are affected each year) in which almost all salamanders and larvae in the pond die. *Ambystoma tigrinum* virus (ATV) is the pathogen believed to be primarily responsible for these die-offs (Jancovich et al. 1997). This, and possibly other iridoviruses, is also apparently the proximate cause of die-offs observed in other *Ambystoma* salamander populations in the U.S. and Canada (Collins et al. 2000, Docherty et al. 2003). It is also possible that some die-offs might occur as a result of low pH (U.S. Fish and Wildlife Service 2002a). A copper smelter at Cananea, Sonora, less than 25 miles south of the border, may have released sulfur plumes resulting in acid precipitation (Blanchard and Stromberg 1987, Platz 1989), but currently there is no evidence to connect salamander die-offs with the copper smelter, and the smelter has not been operated since 1999. ATV may be spread by bullfrogs, birds, cattle, or other animals that move among tanks (Jancovich et al. 1997); however, the viral life cycle appears to be restricted to tiger salamanders as no other syntopic hosts have been identified (Jancovich et al. 2001). In the laboratory, Sonora tiger salamanders exhibited lower survival and growth rates when exposed to the disease as compared to *Ambystoma tigrinum nebulosum* from the White Mountains of Arizona (Collins et al. 2003). Animals that survive ATV exposure may harbor transmissible infection for more than six months. Dispersing metamorphosed salamanders have been found carrying ATV, and may reinfect the aquatic population when they return to a pond to breed (Collins et al. 2003). The disease could be spread by researchers or anglers if equipment such as waders, nets, or fishing tackle used at a salamander tank are not allowed to dry or are not disinfected before use at another tank. ATV has been identified from waterdogs obtained from a Phoenix bait shop, suggesting another mechanism of transmission (Collins et al. 2003). Storfer

(2003) considers ATV an emerging pathogen, with recent spread likely attributable to human activities.

Sonora tiger salamanders also contract chytridiomycosis, a fungal disease associated with global declines of frogs and toads (Berger et al. 1998, Longcore et al. 1999, Speare and Berger 2000, Davidson et al. 2003). However, compared to anurans, infected salamanders exhibit only minimal symptoms (Davidson et al. 2000). In the laboratory, infected Sonora tiger salamanders did not die from the disease and are capable of ridding themselves or much reducing chytrid infections by frequent sloughing of the skin (Davidson et al. 2003). The effect of this disease on salamander populations needs further study.

Sonora tiger salamanders also face the threat of genetic swamping by introduced barred tiger salamanders which are often sold as large larvae or branchiate adults for fishing bait or to anglers trying to establish a population that could be harvested at a later date. Genetic analysis has suggested that barred tiger salamanders have been introduced to some San Rafael Valley ponds, perhaps by anglers using salamanders as bait. Ponds in which introduced barred salamanders are most likely to occur are those that are most accessible, i.e. adjacent to roads on public lands, those that have a history of angling, and those near existing populations of barred salamanders. Salamanders with genetic characteristics similar to barred tiger salamanders have been found in 7 San Rafael Valley ponds in the southeastern portion of the valley (Ziemba et al. 1998). Very low sample sizes (maximum of three individuals tested from these sites) have made it impossible to determine what percentage of salamanders in these ponds had *mavortium*-like sequences and what percentage had *stebbinsi*-like sequences. Although the analysis of allozymes that was used could not determine whether there was any hybridization between the two subspecies, such hybridization is likely when the two subspecies co-occur.

Research on the ecology and viability of Sonora tiger salamander populations should assist in developing a management strategy to protect salamanders and their habitat that will ensure persistence of salamanders in the San Rafael Valley. The genetic status of Sonora tiger salamanders is still being studied, but it appears that some (approximately 25 percent) San Rafael Valley ponds with tiger salamanders contain at least some salamanders with sequences resembling barred tiger salamanders (Ziemba et al. 1998). The threat of genetic swamping by introduced barred tiger salamanders is one of the most difficult threats to assess because genetic testing is often required to distinguish between Sonora tiger salamanders, barred tiger salamanders, and potential hybrids of the two subspecies.

Allozyme analysis has shown very little genetic variability in Sonora tiger salamanders (Jones et al. 1988, 1995; Ziemba et al. 1998). Low genetic variability is a concern because in populations with low heterozygosity, deleterious alleles are expressed more frequently, disease resistance may be compromised, and there is little capacity for evolutionary change in response to environmental change.

Recovery Actions
Federal listing under the Act provided considerable protection to the Sonora tiger salamander and its habitat. Section 9 of the ESA prohibits take of any listed wildlife species, including the Sonora tiger salamander. Because most of the land, cattle ponds, and salamander populations in the San Rafael Valley are on federal lands, most activities that might affect the salamander or its habitat are also subject to Section 7 consultation.

Collecting *Ambystoma* in the San Rafael Valley is prohibited under Arizona Game and Fish Commission Orders 40 and 41, except under special permit. Furthermore, transport and stocking of live bullfrogs and fishing with live bait fish or *Ambystoma* within the range of the Sonora tiger salamander in Arizona are prohibited (R1-316). Sale of live waterdogs at Parker Canyon Lake is prohibited under the same regulation. In the San Rafael Valley, live crayfish can be used as bait, but only at the place of capture. Transported crayfish must be dead. The Sonora tiger salamander is included in AGFD's Draft Species of Special Concern (Arizona Game and Fish Department 1996); however, this designation affords the species and its habitat no legal protection. State of Arizona Executive Order Number 8-16 (Streams and Riparian Resources), signed on June 10, 1989, directs state agencies to evaluate their actions and implement changes, as appropriate, to allow for restoration of riparian resources.

Biological Opinions and incidental take statements were issued in 1997 and 1999 by the FWS during section 7 consultations with the Coronado NF. This consultation process resulted in the development of a "Stock Pond Management and Maintenance Plan" addressing cattle pond maintenance guidelines in order to minimize incidental take of salamanders associated with cleaning out ponds (U.S. Fish and Wildlife Service 1997b, 1999a). The 1997 consultation also provided measures to reduce the possibility that salamanders might be unintentionally killed or moved among cattle ponds by fire suppression activities.

The Sonora Tiger Salamander Recovery Plan was completed in 2002, which outlined goals and objectives for downlisting to threatened status by 2007 (U.S. Fish and Wildlife Service 2002a). However, the recommendation in the 5-year review (FWS 2007) was to leave the species status unchanged. It also stated that there were insufficient sample sizes for population trend analysis, and the level of public interest and/or scientific uncertainty or controversy for the species is low. The review stated that at least five years of data collected in accordance with the current protocol would be necessary to begin to assess any trend in the population. A final version of the five-year report is still pending. However, based on the draft report, the data thus far does not indicate any drastic changes (email from C. Crawford, FWS to S. Plunkett, USFS on 12/30/10). The Sonora tiger salamander monitoring protocol is set up to detect a 5% change in population trends with a minimum of ten years of data, so it will likely require more time before a more telling trend analysis can be conducted. Part of the recovery plan describes recovery actions the Coronado NF could implement in order to assist recovering the species. In addition, the "Stock Pond Management and Maintenance Plan" is included as an appendix to the Recovery Plan.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, the anticipated impacts of all proposed federal actions in the action

area that have undergone formal or informal section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species within the Action Area

The Sonora tiger salamander is known from 71 localities, although not all are currently occupied and some probably do not represent breeding sites. During surveys by the AGFD from 2001-2006, Sonora tiger salamander were found at 38 of 139 stock tanks, which were sampled from 1-7 times each. At 23 of 29 tanks where salamanders were found, and which were sampled more than once, salamanders were not found on at least one visit. All sites where Sonora tiger salamanders have been found in Arizona are located in the Santa Cruz and San Pedro river drainages, including sites in the San Rafael Valley and adjacent portions of the Patagonia and Huachuca mountains in Santa Cruz and Cochise counties. All confirmed historical and extant aquatic populations are found in cattle tanks or impounded ciénegas within 19 mi of Lochiel, Arizona. In the past, salamanders were collected from a ciénega at Rancho Los Fresnos in the San Rafael Valley, Sonora, and they were likely A. m. stebbinsi. However, surveys during 2006 and 2007 failed to locate additional salamanders, and most waters on the ranch were occupied by non-native bullfrogs, crayfish, green sunfish, and/or black bullhead (FWS 2009).

Factors Affecting the Species within the Action Area

Considering that the vast majority of known Sonora tiger salamander sites are on the Coronado NF, this NF encompasses the range of the species, and the rangewide concerns addressed above are all applicable in the action area.

The majority of lands occupied by the Sonora tiger salamander are in MA 4, which emphasizes sustained harvest of livestock forage. A proper grazing system in this MA will "insure renewal of desired vegetative species for livestock forage, big and small game habitat, and to improve soil and water resources." These activities cannot supersede Forest-wide S&Gs, which give preference to riparian-dependent resources and federally-listed species. Because nearly all occupied and potential salamander breeding habitats are used as livestock watering holes, the fate of the salamander is meshed with that of livestock grazing in the San Rafael Valley and adjacent areas.

Allotments that have ponds occupied (currently or historically) by Sonora tiger salamander incorporate the "Stock Pond Management and Maintenance Plan" as part of their plan of operations under the guidance of the LRMP. In addition, the 1996 Regional Amendment S&Gs state that the NF should "emphasize maintenance and restoration of healthy riparian ecosystems" and that management strategies should move "degraded riparian vegetation toward good condition." This is more specifically considered in relation to domestic livestock grazing where S&Gs should "maintain and restore riparian ecosystems."

All of the allotments are largely in federal ownership (remaining lands are privately owned). Thus, management of grazing on many or most of the private inholdings within the allotments is likely affected by how the public lands are grazed, and as a result, grazing on the private lands within the allotments are likely interrelated and interdependent to grazing on the public lands.

According to the definition of the "effects of the action" (which includes effects of interrelated and interdependent activities – 50 CFR 402.02), effects of grazing on both public and private portions of the allotments are considered herein as effects of the action.

The effects of grazing activities on the salamander have been the subject of several previous consultations and a conference, including: 1) August 14, 1995, letter from the FWS concurring that construction of 4.5 km (2.8 mi) of electric fence on the San Rafael allotment is not likely to jeopardize the continued existence of the Sonora tiger salamander (a conference, file 2-21-95-I-383); 2) September 18, 1995, letter from the FWS concurring that issuance of grazing permits on the Duquesne and Campini allotments are not likely to jeopardize the continued existence of the salamander (a conference, file 2-2-95-I-412); 3) June 17, 1997, concurrence that sediment removal from two tanks on the Lone Mountain allotment may affect, but is unlikely to adversely affect the salamander (file 2-21-97-I-296); 4) December 19, 1997, BO on Land and Resource Management Plans, as amended, for Eleven NFs and NGs in the Southwestern Region (U.S. Fish and Wildlife Service 1997b), 5) July 29, 1999, BO on the Coronado NF's Ongoing and Long-term Grazing (U.S. Fish and Wildlife Service 1999a), and 6) October 24, 2002, BO on the Continuation of Livestock Grazing (U.S. Fish and Wildlife Service 2002b).

The December 19, 1997, BO addressed grazing at a plan level. The 1999 and 2002 opinions addressed grazing to the project level in batch consultations. All found that grazing and other activities proposed were not likely to jeopardize the continued existence of the salamander. The opinions provided several terms and conditions to minimize take, including detailed protocols on how to manage and maintain stock tanks where the salamander may occur. Salamander breeding occurs in livestock tanks, most of which are in USFS allotments. These tanks require periodic maintenance to remain viable as both salamander breeding sites and as functional livestock waters. Thus, the survival of the salamander is currently intertwined with that of the Coronado NF's grazing program, and depends on management and periodic maintenance of livestock waters.

Prescribed fire across the Southwest has seen an increasing trend since the WUI initiative in 2000. On the Coronado NF, which has a relatively small area treated, hazardous fuels treatments annually average 12,087 ha (29,867 ac). While the FWS is not aware of any studies that evaluated the effects of fire on salamanders, fire could potentially result in direct death or injury of salamanders, and reduced habitat quality or quantity.

Degradation of watershed condition immediately after fires can result in dramatically increased runoff, sedimentation, and debris flow that can scour aquatic habitats in canyon bottoms or bury them in debris (DeBano and Neary 1996). In degraded watersheds, less precipitation is captured and stored, thus perennial aquatic systems downstream may become ephemeral during dry seasons or drought (Rinne and Neary 1996). Fire could result in degradation of the immediate watershed around a pond, and result in erosion, sedimentation, and ash flow into the pond. Although effects on salamanders are unknown, in salmonid fish, ash and slurry flow into streams can be toxic and populations of macroinvertebrates (salamander prey species) can be drastically reduced after a fire (Rinne 1996), at least temporarily (Roby and Azuma 1995). Smoke diffusion into water and ash flow can result in high levels of phosphorus and nitrogen (Spencer and Hauer 1991) with unknown effects to salamanders.

Siltation of a pond due to erosion and runoff following a fire could also eliminate habitat. However, the effects of siltation may also be more subtle. Lefcort et al. (1997) examined the effects of silt on growth and metamorphosis of larval mole salamanders (*Ambystoma opaceum*) and *A. tigrinum tigrinum.* Salamanders in silty water grew more slowly, metamorphosed sooner, and were more susceptible to infection by a water mold (*Saprolegnia parasitica*) than salamanders in non-silty water.

Possibly the greatest threat to terrestrial salamander populations is fire. Erosion and increased runoff could bury or flood burrows, burrow entrances, rock shelters, or other cover sites. Fire may also reduce surface cover such as logs and debris, resulting in reduced invertebrate populations and reduced prey densities for salamanders (U.S. Fish and Wildlife Service 1999b). Reduced cover may also result in heating and dessication of moist cover sites that salamanders require.

Grazing immediately after a fire can retard recovery of grasses and other plants, and facilitate erosion of slopes through hoof action and reduced vegetation cover. Erosion in the watersheds of occupied breeding sites could contribute to sedimentation or erosion of tanks and loss of habitat. Dan Robinett (Natural Resource Conservation Service, Tucson, Arizona) recommends resting burned sites above 4,000 feet from grazing for a period of two years to facilitate recovery (U.S. Fish and Wildlife Service 1999b). In line with these recommendations, the Coronado NF proposed resting the burned areas in the Maverick Prescribed Fire, Peloncillo Mountains, for two growing seasons (July, August, and September) following the fire.

If aquatic populations of salamanders are eliminated due to disease, ash flow, increased turbidity, or collection, but the habitat remains suitable (i.e. the tank is not silted in or erodes away, and fish are not introduced), the tank is likely to be recolonized by terrestrial salamanders. As a result, effects of the action that result in destruction of breeding sites or introduction of non-native predators are much more serious to the viability of the species than death or injury of individuals.

EFFECTS OF THE ACTION

The S&Gs listed in the Coronado NF LRMP and 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs within these LRMPs are applicable to the Sonora tiger salamander and its habitat. These S&Gs may result in both indirect and direct effects to the species. Please refer to the 2005 BO/CO for a list of the S&Gs presented to the FWS by the USFS as applicable to the Sonora tiger salamander.

The S&Gs for the Coronado NF have not changed since the 2005 BO/CO analysis, and there has also been no significant change in the status of the Sonora tiger salamander since that time. Since no new significant scientific information have become available and no changes in Forest policy or programs have occurred, we have determined that there is no need to change the 2004 BA and 2005 BO/CO effects determinations. Therefore, for a more detailed analysis addressing how the S&Gs affect this species, please refer to the 2005 BO/CO; the following information is simply reiterated from that BO/CO.

A table summarizing the effects to the Sonora tiger salamander from the applicable S&Gs within the Coronado NF LRMP can be found in the 2005 BO/CO. Most of the applicable S&Gs are likely to result in beneficial effects to the Sonora tiger salamander; however, we found several S&Gs that have the potential to result in a lethal, sublethal, or negative behavioral response in Sonora tiger salamanders. The majority, if not all of the S&Gs for MA 1 and MA 2, were considered to have no effect on the Sonora tiger salamander due to the lack of the species presence in these areas. In summary, less than four percent of the applicable S&Gs are likely to cause negative responses of Sonora tiger salamanders, while 80 percent of the S&Gs have positive effects to the species. The remaining 16 percent of the applicable S&Gs have no effect to the Sonora tiger salamander or are subject to interpretation and difficult to analyze.

Some S&Gs were presented for analysis for the Coronado NF which were not assigned a Consultation Resource Program; however, these S&Gs were categorized as Chemical Management under the LRMP Resource Program heading. Standard and Guideline 703 allows for herbicide and pesticide use for forest management. Use of these chemicals in occupied habitat is likely to result in mortality or injury to salamanders, as well as reduced feeding success and reduced vegetation cover if applied on or near water. Similarly, S&G 702 allows for the use of cyanide leaching ponds during mining operations. If allowed in the San Rafael Valley, these ponds would likely result in lethal take of Sonora tiger salamanders that disperse into these areas.

Standard and guideline 702 allows for cyanide leaching as part of mining operations (primarily gold). In the 2005 BO/CO, this S&G was ranked as having potentially lethal effects. However, we present here additional information that describes how unlikely it is for there to be lethal effects to Sonoran tiger salamander on the Coronado NF as a result of this S&G. It should also be noted that there is uncertainty as to why this S&G was put in the LRMP in the first place, and that it is not included in the new Coronado NF LRMP draft, which should be finalized within two years.

There have been no permits for projects that use cyanide leaching on the Coronado NF in at least 20 years (pers. comm. w/M. Linden; USFS; R3 RO; L&M) and there is no anticipation for any in the foreseeable future. However, if a proposed project did include the use of outdoor cyanide leaching, then there are other S&Gs and policies that would provide for the protection of the Sonoran tiger salamander and other T&E species. Mitigation/protection measures would likely include a fully contained or covered leaching system, thus excluding the Sonoran tiger salamander from contact with the leaching agent.

In summary, the Coronado NF does not anticipate cyanide leaching projects within the life of the current LRMP (pers. comm. R. Gerhardt, USFS Coronado NF, 1/21/11); however, if there were a project proposed that included the use of cyanide leaching, then other S&Gs and policies that provide for the protection of T&E species would necessitate the need to design protection measures to prevent contact between the species and the leaching agent. Considering the information provided above, it is extremely unlikely there will be negative effects to the Sonoran tiger salamander from this S&G.

Engineering Program

No applicable S&Gs in the Engineering Program are likely to have direct negative effects on the Sonora tiger salamander. Closing, draining, and revegetating existing roads deemed unneeded in MA 4 would have the potential to beneficially affect the Sonora tiger salamander if the roads are in areas where the Sonora tiger salamander is located. Road closures could benefit the Sonora tiger salamander if roads are near or lead to ponds with Sonora tiger salamanders, thereby reducing the likelihood of road kills (although no salamanders have been observed on roads in the San Rafael Valley), protecting water quality, and, most importantly, reducing disturbance, potential disease transmission, collection, and introduction of non-native predators associated with recreation or other activities.

Fire Management Program

No applicable S&Gs in the Fire Management Program are likely to result in direct negative effects to the Sonora tiger salamander. However, the use of prescribed fire managed by this program as a whole is likely to have a variety of effects on the Sonora tiger salamander. As a benefit, prescribed fire could be used to protect Sonora tiger salamander ponds by reducing the risk of catastrophic wildfire in the surrounding areas. At the project level, there are likely to be negative effects associated with prescribed fire in the form of lethal incidental take of individuals associated with humans, tools, machinery, and burning.

Forestry and Forest Health Program

Only one applicable S&G in this program is likely to have a negative effect on the Sonora tiger salamander. Standard and Guideline 698 allows for the use of herbicides in aquatic fishing lakes. Any use of chemical agents could affect the Sonora tiger salamander, as discussed above; however, because Sonora tiger salamanders are currently only found in stock tanks, there is not likely to be an impact from S&G 698.

Lands and Minerals Program

No applicable S&Gs in the Lands and Minerals Program are likely to result in negative effects to the Sonora tiger salamander. In addition, no negative impacts are anticipated from this program as a whole.

Rangeland Management Program

Within this program, S&G 780 allows for grazing in MA 4. Managing for a proper grazing system to insure renewal of desired vegetative species for livestock forage, big and small game habitat, and to improve soil and water resources and giving priority allotment planning could potentially be beneficial to the Sonora tiger salamander by minimizing the impacts to stock tanks, thereby minimizing impacts to the Sonora tiger salamander. However, there are likely to be impacts to the populations during the time that these areas are improving. The adverse effects from grazing could include: 1) trampling or ingestion of metamorphs, aquatic branchiates, larvae, and eggs; 2) trampling and browsing of vegetation at and near tanks resulting in reduced salamander escape cover and forage potential; 3) increased turbidity and reduction of aquatic cover and egg deposition sites at tanks due to cattle wading into the water; 4) increased likelihood of disease transmission; 5) watershed degradation and resulting increased runoff and sedimentation, requiring more frequent maintenance of tanks; 6) construction of range projects that may result in direct mortality of terrestrial salamanders or that facilitate access to tanks with

subsequent increased chance of introduction of non-native predators, collection or translocation of salamanders, and disease transmission; and 7) maintenance of stock tanks; which although needed for stock tanks to remain as viable breeding habitats can result in injury or mortality of salamanders. The FWS assumes that the Coronado NF will continue to implement the CMs and terms and conditions from previous grazing opinions, discussed above, and the Stock Pond Management and Maintenance Plan outlined in the Recovery Plan, which will minimize many of these effects.

Recreation, Heritage, and Wilderness Program

No applicable S&Gs in the Recreation Program are likely to result in negative effects to the Sonora tiger salamander. However, there may be negative effects from this program not captured in the applicable S&Gs. One of the goals for this program is to, "Maintain the current spectrum of developed, dispersed, and primitive recreation opportunities and increase those opportunities within the capability of the resources and the framework of this plan as needs and funds develop (Coronado NF LRMP)". This goal statement implies a multiple use recreation program which may include camping, hiking, boating, and fishing. Although these activities are not directly identified as threats to the Sonora tiger salamander, they are likely to involve some incidental take of individual salamanders in the form of as disturbance, avoidance of impacted recreation areas, and even mortality if stepped on by humans. Additionally, as these recreational users move through the environment, they might collect salamanders as bait, or contribute to the spread of non-native predators and disease, especially anglers transporting and/or collecting non-native fishes, salamanders, and bullfrogs.

Watershed Management Program

No applicable S&Gs in this program are likely to result in negative effects to the Sonora tiger salamander. In addition, no negative impacts are anticipated from this program as a whole.

Wildlife, Fish, and Rare Plants Program

No applicable S&Gs in this program are likely to result in direct negative effects to the Sonora tiger salamander. However, S&G 667 allows for projects to be implemented which would improve habitat for T&E species. Some of these projects could include prescribed burning, which would help to reduce the risk of catastrophic fire, but are also likely to result in short-term adverse effects to the Sonora tiger salamanders as discussed under the Fire Management Program.

Standard and Guideline 668 allows for maintenance of stock tanks and development of water structures. Sonora tiger salamanders have adapted to successfully breeding in human-made stock ponds due to the disappearance of natural springs and cienegas. However, they are now dependent on humans to maintain this habitat and to maintain it in such a way as to not adversely impact the Sonora tiger salamander. This further increases the threat to Sonora tiger salamanders because of their limited range.

Stock tank maintenance can offset some adverse effects of degraded watersheds and is necessary to maintain suitable breeding habitats for the Sonora tiger salamander. However, maintenance activities can also result in direct or indirect affects to salamanders. If Sonora tiger salamanders are present, equipment may crush animals, they may desiccate if isolated in drying pools, or be

killed during maintenance activities. Maintenance may also eliminate bank and aquatic cover and egg deposition sites, as well as increase turbidity. Typically maintenance is accomplished when tanks are dry or nearly dry. As tanks dry out, many larval salamanders over two months of age and some branchiate salamanders metamorphose and move to upland habitats. Thus, salamander populations are likely to be small or nonexistent at the time maintenance is needed. Most take will be in the form of capture, holding of salamanders, and re-release back into the tank in accordance with the Stock Pond Management and Maintenance Plan; however, some take will be in the form of incidental mortality or injury.

A number of S&Gs in the Wildlife Program provide a great deal of benefit to the Sonora tiger salamander. For example, S&G 634 establishes the maintenance of T&E species habitat as a priority over other species habitats forest-wide. Standards and Guidelines 629 and 779 provide for actions which work towards delisting of T&E species by implementing recovery plans. These S&Gs should not only minimize the effects of other projects, but also result in increased population numbers and sizes. In addition, these S&Gs should help the Forest to prioritize its projects such that negative impacts of other Forest uses could occur largely outside critical salamander areas.

In summary, the applicable S&Gs in the Coronado NF LRMP allow for a variety of effects to the Sonora tiger salamander. To a large extent, activities conducted under the positive S&Gs should benefit the Sonora tiger salamander and/or help to eliminate or minimize the effects of activities conducted under the negative S&Gs. However, the positive S&Gs do not of eliminate the possibility of incidental take, thus incidental take of Sonora tiger salamanders is reasonably certain to occur as a result of implementation of the Coronado NF LRMP.

1996 Regional Amendment

All of the S&Gs analyzed for the 1996 Regional Amendment fall under the Wildlife Program. This Amendment implemented the Recovery Plan for the MSO, northern goshawk guidelines, and some additional grazing guidelines. However, we found that the guidelines used by the USFS for the northern goshawk do not adversely affect this species.

Wildlife, Fish, and Rare Plants Program

No applicable S&Gs analyzed for the Wildlife Program under the 1996 Regional Amendment are likely to result in direct negative effects to the Sonora tiger salamander. Standards and Guidelines 1432, 1445, 1455, 1458, 1468, 1476, and 1508 all allow for some use of prescribed fire and fuels reduction. These S&Gs provide great benefit to the Sonora tiger salamander by reducing the risk of catastrophic wildfire. However, the fuels treatment projects are likely to result in incidental take of individuals, as discussed under the Coronado NF's Fire Management Program.

Cumulative Effects

Cumulative effects are those adverse effects of future state, tribal, local, or private actions that are reasonably certain to occur in the project area. 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.

Federal agencies manage much of the land in the project area, particularly the Coronado NF, Fort Huachuca, and the Coronado National Memorial. Thus, most of the actions that are reasonably expected to occur in the project area that may adversely affect the Sonora tiger salamander would be subject to future section 7 consultations. However, some occupied breeding localities are on private lands or state lands in the center of the San Rafael Valley. Compliance with the ESA for activities on private lands that may result in incidental take of the Sonora tiger salamander, but are not addressed by section 7 consultation, could occur through section 10(a)(1)(B) of the ESA. Some activities on private lands may require permits or funding from federal agencies, consequently section 7 consultations would be required. These private lands are used primarily for grazing, but potentially could be used for other purposes. Effects from the current use of lands for grazing could result in improper livestock grazing on private range land leading to degraded cover habitat for terrestrial Sonora tiger salamanders, degraded water quality for aquatic larvae and branchiate adults, and trampling of various life stages by cattle. Other land uses that could be implemented on private land could include: housing subdivisions, oil and gas exploration and extraction, mining, agriculture, and division into ranchettes. The largest private parcel in the center of the valley (San Rafael Ranch) is covered by a conservation easement that prohibits most of these activities. In addition, there is the potential for anglers on private land to collect salamanders as bait or contribute to the spread of non-native predators, although these activities are prohibited by state law. Furthermore, anglers may contribute to the spread of disease on private lands by moving contaminated bait or equipment between aquatic sites.

Additional cumulative impacts to the Sonora tiger salamander may result from cross-border activities along the U.S./Mexico border. Cross-border activities include, but may not be limited to the following: human traffic, deposition of trash, new trails from human traffic, soil compaction and erosion, increased fire risk from human traffic, water depletion and contamination, introduction and spread of disease, and interference with survey, monitoring, and research efforts.

CONCLUSION

After reviewing the current status of the Sonora tiger salamander, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Sonora tiger salamander. Pursuant to 50 CFR 402.02, to "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. No CH has been designated for the species; therefore, none will be affected.

The FWS anticipates incidental take of the Sonora tiger salamander is reasonably certain to occur as a result of activities authorized under the Coronado NF LRMP and 1996 Regional Amendment. However, the FWS does not believe that such activities will rise to the level of jeopardy for this species for the following reasons:

- The majority (approximately 90%) of Sonora tiger salamander populations occur in stock tanks within the Coronado NF. In cooperation with the FWS, the Coronado NF has developed the "Stock Pond Management and Maintenance Plan for Sonora Tiger Salamander in the San Rafael Valley and Surrounding Areas". This document outlines actions which should minimize the impacts of stock tank use and maintenance to the Sonora tiger salamander. Livestock grazing allotments on the Coronado NF that have ponds occupied by the Sonora tiger salamander incorporate the "Stock Pond Management and Maintenance Plan for Sonora Tiger Salamander in the San Rafael Valley and Surrounding Areas" as part of their plan of operations. Furthermore, the livestock permittees are also dependent upon these stock ponds for livestock production; therefore, it is in the interest of the permittees to keep and maintain these stock ponds.

- Although range and soil conditions are degraded to some extent in most of the allotments where the Sonora tiger salamander occurs, many S&Gs provide for the improvement of range conditions as needed, minimization of roads, appropriate levels of dispersed recreational use, restoration of native riparian habitat, and buffers or filters around water and drainages.

- Arizona Game and Fish Department regulations prohibit collecting *Ambystoma* in the San Rafael Valley, except under special permit, which protects the species from impacts by recreational collectors or anglers on the Coronado NF. In addition, transport and stocking of live bullfrogs and fishing with live bait fish or Ambystoma within the range of the Sonora tiger salamander in Arizona is prohibited, thus providing added protection to the species from recreational activities.

- The Coronado NF LRMP includes S&Gs which direct the Coronado NF to prioritize T&E species over other species, work towards recovery, and even to delist species. These S&Gs should only increase the availability and quality of Sonora tiger salamander habitat on the Coronado NF.

In summary, although the evaluation of the numeric effects analysis does not involve balancing or averaging the rankings, the full suite of S&Gs in the Coronado NF LRMP and 1996 Regional Amendment creates a decision-making framework within which the Coronado NF can continue to implement their LRMP without appreciably reducing the likelihood of the survival or recovery of the Sonora tiger salamander in the wild.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species 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 FWS 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 FWS 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 ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.
The measures described below are non-discretionary, and must be undertaken by the USFS so that they become binding conditions of any grant or permit issued to any applicant, permittee, or contractor, as appropriate, in order for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity covered by this incidental take statement. If the USFS (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant, permittee, or contractor to adhere to the terms and conditions of the incidental take statement through enforceable terms that are included in the permit or grant document issued by the USFS, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Forest must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement [50 CFR 402.14(i)(3)].

Amount of Extent of Take

Incidental take of the Sonora tiger salamander is reasonably certain to occur from the continued implementation of the Coronado NF LRMP and the 1996 Regional Amendment. As discussed in the Effects of the Action, this incidental take is expected to be in the forms of harm (i.e., direct mortality) and harassment. Incidental take attributable to the proposed action will likely be difficult to detect and often the cause of any observed mortality will be impossible to determine (i.e., dead and dying diseased salamanders may be found, but the cause of disease transmission will likely be unknown).

As stated previously, the historic, extant, and current records indicate 71 ponds rangewide have been known to contain Sonora tiger salamanders. Of these, 53 (approximately 90%) occur on the Coronado NF. Forty ponds are currently known to be occupied (within the last five years) by Sonora tiger salamanders, 38 (95%) of which are located on Coronado NF (USFS 2004). The FWS expects that numbers and locations of occupied ponds will vary from year to year depending upon disease outbreaks, drought, and other factors. However, in the long-term, we anticipate no decline in habitat. Therefore, the FWS defines incidental take in terms of the condition and amount of Sonora tiger salamander ponds, and is using this surrogate measure to identify when take has been exceeded. The FWS has determined that the anticipated level of take was most appropriately qualified in terms of habitat alteration. The FWS concludes that the incidental take of Sonora tiger salamanders will be exceeded if habitat loss occurs in two of the 38 occupied ponds on the Coronado NF for a period of two consecutive years as a result of the proposed action not following the guidelines outlined in the stock pond management plan. Any loss of occupied ponds with a site-specific formal consultation may indicate USFS management and LMRP implementation as the reason for extirpation. This would be determined with significant input from species experts.

Effect of the Take
In the accompanying BO, the FWS has determined that this level of anticipated take is not likely to result in jeopardy to the Sonora tiger salamander. Although the FWS anticipates the temporary loss of entire aquatic populations as a result of several aspects of the proposed action, tank populations extirpated by disease or drought are typically recolonized by terrestrial salamanders (Ziemba 1998). The likelihood of aquatic populations being eliminated is greatly reduced by the reasonable and prudent measures and terms and conditions.

REASONABLE AND PRUDENT MEASURES

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Sonora tiger salamander:

1. Minimize or eliminate adverse effects to Sonora tiger salamanders on the Coronado NF.
2. Minimize or eliminate adverse effects to Sonora tiger salamander habitat on the Coronado NF.
3. Monitor the impacts of site-specific projects on the Sonora tiger salamander.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the USFS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline the reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following Term and Condition will implement reasonable and prudent measure 1:

1.1 Design fire use, chemical use, range management, and recreational projects to avoid or minimize adverse effects to the Sonora tiger salamander.

1.2 Implement educational programs for recreational users discouraging the use of non-native salamanders and fishes in Sonora tiger salamander sites.

The following terms and conditions will implement reasonable and prudent measure 2:

2.1 Continue implementation of the “Stockpond Management and Maintenance Plan for the Sonora Tiger Salamander in the San Rafael Valley and Surrounding Areas” as developed in the FWS’s December 19, 1997, subsequent BOs, and as portrayed in Attachment 2 of the recovery plan.

2.2 Design projects in occupied Sonora tiger salamander habitat to incorporate the appropriate components of the Sonora Tiger Salamander Recovery Plan with the goal of implementing projects that have beneficial, insignificant, or discountable effects to the salamander and its habitat.

The following terms and conditions will implement reasonable and prudent measure 3:

3.1 The Coronado NF shall monitor incidental take resulting from the proposed action and report their findings to the FWS. Incidental take (implementation) monitoring shall include information such as when or if the project was implemented, whether the project was implemented as analyzed in the site-specific BO (including CMs, and BMPs), breeding season(s) over which the project occurred, relevant salamander survey information, and any other pertinent information about the project's effects on the species.

3.2 Annual reports, which will include this species, will be sent to the appropriate local FWS Ecological Services field office by March 1st of each year.

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 action, the level of anticipated incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation. Meanwhile, the USFS must cease the activity resulting in the take if it is determined that the impact of additional taking will cause an irreversible and adverse impact on the species. The USFS must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures. This BO does not authorize any form of take not incidental to implementation of the proposed action. Note that this opinion anticipates but does not authorize take of Sonora tiger salamanders due to illegal activities such as illegal transport and release of fish or salamanders, capture of Sonora tiger salamanders, and off-road vehicle activity.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA direct federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information on listed species. The FWS recommends the following conservation activities:

1. The USFS is encouraged to participate in, implement, and/or help fund studies of vectors of disease transmission, salamander metapopulation dynamics, distribution of the *mavortium* genome in the San Rafael Valley, the movements and habitat use of terrestrial salamanders, and other topics that may improve our understanding of the conservation and recovery needs of the Sonora tiger salamander. The USFS, FWS, and others would work to develop genetic testing of populations as an ESA section 7(a) (1) action if this occurs.

2. Many S&Gs call for watershed, range, and/or habitat improvements. These improvements are not given a timeframe, thus populations may be impacted and individuals may be taken over time. It is recommended that the USFS prioritize the projects using some combination of factors which recognize extreme environmental degradation and T&E occupied sites.

3. Implement the Sonora Tiger Recovery Plan (U.S. Fish and Wildlife Service 2002a) per the implementation schedule in that document.

4. Implement area or route closures in important breeding populations to reduce impacts on breeding success and dispersing Sonora tiger salamanders.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitat, the FWS requests notification of the implementation of any conservation recommendations.

HUACHUCA WATER UMBEL

STATUS OF THE SPECIES

Description

The Huachuca water umbel *(Lilaeopsis schaffneriana* ssp. *recurva)* is an herbaceous, semi-aquatic to occasionally fully aquatic, perennial plant with slender, erect leaves that grow from creeping rhizomes. The leaves are cylindrical, hollow with no pith, and have septa (thin partitions) at regular intervals. The yellow/green or bright green leaves are generally 0.04-0.12 inch (1-3 mm) in diameter and often 1-2 inches (3-5 cm) tall, but can reach up to 8 inches (20 cm) tall under favorable conditions. Three to ten very small flowers are borne on an umbel that is always shorter than the leaves. The fruits are globose, 0.06-0.08 in (1.5-2 mm) in diameter, and usually slightly longer than wide (Affolter 1985).

The Huachuca water umbel was first described by A.W. Hill based on the type specimen collected near Tucson in 1881 (Hill 1926). Hill applied the name *Lilaeopsis recurva* to the specimen, and the name prevailed until Affolter (1985) revised the genus. Affolter applied the name *L. schaffneriana* var. *recurva* to plants found west of the continental divide.

Legal Status: On January 6, 1997, the FWS listed the Huachuca water umbel as an endangered species (FWS 1997). Critical habitat was designated for the species on the upper San Pedro River, Garden Canyon on Fort Huachuca, and other areas of the Huachuca Mountains, San Rafael Valley, and Sonoita Creek on July 12, 1999 (FWS 1999).

Distribution and Abundance

Huachuca water umbel has been documented from 33 sites in Santa Cruz, Cochise, and Pima counties, Arizona, and in adjacent Sonora, Mexico, west of the continental divide (Haas and Frye 1997, Saucedo 1990, Warren et al. 1989, Warren et al. 1991, Warren and Reichenbacher 1991, FWS 1999, EEC 2001, EEC 2004, Anderson 2006, McLaughlin 2006, Titus and Titus 2006, Titus and Titus 2008, FWS 2008, Titus and Titus pers. com 2011). The plant is presumed to be extirpated from eight of these sites (Affolter 1985, FWS 1999, EEC 2001, Titus and Titus 2006, Titus and Titus 2008, pers com. 2011). The 25 extant sites occur in five major watersheds - San

Pedro River, Santa Cruz River, Rio Yaqui, Rio Sonora, and Rio Magdalena. All sites are between 2,533 and 6,500 feet in elevation. In addition, several sites have been established or augmented on Fort Huachuca and the Audubon Research Ranch (Titus and Titus 2008, Vernadero 2010, p. 1).

Before 1890, the spatially intermittent, perennial flows on the middle Santa Cruz River most likely provided a considerable amount of habitat for Huachuca water umbel and other aquatic plants. The middle section of the Santa Cruz River mainstem is an approximate 80 mile (130 km) reach that flowed perennially from the Tubac area south to the U.S./Mexico border and intermittently from Tubac north to the Tucson area (Davis 1986). Davis (1986) quotes from the July 1855, descriptive journal entry of Julius Froebel while camped on the Santa Cruz River near Tucson: ''rapid brook, clear as crystal, and full of aquatic plants, fish, and tortoises of various kinds, flowed through a small meadow covered with shrubs.'' This habitat and species assemblage no longer occurs in the Tucson area.

Habitat

The following information is taken from the 2005 BO/CO. The Huachuca water umbel grows in cienegas (marshy wetlands), and along streams, rivers, and springs in southern Arizona and northern Sonora, Mexico, typically in mid-elevation wetland communities often surrounded by relatively arid environments (FWS 1997). These wetland communities are usually associated with perennial springs and stream headwaters, have permanently or seasonally saturated highly organic soils, and have a low probability of flooding or scouring (Hendrickson and Minckley 1984). The Huachuca umbel can grow in saturated soils or as an emergent in water depths up to about 10 in (25 cm). Cienegas support diverse assemblages of animals and plants, of which many species are of limited distribution, such as the Huachuca water umbel (Hendrickson and Minckley 1984). The surrounding non-wetland vegetation can be desert scrub, grassland, oak woodland, or conifer forest at elevations of 2,000-7,100 ft. (610-2,160 m) (AGFD 1997).

Cienegas, perennial streams, and rivers in the desert southwest are extremely rare. The AGFD (1993) estimated that riparian vegetation associated with perennial streams comprises about 0.4 percent of the total land area of Arizona, with present riparian areas being remnants of what once existed. The state of Arizona (1990) estimated that up to 90 percent of the riparian habitat along Arizona's major desert watercourses has been lost, degraded, or altered.

The physical and biological habitat features essential to the conservation of Huachuca water umbel include a riparian plant community that is fairly stable over time and not dominated by non-native plant species, a stream channel that is relatively stable but subject to periodic, nonscouring flooding, refugial sites (sites safe from catastrophic flooding), and a substrate (soil) that is permanently wet or nearly so, for growth and reproduction of the plant.

Critical Habitat: Seven CHUs have been designated for Huachuca water umbel; all areas are in Santa Cruz and Cochise counties, Arizona, and include stream courses and adjacent areas out to the beginning of upland vegetation. The Scotia, Sunnyside, and Bear canyon units (3, 4, and 6) are within the USFS boundary of the Coronado NF. The remaining CHUs are in lands adjacent to the USFS. The following general areas are designated as CH (see legal descriptions for exact CH boundaries):

Unit 1 - approximately 1.25 mi (2.0 km) of Sonoita Creek southwest of Sonoita;

Unit 2 - approximately 2.7 mi (4.4 km) of the Santa Cruz River on both sides of Forest Road 61, plus approximately 1.9 mi (3 km) of an unnamed tributary to the east of the river;

Unit 3 - approximately 3.4 mi (5.4 km) of Scotia Canyon upstream from near Forest Road 48;

Unit 4 - approximately 0.7 mi (1.1 km) of Sunnyside Canyon near Forest Road 117 in the Huachuca Mountains;

Unit 5 - approximately 3.8 mi (6.1 km) of Garden Canyon near its confluence with Sawmill Canyon;

Unit 6 - approximately 1.0 mi (1.6 km) of Rattlesnake Canyon and 0.6 mi (1.0 km) of an unnamed canyon, both of which are tributaries to Lone Mountain Canyon; approximately 1.0 mi (1.6 km) of Lone Mountain Canyon; and approximately 1.0 mi (1.6 km) of Bear Canyon; an approximate 0.6-mi (0.9-km) reach of an unnamed tributary to Bear Canyon; and

Unit 7 - approximately 33.7 mi (54.2 km) of the San Pedro River from the perennial flows reach north of Fairbank (Arizona Department of Water Resources 1991) to 0.13 mi (200 m) south of Hereford, San Pedro Riparian National Conservation Area.

The specific biological and physical features, referred to as the PCEs, essential to the conservation of the Huachuca water umbel include, but are not limited to, the habitat components that provide:

1. Sufficient perennial base flows to provide a permanently or nearly permanently wetted substrate for growth and reproduction of Huachuca water umbel*;*

2. A stream channel that is relatively stable, but subject to periodic flooding that provides for rejuvenation of the riparian plant community and produces open microsites for water umbel expansion;

3. A riparian plant community that is relatively stable over time and in which non-native species do not exist or are at a density that has little or no adverse effect on resources available for water umbel growth and reproduction; and

4. In streams and rivers, refugial sites in each watershed and in each reach, including but not limited to springs or backwaters of mainstem rivers, that allow each population to survive catastrophic floods and recolonize larger areas.

Activities that may result in the destruction or adverse modification of CH include those that alter the PCEs ability to function properly and serve the intended conservation role for the species. Such activities may include, but are not limited to:

1. Activities such as damming, water diversion, channelization, excess groundwater pumping, or other actions that appreciably decrease base flow and appreciably reduce the wetted surface area of rivers, streams, cienegas, or springs;

2. Activities that alter watershed characteristics in ways that would appreciably reduce groundwater recharge or alter natural flooding regimes needed to maintain natural, dynamic riparian communities. Such activities adverse to Huachuca water umbel CH could include, but are not limited to: vegetation manipulation such as chaining or harvesting timber; maintaining an unnatural fire regime either through fire suppression, or too-frequent or poorly-timed prescribed fires; mining; military maneuvers, including bombing and tank operations; residential and commercial development; road construction; and improper livestock grazing that reduces fire frequency or otherwise degrades watersheds;

3. Activities that appreciably degrade or destroy native riparian communities, including but not limited to improper livestock grazing, clearing, cutting of live trees, introducing or encouraging the spread of non-native species, and heavy recreational use; and

4. Activities that appreciably alter stream channel morphology such as sand and gravel mining, road construction, channelization, impoundment, improper livestock grazing, watershed disturbances, off-road vehicle use, heavy or poorly planned recreational use, and other uses.

Life History
For a detailed discussion of Huachuca water umbel life history, please refer to the 2005 BO/CO.

Reasons for Listing
The FWS listed the Huachuca water umbel as an endangered species under the ESA on January 6, 1997. The primary threat was habitat alterations.

Threats: Improper livestock grazing, mining, hay harvesting, timber harvest, fire suppression, and other activities in the nineteenth century led to widespread erosion and channel entrenchment in southeastern Arizona streams and cienegas when above-average precipitation and flooding occurred in the late 1800s and early 1900s (Bahre 1991, Bryan 1925, Dobyns 1981, Hastings and Turner 1980, Hendrickson and Minckley 1984, Martin 1975, Sheridan 1986, Webb and Betancourt 1992, Hereford 1993). A major earthquake near Batepito, Sonora, approximately 40 miles south of the upper San Pedro Valley, resulted in land fissures, changes in groundwater elevation and spring flow, and may have preconditioned the San Pedro River channel for rapid flood-induced entrenchment (Hereford 1993, Geraghty and Miller, Inc. 1995). These events contributed to long-term or permanent degradation and loss of cienega and riparian habitat on the San Pedro River and throughout southern Arizona and northern Mexico. Much habitat of the Huachuca water umbel and other cienega-dependent species was presumably lost at that time.

Wetland degradation and loss continues today. Human activities such as groundwater overdrafts, surface water diversions, impoundments, channelization, improper livestock grazing, chaining, agriculture, mining, sand and gravel operations, road building, non-native species introductions, urbanization, wood cutting, and recreation all contribute to riparian and cienega habitat loss and degradation in southern Arizona. The local and regional effects of these activities are expected to increase with the increasing human population.

Livestock grazing potentially affects Huachuca water umbel at the ecosystem, community, population, and individual levels. Livestock grazing can affect the umbel through trampling and changes in stream hydrology and loss of stream bank stability; however, existence of the umbel appears to be compatible with well-managed livestock grazing (FWS 1997). Cattle generally do not eat water umbel because the leaves are too close to the ground, but they can trample plants. Huachuca water umbel is capable of rapidly expanding in disturbed sites and could recover quickly from light trampling by extending undisturbed rhizomes (Warren *et al.* 1991). Light trampling also may keep other plant density low, providing favorable *Lilaeopsis* microsites. Well-managed livestock grazing and Huachuca water umbel are compatible. In overgrazed areas, stream headcutting can threaten cienegas where the umbel occurs. Such headcutting occurs at Black Draw just south of the international boundary and at Los Fresnos, in the San Rafael Valley, Sonora, Mexico.

Groundwater pumping has eliminated habitat in the Santa Cruz River north of Tubac, and threatens habitat in the San Pedro River. Portions of the San Pedro River occupied by the umbel could be dewatered within a few years unless measures are implemented very soon to halt or mitigate groundwater pumping in the Sierra Vista-Fort Huachuca area (ASL 1998). Severe recreational impacts in unmanaged areas can compact soils, destabilize stream banks, and decrease riparian plant density, including densities of the Huachuca water umbel. Populations in Bear Canyon in the Huachuca Mountains have been impacted by trampling and off-highway vehicles.

A suite of non-native plant species has invaded wetland habitats in southern Arizona (Stromberg and Chew 1997); including those occupied by the Huachuca water umbel (Arizona Department of Water Resources 1994). In some cases their effect on the umbel is unclear; however, in certain microsites, the non-native Bermuda grass, *Cynodon dactylon*, may directly compete with the umbel. Bermuda grass forms a thick sod in which many native plants are unable to establish. Watercress is another non-native plant now abundant along perennial streams in Arizona. It is successful in disturbed areas and can form dense monocultures that can outcompete Huachuca water umbel populations.

Riparian areas and cienegas offer oasis-like living and recreational opportunities for residents of southern Arizona and northern Sonora. Riparian areas and cienegas such as Sonoita Creek, the San Pedro River, Canelo Hills Cienega, and the perennial creeks of the Huachuca Mountains receive substantial recreational visitation, and this is expected to increase with an increasing southern Arizona population. While well-managed recreational activity is unlikely to extirpate water umbel populations, severe impacts in unmanaged areas can compact soils, destabilize stream banks, and decrease riparian plant density, including densities of Huachuca water umbel.

Limited numbers of populations and the small size of populations make the Huachuca water umbel vulnerable to extinction as a result of stochastic events that are often exacerbated by habitat disturbance. For instance, the restriction of this taxon to a relatively small area in southeastern Arizona and adjacent Sonora increases the chance that a single environmental catastrophe, such as a severe tropical storm or drought, could eliminate populations or cause extinction. Populations are in most cases isolated, as well, which makes the chance of natural recolonization after extirpation less likely. Small populations are also subject to demographic and genetic stochasticity, which increases the probability of population extirpation (Shafer 1990, Wilcox and Murphy 1985).

Climate Change

Potential effects of climate change throughout Arizona and New Mexico are described in the Introduction section of this BO. Climate forecasts project not only temperature increases but also an increase in the frequency of hot extremes, heat waves, and heavy precipitation events. Ultimately, we expect this to result in drier future conditions across the Southwest and an increased probability of drought. Due to these projections, we anticipate that the wetland communities in which Huachuca water umbel lives may be less stable over times due to increased likelihood of drought and extreme weather events.

As stated in the 2011 BA, no research has been initiated related to the specific effects of climate change on this species; however, there are currently no expectations of measurable changes in climate within the temporal bounds of the proposed action. Despite the current limits of climate change effects analysis, the 2011 BA also states that the USFS Southwestern Region has developed guidance for addressing climate change in NF LRMP revisions, which are broad and general in scope and which rely on adaptive management as climate change science evolves. Therefore, as we build a better understanding of the potential effects resulting from climate change on Huachuca water umbel distribution, FWS expects that this increased knowledge will be incorporated into the revisions of the Coronado NF LRMP.

Recovery Actions

The following information is reiterated from the 2011 BA. Within the Coronado NF, permanent monitoring transects have been established that include the entire occupied habitat in Scotia and Bear canyons. Seven exclosures have been constructed to protect the species from livestock grazing and, in one case, recreation. Stricter than usual utilization standards were implemented on the Lone Mountain allotment to protect the plant (T. Skinner, Coronado NF, e-mail pers. comm. with C. McDonald, 29 July 2003). The USFS has requested water rights for two springs in Scotia Canyon, one for 10.3 ac ft. and the other for 0.3 ac ft. These are in the claims process and will be finalized when the San Pedro River adjudication process is completed. The USFS has a water right on Bear Spring for 0.2 ac ft. and two claims in process for Van Horn Spring and the Bear Creek-Cave Creek confluence (1.5 ac ft.) near the USFS boundary (J.R. Abbott, Coronado NF Supervisor, *in litt.* 1994).

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, the anticipated impacts of all proposed federal actions in the action

area that have undergone formal or informal section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

Six of the extant sites where Huachuca water umbel occurs are under management of the USFS within the Coronado NF (Sierra Vista RD). These are the Scotia, Bear, Sunnyside, and Sycamore Canyons, and the O'Donnell Creek and Freeman Springs sites which were mistakenly omitted from the 2005 BO/CO. Scotia Canyon has one of the largest populations with plants occupying most of the suitable habitat along the 4,800 foot perennial reach of the stream. The four canyon sites are at the highest known elevations for Huachuca water umbel; they are in the upper parts of the watershed and relatively secure from water withdrawals or water diversions. The canyon sites are grazed, but monitoring shows no adverse effects to Huachuca water umbel. The O'Donnell Creek and Freeman Springs sites are at lower elevation, surrounded by woodlands, and are protected from grazing by exclosures.

Critical Habitat

As stated in the Status of the Species section above, the Coronado NF contains 3 CH units for the Huachuca water umbel. These include Units 3, 4, and 6. Unit 3 contains approximately 3.4 mi (5.4 km) of Scotia Canyon upstream from near Forest Road 48; Unit 4 contains approximately 0.7 mi (1.1 km) of Sunnyside Canyon near Forest Road 117 in the Huachuca Mountains; and Unit 6 consists of approximately 1.0 mi (1.6 km) of Rattlesnake Canyon and 0.6 mi (1.0 km) of an unnamed canyon, both of which are tributaries to Lone Mountain Canyon; approximately 1.0 mi (1.6 km) of Lone Mountain Canyon; and approximately 1.0 mi (1.6 km) of Bear Canyon; an approximate 0.6-mi (0.9-km) reach of an unnamed tributary to Bear Canyon.

Factors Affecting the Species within the Action Area

As stated in both the 2005 BO/CO and the 2011 BA, water withdrawals, diversions, stream channelization, and levies in southern Arizona and Sonora have reduced the habitat available for Huachuca water umbel. Several historical locations no longer provide any suitable habitat because perennial stream flows have ceased due to lowered water tables. Continued human population growth in southern Arizona is expected to put greater pressure on water resources. Widespread watershed degradation occurred in southern Arizona in the late 1800s due to uncontrolled livestock grazing, mining, hay harvesting, timber harvesting, and other practices such as fire suppression. This led to widespread erosion and channel entrenchment that has contributed to long-term or permanent degradation and loss of cienega and riparian habitats throughout southern Arizona and northern Mexico. Poor livestock management can destabilize stream channels and disturb cienega soils creating conditions unfavorable to Huachuca water umbel, which requires stable stream channels and cienegas. Such management can also change riparian structure and diversity causing a decline in watershed conditions. However, livestock grazing that is well managed can be compatible with Huachuca water umbel. Cattle generally do not eat the plants because the leaves are too close to the ground, but they can trample plants. Huachuca water umbel is capable of rapidly expanding from rhizomes and can recover quickly from light trampling. Light trampling may also keep other plant density low thus providing favorable Huachuca water umbel microsites (FWS 1997).

Critical Habitat
Springs are the source for base flows for the CHUs. The watersheds for the springs are contained within MAs 4 and 9 on the Forest MA 9 is wilderness, which has minimal management, mostly directed towards maintaining wilderness values. MA 4 is managed primarily for sustained harvest of forage and fuelwood while maintaining and improving game animal habitat. The vegetation surrounding Scotia, Sunnyside, and Bear Canyons is woodland and conifer forest. The vegetation surrounding Sycamore Canyon is mostly grassland, with that of O'Donnell Creek and Freeman Springs mostly woodland.

Seven exclosures have been built in occupied water umbel habitat to protect the species from the effects of livestock grazing. Stricter forage utilization levels are in place on the Lone Mountain allotment, where Huachuca water umbel and CH is located. The USFS is pursuing water rights on springs in this area.

EFFECTS OF THE ACTION

The S&Gs listed in the Coronado NF LRMP and 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs are related to the Huachuca water umbel and its habitat. The S&Gs, if applied to project-level activities, may result in both indirect and direct effects to the species.

The 2005 BO/CO included tables showing the S&Gs considered for each species' analysis and a ranking table summarizing the types of effects to species (lethal, sublethal, etc.) expected to result from the S&Gs. Because there have been no changes in Forest policy or programs that would change the 2004 BA (USFS) and 2005 BO/CO (FWS) effects determination for this species, we hereby incorporate by reference the ranking tables and effects analysis presented in the 2005 BO/CO and provide a narrative summary below.

Effects of the Action on the Huachuca water umbel
The Huachuca water umbel occurs in six sites on the Coronado NF each within MA 7a, which includes all Forest riparian areas. The primary management emphasis is to perpetuate the unique wildlife or vegetative species in this MA and to improve and manage riparian areas to benefit riparian dependent resources. Dispersed recreation and other uses may be allowed to the extent they do not degrade the unique values. The lands surrounding these riparian areas are in MA 4, and the primary emphasis is the sustained harvest of livestock forage and fuelwood while maintaining and improving game and animal habitat. All umbel habitat on the Coronado NF is within grazing allotments.

Management guidance provided by the S&Gs within the Coronado NF LRMP mainly supports the long-term conservation and recovery of the Huachuca water umbel. The S&Gs address a few of the key threats to the species, and provide direction for minimizing such threats. Less than seven percent of the S&Gs could cause mortality of Huachuca water umbel plants, while 37 percent of the S&Gs have positive effects for this species. The remaining 56 percent of the S&Gs have no effect on Huachuca water umbel or the S&Gs are open to interpretation and difficult to analyze. Although this analysis was conducted only for the four canyon sites of

Huachuca water umbel, similar conclusions can be drawn for the O'Donnell Creek and Freeman Springs sites. Because both sites are in exclosures, we do not anticipate that any activities will occur within these sites that would be contrary to the S&Gs.

The S&Gs with the potential to adversely affect the Huachuca water umbel are the result of the Fire Management Program, which includes S&G 798 that allows for prescribed fire, which can negatively impact the species' habitat. However, the water umbel grows in habitats that are not likely to burn, although habitat may be altered by the post burn runoff and sedimentation in occupied habitat. In addition, the Rangeland Management Program contains S&Gs that could lead to habitat damage and possible mortality of umbel plants. Huachuca water umbel is compatible with some types of livestock grazing, however. Herbicide treatments within this program could also cause umbel mortality.

1996 Regional Amendment

The management direction provided by the S&Gs in the 1996 Regional Amendment relates to the conservation of MSOs and northern goshawks. The S&Gs promote healthy forest ecosystems; functioning watersheds; and riparian and aquatic systems (USFS 2004). We found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

Overall, the S&Gs within the 1996 Regional Amendment are providing for water umbel habitat maintenance and recovery. Standard and Guideline 1468 deals with prescribed fire in MSO protected areas. There is one location of water umbel that is within a MSO protected area and it is possible that fire could have adverse effects on those plants. Standard and Guideline 1510 provides the most benefits to water umbel because it ensures that forage use by grazing ungulates will be maintained at or above a condition which assures the recovery and continued existence of listed species.

Effects of the Action on Critical Habitat for the Huachuca water umbel

The following information has not changed since the 2005 BO/CO and is hereby incorporated by reference. There are seven CH units for Huachuca water umbel; three of these (Units 3, 4, and 6) are on the Coronado NF. These are the Scotia, Sunnyside, and Bear Canyon units. All are located in the Huachuca Mountains on the Sierra Vista Ranger District.

The applicable S&Gs were also analyzed for effects to Huachuca water umbel CH. Huachuca water umbel CH has four PCEs. In general, 53 percent of the S&Gs within the Coronado NF LRMP maintain the PCEs of CH. Only four percent of the S&Gs negatively affect all of the PCEs, while eight percent negatively affects three or less of the PCEs. The remaining 35 percent do not affect CH or were open to interpretation and difficult to analyze.

Almost all of the S&Gs analyzed for the species apply to CH; CH S&Gs are a subset of the species analysis. As such, the effects from the S&Gs do not differ significantly from the effects described for the species. Refer to that section of the 2005 BO/CO for a breakdown by program area of the effects to Huachuca water umbel CH.

1996 Regional Amendment

As stated in the 2005 BO/CO, one S&G (1510) from the 1996 Regional Amendment affects CH of Huachuca water umbel. This S&G maintains all four PCEs.

Impacts to Recovery
Recent case law directs the FWS to evaluate the proposed action's effects to both the species and its CH in terms of survival and recovery, to include a determination of at what point a species' recovery would be achieved, and whether the proposed action would preclude progress towards that end.

At this time, a Recovery Plan for the Huachuca water umbel has not yet been developed. Despite the lack of a Recovery Plan, the status of Huachuca water umbel appears to be relatively stable within its known range in the U.S. and Mexico (FWS 2011). In the analyses in the Effects of the Proposed Action section above, the applicable S&Gs from the Coronado NF LRMP, including the S&Gs from the 1996 Plan Amendment, were analyzed individually to determine their effects to the species and CH. The S&Gs were also assigned numeric values based on their effect to the species and/or PCEs of CH, and these amalgamated values are useful for a qualitative analysis of the proposed action's effect to recovery. During the 2005 consultation, FWS and USFS determined that, although 7 percent of the S&Gs could cause a lethal response from Huachuca water umbel, 29 percent were maintaining habitat and providing recovery, 7 percent were moving towards recovery and 1 percent were implementing the species recovery plan. The remainder of the S&Gs were either ill-defined and open to interpretation, not applicable to the species, non-discretionary, or provided only a heading. Likewise, the 1996 Regional Amendment was found to contain 2 percent of the S&Gs that could cause a lethal response, but this is offset by the 14 percent that maintain habitat and provide recovery. Again, the remainder of the S&Gs fell into one of the four previously-mentioned rankings.

While the Coronado NF is making progress towards the recovery of the Huachuca water umbel, we do not feel the species should be delisted at this time. The FWS is currently preparing a 5-year status review for this species to evaluate ongoing and/or worsening threats. It should be noted that the primary threat to the umbel is habitat alterations as a result of wetland degradation and loss. While improper livestock grazing, road construction, and prescribed fire activities have the potential to adversely affect the umbel, we do not believe that these actions will preclude recovery of this species because monitoring has shown that populations are currently stable.

For this analysis, we have focused on the ability of the S&Gs, if fully implemented through specific projects, to protect the physical and biological factors of the Huachuca water umbel's habitat, including CH, so that the species' natural ecological resilience can continue to ensure its survival and recovery in the wild. As mentioned above, the primary management emphases in the MA (7a) where the species occurs is to perpetuate unique wildlife or vegetative species and to improve and manage riparian areas to benefit riparian dependent resources. This management emphasis will help the Coronado NF move towards recovery of the Huachuca water umbel as a whole and in the CH units that occur on the NF.

Summary of Effects
Adverse effects to Huachuca water umbel CH may occur from the implementation of the Coronado NF LRMP. However, the proposed action will not alter the ability for the PCEs to

function properly. Management direction provided in the Coronado NF LRMP and 1996 Regional Amendment allows the PCEs for the Huachuca water umbel to remain functional and serve the intended conservation role for the species.

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.

Although most of the Huachuca water umbel locales are in federal ownership, one location occurs on The Nature Conservancy preserve, and several other locations exists on private property. The private property locations are protected by conservation easements.

Cumulative impacts to the Huachuca water umbel may occur from cross-border activities along the U.S./Mexico border. The following cross-border activities include, but may not be limited to the following: human traffic; deposition of trash; new trails from human traffic; soil compaction and erosion; increase fire risk from human traffic, water depletion and contamination; introduction and spread of disease; construction of the border fence; increased roads providing access to the border fence; and interference of survey, monitoring, and research.

CONCLUSION

After reviewing the current status of the Huachuca water umbel, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the Coronado NF LRMP and 1996 Regional Amendment, as proposed, are not likely to jeopardize the continued existence of the Huachuca water umbel and are not likely to destroy or adversely modify designated CH. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

This BO does not rely on the regulatory definition of "destruction or adverse modification" of CH in 50 CFR 402.02 because of various court cases surrounding the FWS's jeopardy and adverse modification analyses. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to CH. Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of CH and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of CH generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects

throughout the species' range, or appreciably diminish the capability of the CH to satisfy essential requirements of the species" (FWS and NMFS 1998:4-34).

Of the 25 extant sites, 12 are under the management of BLM (Tucson Field Office), Department of Defense (Fort Huachuca), FWS (San Bernardino National Wildlife Refuge), Arizona State Park Department, and private citizens. No known cumulative effects are anticipated for water umbel populations on non-federal lands. The private property locations are protected by conservation easements.

The Coronado NF, Sierra Vista Ranger District, manages six Huachuca water umbel sites in the Huachuca Mountains. These are the Scotia, Bear, Sunnyside, and Sycamore Canyon sites and the O'Donnell Creek and Freeman Springs sites. Scotia Canyon has one of the largest populations with plants occupying most of the suitable habitat along the 1,500 m (4,800 ft.) perennial reach of the stream. The four canyon sites are at the highest known elevations for Huachuca water umbel. They are in the upper parts of the watershed and relatively secure from water withdrawals or water diversions. The sites are grazed, but monitoring shows no adverse effects to Huachuca water umbel. The Freeman Spring and O'Donnell Creek sites are lower in the watershed and subject to water withdrawals or water diversions, however, both have cattle exclosures. The Coronado NF has contributed to Huachuca water umbel conservation by fencing known locations, restricting livestock access in designated CH, reducing recreation impacts in sensitive habitat, and monitoring water umbel populations.

The continued implementation of the Coronado NF LRMP may result in habitat modification and mortality of Huachuca water umbel. However, the FWS does not believe the impacts of the proposed action will rise to the level of jeopardy or adverse modification for the species and its CH. The FWS bases this conclusion on the management direction of the Coronado NF LRMP, which conserves Huachuca water umbel populations with the following:

- Standard and guideline 627 maintains or improves occupied habitat of listed species through the mitigation of Forest activities.

- Standard and guideline 632 allows for project planning to minimize effects to listed species, prior to implementation.

- Standard and guideline 676 gives preferential consideration to riparian-dependent resources over other resources.

With the implementation of these beneficial S&Gs within the Coronado NF LRMP, as well as the continuing conservation efforts conducted by the Coronado NF, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of the Huachuca water umbel. Based on the above analyses, it is the FWS's biological opinion that the proposed action will not alter the ability of the PCEs to function properly. As such, designated CH for the Huachuca water umbel will remain functional to serve its intended conservation role for the species. Therefore, the FWS concludes that the proposed action is not likely to destroy or adversely modify designated CH for the Huachuca water umbel.

INCIDENTAL TAKE STATEMENT

Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of federally listed endangered plants, or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulation, or in the course of any violation of a state criminal trespass law.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. Consider adopting a policy that uses only native species for watershed rehabilitation post-fire seeding and general site rehabilitation.
2. Continue monitoring Huachuca water umbel on Coronado NF lands.
3. Participate in the preparation of the recovery plan for Huachuca water umbel.

In order for the FWS to be kept informed of action minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

PIMA PINEAPPLE CACTUS

STATUS OF THE SPECIES

Description

The Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*) is a low-growing, hemispherical plant known from the semi-desert grassland and Sonoran desert scrub of southern Arizona and northern Mexico. Pima pineapple cacti can be single-stemmed, multi-headed, or appear in clusters (FWS 1993). Adults of the species measure 4-18 inches (10-46 centimeters) tall and 3-7 inches (7.5-18 centimeters) in diameter. Spines of the pineapple cactus are very stout, and form clusters consisting of one strong, hooked central spine, and 6-15 straight radial spines (FWS 1993). The spines are initially straw colored, but become black with age. Pineapple cactus flowers are silky yellow in color, and the fruit is green ellipsoid, succulent, and sweet. The Pima pineapple cactus occurs on lands of the Tohono O'odham Nation, state of Arizona, and private lands. The cactus also occurs on federal lands under management of the BLM, USFS, FWS, and Bureau of Reclamation (Arizona Rare Plant Committee 2001).

Coryphantha scheeri var. *robustispina* was first collected in 1856 by Mr. A. Schott, from grasslands on the south side of the Baboquivari Mountains in Sonora, Mexico. These plants were originally named *Mammillaria robustispina*, and subsequently underwent several name changes (FWS 1993). Lyman Benson (1969) published the most recent revision, which split *Coryphantha scheeri* into three varieties, including the variety *robustispina*. The Pima pineapple cactus is also known as Scheer's strong-spined cory cactus.

Legal Status: On September 23, 1993, the FWS listed the Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*) as an endangered species under the authority of the Endangered Species Act, as amended. Critical habitat for the species has not been designated.

The Pima pineapple cactus was included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) on July 1, 1975. This action requires the country of origin to obtain a permit to export species listed in under CITES. Commercial trade is permitted, but only after the country of export has determined that such trade will not harm wild populations of the species (FWS 1993). International movement of the Pima pineapple cactus is minimal.

The Pima pineapple cactus is protected as a "Highly Safeguarded Species" under the Arizona Native Plant Law. This law prohibits the illegal taking of this species on state and private lands without a permit for educational or research purposes. However, as stated in your 2004 BA, the Arizona Native Plant Law does not provide for protection of plants in situ through restrictions on development activities.

In 2005, a 5-year review was initiated for this cactus (70 FR 5460). This review was completed in 2007 and recommended no change to the cactus's classification as an endangered species (FWS 2007).

Distribution and Abundance

The distribution and abundance information has not changed since the 2005 BO/CO so we have summarized that information here and incorporate the remainder by reference. Pima pineapple cactus is found at elevations of 2,300-4,500 feet (700 to 1,400 meters) in Pima and Santa Cruz counties, Arizona, and northern Sonora, Mexico. The range of the species extends east from the Baboquivari Mountains, 45 miles to the western foothills of the Santa Rita Mountains; and extends south from Tucson, Arizona, 50 miles to Sonora, Mexico.

The FWS completed the 5-year status review for this species in February 2007, and the following information is reiterated from that document. According to the completed review, it is difficult to address abundance and population trends for this species due its very general habitat requirements. The Pima pineapple cactus occurs at low densities widely scattered, sometimes in clumps, across the valley bottoms. The species can be difficult to detect, especially in dense grass cover. For this reason, systematic surveys are expensive and have not been conducted for much of its range. Therefore, location information in the database has been gathered opportunistically, either through small systematic surveys usually associated with specific development projects, or larger surveys that are typically only conducted in areas that seem highly suited for the species.

The most recent BO on the Pima pineapple cactus (FWS 2011) states that we do know the number and fate of the cactus that have been detected during surveys for projects that have undergone section 7 consultation. According to this 2011 BO on the Proposed Reconfiguring of the Existing Traffic Interchange Ramp Connections between I-19 and Sahuarita Road, section 7 consultations on development projects have allowed us to become aware of 2,705 plants found on approximately 15,217 acres within the range of the Pima pineapple cactus. Of the total number of plants, 1,992 (74 percent) were destroyed, removed, or transplanted as a result of development, mining, and infrastructure projects. In terms of habitat, some of the measured acres likely did not provide Pima pineapple cactus habitat but that amount is difficult to quantify because it was not consistently delineated in every consultation. Of the 15,217 acres, however, the BO states that we are aware of 14,552 acres (96 percent) have been either permanently or temporarily impacted. Similarly, through section 7 consultations on non-development-related projects (e.g., fire management plans, grazing, buffelgrass control), we are aware of an additional 781 plants within an unknown number of acres; the number of acres is unknown because these types of projects are often surveyed inconsistently, if at all.

Across the entire Pima pineapple cactus range, it is difficult to quantify the total number of cactus lost and the rate and amount of habitat loss for the following three reasons: 1) we review only a small portion of projects within the range of the cactus (only those that have federal involvement and are subject to section 7 consultation), 2) development that takes place without any jurisdictional oversight is not tracked within Pima and Santa Cruz counties, and 3) many areas within the range of the cactus have not been surveyed; therefore, we do not know how many plants exist nor how much habitat is presently available. It is important to note that the above survey results have never been used as an estimate of the entire Pima pineapple cactus population nor was a population estimate ever extrapolated from these data (FWS 2007).

As stated in the 2011 BA, there are 5,553 records for the Pima pineapple cactus in the Arizona Natural Heritage Program database. Of these, about 1,340 records are documented as being extirpated (FWS 2007).

Habitat

Pima pineapple cacti grow in alluvial basins and hillsides of semi-desert grasslands and desert scrub. The plant occurs most commonly in open areas on flat ridge tops or areas with less than 10-15 percent slope (FWS 1993). Pima pineapple cacti are also found in the transition zone between the semi-desert grasslands and desert scrub. Vegetation within this transition zone is dominated by mid-sized mesquite trees, half shrubs, and patches of native grass and scattered succulent (FWS 2004). Soils range from shallow to deep, and silty to rocky. Dominant plant species vary, but include *Acacia constricta* (white-thorn acacia), *Larrea tridentate* (creosote bush), *Prosopsis velutina* (velvet mesquite), *Ambrosia deltoidea* (triangle-leaf bursage), *Gutierrezia microcephala* (thread snakeweed), *Opuntia fulgida* (chain fruit cholla), *Isocoma tenuisecta*, *Eragrostis lehmanniana* (Lehman's lovegrass), and various other cacti and grasses (Mills 1991).

Life History

As stated in the 2005 BO/CO, the Pima pineapple cactus is a succulent perennial plant. Please refer to the 2005 BO/CO for a complete explanation of the cactus' life history.

Reasons for Listing

The Pima pineapple cactus was listed as an endangered species without CH on September 23, 1993 (58 FR 49875). Factors that contributed to the listing include habitat loss and degradation, habitat modification and fragmentation, limited geographical distribution and species rareness, illegal collection, and difficulties in protecting areas large enough to maintain functioning populations.

Threats: The following information is reiterated from the 2005 BO/CO. Major threats to the Pima pineapple cactus relate to habitat loss and degradation, including urban development activities, which cause destruction and fragmentation of existing habitat; livestock operations and crop development, which degrade habitat; and mining and aggressive non-native grasses, which result in a loss of cactus habitat.

Urban construction associated with the rapidly growing population occurs throughout the range of the species, and is the most significant cause of habitat loss and fragmentation. Home building, commercial development, road construction and maintenance, and utility corridor construction are some of the activities that have caused and continue to cause the loss of pineapple cactus habitat (FWS 1993). Urban development and other commercial activities continue to detrimentally impact the habitat of the Pima pineapple cactus.

The entire undeveloped part of the pineapple cactus' range is used for livestock grazing. Range management practices used to modify desert communities for grass production have affected the species more than direct livestock impacts. Indirectly, livestock operations may cause the introduction of exotic grasses, including Lehmann lovegrass (*Eragrostis lehmanniana*). Up to 75 percent of Pima pineapple cactus habitat has been significantly altered by the introduction of Lehmann lovegrass, which out competes native grasses, and has created monotypic stands over large areas of mid-elevation southern Arizona (FWS 1993). Lehmann lovegrass provides abundant fine fuels, threatening the destruction of pineapple cactus habitat by wildfire.

Pima pineapple cactus habitat is also threatened by farm and crop production. The Avra and Altar valleys and the Santa Cruz River basin are currently being cultivated for farming. Such areas were most likely historical habitat for the Pima pineapple cactus (FWS 1993). Farm and crop development alter the landscape in a manner that is nearly irreversible in terms of supporting Pima pineapple cactus populations.

Climate Change

As stated in the 2011 BA, no research has been initiated related to the specific effects of climate change on this species; however, there are no expectations of measurable changes in climate within the temporal bounds of the proposed action. Despite the current limits of climate change effects analysis, the 2011 BA also states that the USFS Southwestern Region has developed guidance for addressing climate change in NF LRMP revisions, which are broad and general in scope and which rely on adaptive management as climate change science evolves. Therefore, as we build a better understanding of the potential effects resulting from climate change on Pima

pineapple cactus distribution, FWS expects that this increased knowledge will be incorporated into the revisions of the Coronado NF LRMP.

Recovery Actions

As stated in the 2011 BA, there have been some notable conservation developments for this species. There are two established conservation banks, one on a private ranch in the Altar Valley and another owned by Pima County which includes areas in both the Altar Valley and south of Green Valley. Nine projects have used the bank to mitigate the loss of Pima pineapple cactus and habitat from residential and commercial development. Pima County and the City of Tucson's large-scale conservation efforts for this species are not yet complete, but strategies for Pima pineapple cactus conservation will likely include additional conservation banks, acquisition of occupied and suitable Pima pineapple cactus habitat, a revision of both the City and County ordinances dealing with native plant protection, and provisions for the protection of Pima pineapple cactus and habitat within subdivisions (FWS 2007).

Two small exclosures were constructed in 1996 on the Sierra Vista RD to protect the cactus and evaluate the effect of livestock grazing. Plants are being monitored along the Sopori Road access to the Nogales RD (T. Skinner, Coronado NF, pers. comm. e-mail to C. McDonald, 29 July 2003).

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area, the anticipated impacts of all proposed federal actions in the action area that have undergone formal or informal section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

As stated in the 2011 BA, the Pima pineapple cactus occurs within MA 4 of the Coronado NF in the Nogales and Sierra Vista RDs. These populations are somewhat disjunct from the main distribution to the north. They represent only a minor part of the species' distribution and abundance, but are significant for their safety from potential development. As discussed in the 2005 BO/CO, the Pima pineapple cactus populations on the Coronado NF are not susceptible to the land development threats responsible for destroying much of the species' habitat on private lands.

As stated in the 2005 BO/CO, there are approximately 100 Pima pineapple cactus on lands managed by the Coronado NF. The majority of the cacti occur on the Sierra Vista RD, but a few individuals are on the Nogales RD. Most of these plants have been monitored sporadically for the last 5 to 10 years. The predominant land use on the Forest is grazing. Lehmann's lovegrass dominates the herbaceous community.

Factors Affecting the Species within the Action Area
The following factors affecting the species on the Coronado NF are reiterated from the 2005 BO/CO. Dispersed, patchy clusters of individual Pima pineapple cactus are becoming increasingly isolated as current land-management practices, increased recreational use when adjacent to urban expansion, and the continuing aggressive spread of non-native grasses threatens the habitat of the species. Also, the illegal collection of Pima pineapple cactus has been documented on numerous occasions throughout the range of the species. Hobbyists and commercial collectors are the two groups most likely to collect this species (FWS 1993).

Improper livestock grazing during the mid-to-late 1800s and continuing livestock grazing practices may have significantly altered the ecosystem. Effects of improper livestock grazing include: erosion, changes in hydrology and microclimate, invasion of weedy exotic plant species, shifts in density, relative abundance, and vigor of native species (FWS 1993). Also, some modern range management practices, such as imprinting, chaining, and ripping can directly damage or destroy plants, as well as reduce the shrub component of the plant community.

The seeding of non-native grasses, predominately Lehman's lovegrass (Eragrostis lehmanniana), usually follows mechanical manipulation. This aggressive exotic species is introduced to provide cattle forage and soil stabilization. The exotic grass species, Mediterranean grass (Schismus barbatus) is also common in Sonoran desert-scrub grassland transition habitats. Mediterranean grass habitats contribute dense, fine fuels that are readily flammable and carry fires in fire-intolerant habitat. The invasion of exotic plant species alters the fire regime, resulting in the destruction of Pima pineapple cactus by fire, as was described in your 2004 BA. Under these altered community conditions, the elimination of grazing may do more damage than its presence. Although trampled plants have been seen in grazed areas, grazing removes much of the grass that is competing for space, water, and nutrients, and removes the standing dead grass thus reducing the fire hazard (FWS 1993).

Off-road vehicle use can cause problems for Pima pineapple cactus. The cacti are small and can be covered by grass, making them difficult to see. Cacti on the Sierra Vista RD occur in relatively flat areas that are very popular for off-road vehicle use. This activity is not authorized by the USFS, but the area was not adequately signed for non-entry. The Coronado NF increased patrols during weekends and holidays to more effectively manage this activity in occupied habitat.

EFFECTS OF THE ACTION

The S&Gs listed in the Coronado NF LRMP and 1996 Regional Amendment provide direction for the development of site-specific actions. Multiple S&Gs are related to the Pima pineapple cactus and its habitat. The S&Gs, if applied to project-level activities, may result in both indirect and direct effects to the species. The 2005 BO/CO included a thorough analysis of the S&Gs and their effects on the Pima pineapple cactus. Tables were presented that showed the S&Gs applicable to the species along with a ranking table describing the effect of applicable S&Gs on the species. Because there have been no changes in Forest policy or programs since the 2005 analysis and there is no new significant scientific information on the Pima pineapple cactus, we

hereby incorporate by reference the 2005 BO/CO effects analysis and provide a narrative summary below.

On the Coronado NF, Pima pineapple cactus occurs in MA 4. The emphasis for this area is sustained harvest of livestock forage and fuelwood while maintaining and improving game and animal habitat. Grasslands and mixed grasslands in MA 4 are to be managed at Level C (extensive livestock management) and D (intensive livestock management). The Coronado supports a very small population of this species relative to the remaining populations outside the Forest. Nevertheless, the Forest provides habitat that is not threatened by residential and urban development, the primary threat to the Pima pineapple cactus.

Twenty percent of the S&Gs could result in mortality of plants, while 30 percent of the S&Gs have some beneficial effects for the species. The remaining 50 percent of the S&Gs are not applicable to the species or were open to interpretation and difficult to analyze.

The primary source of protection for the Pima pineapple cactus comes from the Wildlife, Fish, and Rare Plants Program. Through this program, the Forest is directed to maintain or improve habitat of listed species through mitigation of Forest activities (S&G 627). The Coronado NF is also guided to develop overall direction for listed species in cooperation with state and federal agencies (S&G 629) and conduct inventories and surveys for listed species (S&G 631). All of the S&Gs in this program area ultimately will benefit the cactus and aid in recovery while simultaneously minimizing the negative effects from other program areas.

Other benefits to the Pima pineapple cactus result from the Engineering; Forestry and Forest Health; Recreation, Heritage, and Wilderness, and Watershed Management Programs. Of the three S&Gs within the Engineering Program that are applicable to the Pima pineapple cactus, two are open to interpretation and difficult to analyze and one, specific to MA 4, allows the Forest to close roads that are not needed. This is considered beneficial to the cactus. Another beneficial effect to the Pima pineapple cactus comes from S&G 704 from the Forestry and Forest Health Program; this S&G prioritizes listed species' habitat needs above the need to manipulate vegetation to control insects or disease. The Recreation, Heritage, and Wilderness Program also may benefit the cactus as S&Gs 612 and 613 direct the Forest to conduct evaluations of dispersed recreation activity for areas receiving high use and develop capability limits for dispersed recreation. The Watershed Management Program also provides benefits to cactus habitat through S&Gs that guide the Forest to repair watersheds in unsatisfactory conditions.

The S&Gs determined to have adverse effects to the Pima pineapple cactus primarily stem from the Rangeland Management Program. Standards and Guidelines related to pesticide and herbicide application under this program may be harmful to the cactus. Other S&Gs (780 and 780a-b) can lead to cactus mortality and habitat damage by allowing structural and non-structural improvements to maintain grazing capacity, use different methods (chaining, seeding, fire) to maintain range resources, and to develop proper grazing methods to benefit forage, game species, and soil and water resources. The Watershed Management Program also may adversely affect the cactus by S&G 782 specific to MA 4 that allows the use of non-native seed in watershed rehabilitation projects, which can introduce exotic grasses that can alter the habitat for the pineapple cactus.

1996 Regional Amendment
The management direction provided by the S&Gs in the 1996 Regional Amendment relates to the conservation of MSOs and northern goshawks. The S&Gs promote healthy forest ecosystems; properly functioning watersheds; and riparian and aquatic systems (USFS 2004). There is only one S&G (1510) that applies to the cactus. In addition, we found that the guidelines used by the USFS for the northern goshawk do not appreciably affect this species.

The one S&G from the 1996 Regional Amendment that applies to Pima pineapple cactus states that forage use by grazing ungulates will be maintained at or above a condition which assures the recovery and continued existence of listed species. The implementation of this S&G, which is applicable to the Rangeland Management Program, should preserve and protect, at a minimum, the known locations of Pima pineapple cactus on the Coronado NF.

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.

As stated in the 2005 BO/CO, the Coronado NF supports a very small population of Pima pineapple cactus. The majority of the range is scattered over state, tribal, and private lands in the Altar and Santa Cruz valleys of Pima and Santa Cruz Counties in southeast Arizona. Some of this land is adjacent to the Forest. Actions that continue to threaten the species are residential and commercial development (many have no federal nexus), mining, and the illegal removal/collection of plants.

Additional cumulative impacts to the Pima pineapple cactus may occur from cross-border activities along the U.S./Mexico border. The following cross-border activities include, but may not be limited to the following: human traffic, deposition of trash, new trails from human traffic, soil compaction and erosion, increase fire risk from human traffic, water depletion and contamination, introduction and spread of disease, and interference of survey, monitoring and research.

CONCLUSION

After reviewing the current status of the Pima pineapple cactus, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the continued implementation of the S&Gs within the Coronado NF LRMP and the 1996 Regional Amendment, as proposed, are not likely to jeopardize the continued existence of the Pima pineapple cactus. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. No CH has been designated for this species; therefore, none will be affected.

Pima pineapple cactus occurs in 50 townships within its U.S. range, mainly on state trust lands, and private property. There are approximately 100 Pima pineapple cactus on lands managed by the Coronado NF, the majority of which occur on the Sierra Vista Ranger District. A few individual plants are located on the Nogales Ranger District. Most of these plants have been monitored sporadically for the last 5-10 years. The population seems relatively stable. These populations lie within the southern end of the species' range, disjunct from the main distribution to the north, and represent only a minor part of the species' distribution and abundance.

Cumulative effects considered in our analysis include residential and commercial development (many with no federal nexus), mining, and the illegal removal/collection of plants. The baseline for the species continues to degrade as a result of these activities. Pima pineapple populations on the Coronado NF are not susceptible to the land development threats responsible for destroying much of the species' habitat on private lands. The population on the Coronado NF represents a very small portion of the overall distribution of the species.

The continued implementation of the Coronado LRMP may result in habitat modification and mortality of the Pima pineapple cactus. However, the FWS does not believe the impacts of the proposed action will rise to the level of jeopardy for the species. The FWS bases this conclusion on the management direction of the Coronado NF LRMP, which conserves Pima pineapple cactus populations with the following:

- The Coronado NF has carried out several actions to protect Pima pineapple cactus and its habitat. These include building exclosures that protect at least 50% of the cacti from the effects of livestock grazing; delineating potential habitat and surveying for Pima pineapple cactus; and attempting to control unauthorized off-road vehicle activity in occupied habitat.

- The Coronado NF has surveyed much of the suitable habitat on the Coronado NF.

- The Coronado NF constructed two small exclosures on the Sierra Tordilla grazing allotment to protect the Pima pineapple cactus and evaluate the effects of livestock grazing; plants are also being monitored along the Sopori Road access to the Nogales Ranger District.

- The Coronado NF has spent considerable time managing the off-road vehicle use in the areas that support Pima pineapple cactus on the Sierra Vista Ranger District. In addition, roads have been signed and areas have been closed to protect occupied habitat.

- Standard and Guideline 627 contains guidance for maintaining or improving occupied habitat for listed T&E species through the modification of USFS activities.

With the conservation efforts put forth by the Coronado NF, as well as the beneficial S&Gs of the Coronado NF, the FWS concludes that the proposed action is not likely to jeopardize the continued existence of the Pima pineapple cactus.

INCIDENTAL TAKE STATEMENT

Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of federally listed endangered plants, or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulation, or in the course of any violation of a state criminal trespass law.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. Continue monitoring Pima pineapple cactus on Coronado NF lands.

In order for the FWS to be kept informed of action minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

DISPOSITION OF DEAD OR INJURED LISTED SPECIES

Upon locating a dead, injured, or sick listed species initial notification must be made to the FWS Law Enforcement Office, 2450 W. Broadway Rd, Suite 113, Mesa, Arizona, 85202, telephone: 480/967-7900, within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

REINITIATION NOTICE

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 retained (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 CH 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 CH not considered in this opinion; or (4) a new species is listed or CH 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.

LITERATURE CITED

Description of the Proposed Action and Consultation Approach

U.S. Department of Agriculture/U.S. Department of the Interior. 2003. Interagency strategy for the implementation of Federal Wildland Fire Management Policy. Washington, D.C. 62pp.

U.S. Fish and Wildlife Service. 1996a. Biological opinion to the Forest Service, Southwestern Region: Mexican spotted owl and critical habitat and Existing Forest Plans. July 12, 1996.

_____. 1996b. Biological opinion to the Forest Service, Southwestern Region: Mexican spotted owl and critical habitat and Forest Plan Amendments. May14, 1996.

_____. 1996c. Biological opinion to the Forest Service, Southwestern Region: Mexican spotted owl and critical habitat and Forest Plans Amendments. November 25, 1996.

_____. 1997. Biological opinion and conference opinion on Land Resource Management Plans, as Amended, for Eleven National Forest and National Grasslands in the Southwestern Region. December 19, 1997.

_____. 2005. Programmatic Biological and Conference Opinion on the Continued Implementation of the Land and Resource Management Plans for the Eleven National Forests and National Grasslands of the Southwestern Region. June 10, 2005.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Consultation handbook: procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act.

U.S. Forest Service. 2004. Proposed rule and request for comments for travel management; designated routes and areas for motor vehicle use. Federal Register vol. 69, no. 135:42381.

_____. 2004. Biological Assessment for the Continued Implementation of the Land and Resource Management Plans for the Eleven National Forest and National Grasslands in the Southwestern Region. Final, April 8, 2004.

Mount Graham red squirrel

Allen, J.A. 1894. Description of ten new North American mammals, and remarks on others. Bull. Amer. Mus. Nat. Hist. 6:320-321.

Arizona Game and Fish Department. 2001. Wildlife views. Phoenix, Arizona, USA.

_____. 2003. *Tamiasciurus hudsonicus grahamensis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Phoenix, Arizona, USA.

_____. 2004. Written briefing on the effects of the Pinaleno fires on Mt. Graham red squirrel habitat.

Froehlich, G.F. 1990. Habitat use and life history of the Mt. Graham red squirrel. Thesis, University of Arizona, Tucson, Arizona, USA.

Hoffmeister, D.F. 1956. Mammals of the Graham (Pinaleno) Mountains, Arizona. American Midland Naturalist 55:257-288.

Mannan, R.W. and A.A. Smith. 1991. Identification of distinguishing characteristics around middens of Mount Graham red squirrels. Forest Service, Coronado National Forest, Tucson, Arizona, USA.

Riddle, B.R., T.L. Yates, and T.E. Lee Jr. 1992. Molecular divergence and variation in the endangered Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*). Final report submitted to the Mount Graham Red Squirrel Study Committee. Unpublished. Tucson, Arizona, USA.

Smith, et al. 1988. Mount Graham red squirrel. An expanded biological assessment of impacts: Coronado National Forest Land Management Plan and University of Arizona Proposal for Mt. Graham Astrophysical Development.

Spicer, R.B., J.C. deVos, and R.L. Glinski. 1985. Status of the Mount Graham Red Squirrel *Tamiasciurus hudsonicus grahamensis* (Allen), of Southeastern Arizona. Arizona Game and Fish, Phoenix, Arizona, USA.

Sullivan, R.M. and T.L. Yates. 1995. Population genetics and conservation biology of relict populations of red squirrels. Pages 193-208 *in* C.A. Istock and R.S. Hoffmann, editors. Storm over a mountain island: conservation biology and the Mt. Graham red squirrel. University of Arizona Press, Tucson, Arizona, USA.

U.S. Fish and Wildlife Service. 1987. Endangered and threatened wildlife and plants: Determination of endangered status for the Mount Graham red squirrel. Federal Register 52(106): 20994-20999.

_____. 1988. Biological opinion for the Coronado National Forest plan and the Mt. Graham astrophysical area plan. July 14, 1988. Consultation number 2-21-88-F-075. U.S. Fish and Wildlife Service, Albuquerque, New Mexico, USA.

_____. 1990. Endangered and threatened wildlife and plants; designation of critical habitat for the endangered Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*). Federal Register 55:425-429

_____. 1990. Endangered and threatened wildlife and plants; designation of critical habitat for the endangered Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*). Federal Register 55:425-429.

_____. 1992. Mount Graham Red Squirrel Recovery Plan. U.S. Fish and Wildlife Service, Phoenix, Arizona, USA.

_____. 2000. Biological opinion for the Pinaleno Ecosystem Management Demonstration Project. October 5, 2000. Consultation number 2-21-98-F-282. U.S. Fish and Wildlife Service, Tucson, Arizona, USA.

U.S. Forest Service. 2004. Biological assessment on eleven land and resource management plans, Southwestern Region, Albuquerque, New Mexico, USA.

_____. 2004a. Status Paper: Mt. Graham Forest Insect outbreaks. Coronado National Forest. January 15, 2004. Enclosure to January 16, 2003, public letter to interested parties. File code 2400-4/5150-1. Coronado National Forest, Supervisor's Office, Tucson, Arizona, USA.

_____. 2004b. Nuttall Complex: Burned Area Emergency Response (BAER) Team Executive Summery. Coronado National Forest, Safford, Arizona. July 20, 2004. 12pp+maps.

Vahle, J. R. 1978 Red squirrel use of southwestern mixed conifer habitat. Thesis, Arizona State University, Tempe, Arizona, USA.

Wilson, J.L., R. Fitzgibbon, and S. Dudley. 1999. Evaluation of a spruce and western balsam bark beetle outbreak on the Mt. Graham, Safford Ranger District, Coronado National Forest. Unpublished. Forest Service, Southwestern Region, Flagstaff, Arizona, USA.

Mexican Spotted Owl

Bond, M.L., R.J. Gutierrez, A.B. Franklin, W.S. LaHaye, C.A. Hay, and M.E. Seamans. 2002. Short-term effects of wildfire on spotted owl survival, site fidelity, mate fidelity, and reproductive success. Wildlife Society Bulletin 30(4):1022-1028.

Breshears, D.D., N.S. Cobb, P.M. Rich, K.P. Price, C.D. Allen, R.G. Balice, W.H. Romme, J.H. Kastens, M.L. Floyd, J. Belnap, J.J. Anderson, O.B. Myers, and C.W. Meyers. 2005. Regional vegetation die-off in response to global-change-type drought. Proceedings of the National Academy of Sciences, USA (PNAS) 102(42): 15144-48.

Cook, E.R., C.A. Woodhouse, C.M. Eakin, D.M. Meko, and D.W. Stahle. 2004. Long-term aridity changes in the western United States. Science 306: 1015-1018.

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

Courtney, S.J., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Guitierrez, J.M. Marzluff, and L. Sztukowski. 2004. Scientific Evaluation of the Status of the Northern Spotted Owl. Sustainable Ecosystems Institute, Portland, Oregon. 508 pp.

Delaney, D. K., T. G. Grubb, and P. Beier. 1999. Activity patterns of nesting Mexican spotted owls. Condor 101:42-49.

Dettinger, M.D. and D.R. Cayan. 1995. Large scale atmospheric forcing of recent trends toward early snowmelt runoff in California. Journal of Climate 8: 606-623.

Dettinger, M.D. and H.F. Diaz. 2000. Global characteristics of streamflow seasonality and variability. Journal of Hydrometeorology 1: 289-310.

Ganey, J.L., and J.A. Dick. 1995. Chapter 4: Habitat relationships of Mexican spotted owls: current knowledge. Pp. 1-42 *in* Recovery plan for the Mexican spotted owl (*Strix occidentalis lucida*), Volume II. USDI Fish and Wildlife Service, Albuquerque, New Mexico, USA. Available from: http://mso.fws.gov/recovery-plan.htm

Gutiérrez, R. J., A. B. Franklin, and W. S. LaHaye. 1995. Spotted Owl (Strix occidentalis). The birds of North America. The Academy of Natural Sciences Philadelphia, and The American Ornithologists Union, Washington, D.C.. No. 179:28 pp.

Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for policy makers. In: Climate Change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Quin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available at http://www.ipcc.ch/.

Lee, B.V., R. Smith, and J. Bate. 2006. Chapter 7: Ecological & Biological Diversity of the Apache-Sitgreaves National Forests *in* Ecological and Biological Diversity of National Forests in Region 3. The Nature Conservancy, Washington, D.C., USA.

Mueller, R.C., C.M. Scudder, M.E. Porter, R.T. Trotter III, C.A. Gehring and T.G. Whitham. 2005. Differential tree mortality in response to severe drought: Evidence for long-term vegetation shifts. Journal of Ecology 93(6): 1085-1093.

Reiners, W.A., W.L. Baker, J.S. Baron, D.M. Debinski, S.A. Elias, D.B. Fagre, J.S. Findlay, L.O. Mearns, D.W. Roberts, T.R. Seastedt, T.J. Stohlgren, T.T. Veblen, and F.H. Wagner. 2003. Natural Ecosystems 1: The rocky mountains (pp. 145-184). *In* Wagner, F.H. (Ed.), Preparing for Climate Change: Rocky Mountain/Great Basin Regional Assessment Team for the U.S. Global Change Research Program. Utah State University. 240 pp.

Smith, S.J, T. Wigley, and J.A. Edmonds. 2000. "A new route toward limiting climate change?" Science 290 (5494): 1109-1110.

Stewart, I.T., D.R. Cayan, and M.D. Dettinger. 2004. Changes in snowmelt runoff timing in western North American under a "business as usual" climate change scenario. Climate

Change 62: 217-232.

U.S. Department of Agriculture, Forest Service (USDA Forest Service). 2011. Wallow Wildfire Resource Report – Wildlife, Apache-Sitgreaves National Forest. 45pp.

U.S. Fish and Wildlife Service (USDI Fish and Wildlife Service). 1993. Endangered and threatened wildlife and plant: final rule to list the Mexican spotted owl as a threatened species. Federal Register 58:14248-14271.

_____. 1995. Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*). U.S. Fish and Wildlife Service. Albuquerque, New Mexico, USA.

_____. 2004. Endangered and threatened wildlife and plants; final designation of critical habitat for the Mexican Spotted Owl: final rule. Federal Register 69(168): 53182-53230.

_____. 2011. Draft Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision. U.S. Fish and Wildlife Service. Albuquerque, New Mexico, USA.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Consultation handbook: procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act.

Desert pupfish

Belsky, A.J., A. Matzke and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54:49-431.

Bisson, P.A., T.P. Quinn, G.H. Reeves, and S.V. Gregory. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest river systems. Pp. 1-542. *In*: Watershed management; balancing sustainability and environmental change. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Black, G. F. 1980. Status of the desert pupfish, *Cyprinodon macularius* (Baird and Girard), in California. California Dept. Fish and Game, Inland Fisheries, Endangered Species Proj., Rancho Cordova.

Bolster, B. C. 1990. Five year status report for desert pupfish, *Cyprinodon macularius macularius*. California Department of Fish and Game, Inland Fisheries Division, Endangered Species Project, Rancho Cordova.

Brooks, J.E. 1985. Factors affecting the success of Gila topminnow (*Poeciliopsis o. occidentalis*) introductions on four Arizona National Forests. Arizona Game and Fish Department, Phoenix. 43pp.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117:1-21.

Clarkson, R. W., and J. C. DeVos, Jr. 1986. The bullfrog, *Rana catesbeiana* Shaw, in the lower Colorado River, Arizona-California. Copeia (1986):42-49.

Cohen, N. W., and W. E. Howard. 1958. Bullfrog food and growth at the San Joaquin Experimental Range, California. Copeia (1958): 223-225.

Eigenmann, C. H., and R. S. Eigenmann. 1888. *Cyprinodon californiensis* Girard. Western American Sci. 5:3-4.

Erman, D.C., J.D. Newbold, and K.B. Roby. 1977. Evaluation of streamside bufferstrips for protecting aquatic organisms. California Water Resources Center, Univ. of California, Davis, CA. 48 pp.

Evermann, B. W. 1916. Fishes of the Salton Sea. Copeia 1916:61-63.

Fleischner, T.L. 1994. Ecological cost of livestock grazing in western North America. Conservation Biology 8(3):629-644.

Garman, S. 1895. The cyprinodonts. Memoirs of the Museum of Comp. Zool. 19:1-179.

Gilbert, C. H., and N. B. Scofield. 1898. Notes on a collection of fishes from the Colorado Basin in Arizona. Proc. U.S. National Museum 20:487-499.

Gunderson, D.R. 1968. Floodplain use related to stream morphology and fish populations. Journal of Wildlife Management 32(3):507-514.

Hendrickson, D. A., and W. L. Minckley. 1984. Cienegas - vanishing climax communities of the American Southwest. Desert Plants 6(3):131-175.

Hendrickson, D. A., and A. Varela-Romero. 1989. Conservation status of desert pupfish, *Cyprinodon macularius*, in Mexico and Arizona. Copeia 1989:478-483.

Jancovich, J. K., E. W. Davidson, J. F. Morado, B. L. Jacobs, and J. P. Collins. 1997. Isolation of a lethal virus from the endangered tiger salamander, *Ambystoma tigrinum stebbinsi*. Diseases of Aquatic Organisms 31:161-167.

Kauffman, J.B. and W.C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications: a review. Journal of Range Management 37(5):437-448

Lau, S. and C. Boehm. 1991. A distribution survey of desert pupfish (Cyprinodon macularius) around the Salton Sea, California. Final Report for Section 6, Project No. EF9oXII-1, prepared for California Department of Fish and Game, Inland Fisheries Division.

Lowrance, R., R. Todd, J. Fail,Jr., O. Hendrickson,Jr., R. Leonard, and L. Asmussen. 1984. Riparian forests as nutrient filters in agricultural watersheds. BioScience 34(6):374-377.

Mahoney, D.L., and D.C. Erman. 1981. The role of streamside bufferstrips in the ecology of aquatic biota. California Riparian Systems Conference, Sept. 17-19, 1981.

Marlow, C.B. and T.M. Pogacnik. 1985. Time of grazing and cattle-induced damage to streambanks. Pp. 279-284. *In*: Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference. April 16-18, 1985, Tucson, AZ. Johnson, R.R., C.D. Ziebell, D.R. Patton, P.F. Ffolliott, and R.H. Hamre, Eds. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station General Technical Report RM-120, Ft. Collins, CO.

Miller, R. R. 1943. The status of *Cyprinodon macularius* and *Cyprinodon nevadensis*, two desert fishes of western North America. Occasional Papers of the Museum of Zool., Univ. of Michigan 473:1-25.

___, and L. A. Fuiman. 1987. Description and conservation status of *Cyprinodon macularius eremus*, a new subspecies of pupfish from Organ Pipe Cactus National Monument, Arizona. Copeia 1987(3):593-609.

Minckley, C. 2000. Trip to Cienega de Santa Clara, 19-22 June 2000. Memo to Stewart Jacks PL-AZFRO, Charlie Sanchez, ARD International Affairs; FWS, Arizona Fishery Resource Offices – Parker, Parker, AZ. 2pp.

Minckley, W. L. 1980. *Cyprinodon macularius* Baird and Girard. Desert pupfish. Page 497 *in* Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAlister, and J. R. Stauffer, Jr., eds., Atlas of North American Freshwater Fishes. North Carolina Museum of Nat. Hist., Raleigh.

___, R. R. Miller, and S. M. Norris. 2002. Three new pupfish species, *Cyprinodon* (Teleostei, Cyprinodontidae), from Chihuahua, Mexico, and Arizona, USA. Copeia 2002(3):687-705.

Osborne, L.L. and D.A. Kovacic. 1993. Riparian vegetated buffer strips in water quality restoration and stream management. Freshwater Biology 29:243-258.

Roberts, B.C., and R.G. White. 1992. Effects of angler wading on survival of trout eggs and pre-emergent fry. N. American J. Fish. Manage. 12:450-459.

Turner, B. J. 1983. Genic variation and differentiation of remnant natural populations of the desert pupfish, *Cyprinodon macularius*. Evolution 37:690-700.

___. 2000. Draft recovery plan for the California red-legged frog (*Rana aurora draytonii*). Region 1, US Fish and Wildlife Service, Portland, Oregon.

Voeltz, J. B., and R. H. Bettaso. 2003. 2003 Status of the Gila topminnow and desert pupfish in Arizona. Nongame and Endangered Wildlife Program Technical Report 226, Arizona Game and Fish Department, Phoenix. 124pp.

Weedman, D. A., and K. L. Young. 1997. Status of the Gila topminnow and desert pupfish in Arizona. Nongame and Endangered Wildlife Program Technical Report 118, Arizona Game and Fish Department, Phoenix. 141pp.

Gila chub

Baird, S. F. and C. Girard. 1854. Descriptions of new species of fishes collected from Texas, New Mexico, and Sonora by Mr. John H. Clark, on the U.S. and Mexican Boundary Survey. Proceedings Academy National Sciences Philadelphia 7: 24–29.

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

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

Brown, D. K., A. A. Echelle, D. L. Propst, J. E. Brooks, and W. L. Fisher. 2001. Catastrophic wildfire and number of populations as factors influencing risk of extinction for Gila trout (*Oncorhynchus gilae*). Western North American Naturalist 61:139–148.

Bureau of Land Management (BLM). 1998. Muleshoe Ecosystem Management Plan and Environmental Assessment. Tucson, Arizona.

Burns, D. C. 1991. Cumulative effect of small modifications to habitat. Fisheries 16:12–17.

Carman, S. M. 2006. Colorado River Basin chubs, roundtail chub (*Gila robusta*), Gila chub (*Gila intermedia*), headwater chub (*Gila nigra*), Recovery Plan. New Mexico Department of Game and Fish, Santa Fe, New Mexico.

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

Christensen, N. S., A. W. Wood, N. Voisin, D. P. Lettenmaier, and R. N. Palmer. 2004. The effects of climate change on the hydrology and water resources of the Colorado River Basin**.** Climatic Change 62:337–363.

Christensen, N. S., and D. P. Lettenmaier. 2006. A multimodel ensemble approach to assessment of climate change impacts on the hydrology and water resources of the Colorado River Basin. Hydrology and Earth System Sciences Discussion 3:1417–1434.

Clarkson, R. W., P. C. Marsh, S. E. Stefferud, and J. A. Stefferud. 2005. Conflicts between native fish and non-native sport fish management in the southwestern United States. Fisheries 30:20–27.

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

Cushing, C. E., Jr., and P. A. Olson. 1963. Effects of weed burning on stream conditions. Transactions of the American Fisheries Society 92:303–305.

DeMarais, B. D. 1986. Morphological variation in Gila (Pisces, Cyprinidae) and geologic history: Lower Colorado River Basin. M.S. thesis. Arizona State University, Tempe, Arizona.

Desert Fishes Team. 2003. Status of federal and state listed warm water fishes of the Gila River basin, with recommendations for management. Report Number 1.

Dowling, T. E., P. C. Marsh, C. D. Anderson, M. S. Rosenberg, and A. T. Kelsen. 2008. Population structure in the roundtail chub (*Gila robusta* complex) of the Gila River basin as determined by microsatellites. Draft Final Report to Arizona Game and Fish Department, Contract AGR 4/21/04. Arizona State University, School of Life Sciences, Tempe, Arizona.

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

Dudley, R. K. 1995. The effects of green sunfish on the distribution, abundance and habitat use of Gila chub in Sabino Creek, Tucson, Arizona. M.S. thesis. The University of Arizona, Tucson, Arizona.

Dudley, R. K., and W. J. Matter. 2000. Effects of small green sunfish (*Lepomis cyanella*) on recruitment of Gila chub (*Gila intermedia*) in Sabino Creek, Arizona. Southwestern Naturalist 45:24–29.

Earl, S. R., and D. W. Blinn. 2003. Effects of wildfire ash on water chemistry and biota in south-western U.S.A. streams. Freshwater Biology 48:1015–1030.

Ehret, S., and B. Dickens. 2009. Romero Canyon Survey Trip Report, June 1-2, 2009. Arizona Game and Fish Department, Region V Fisheries Program, Phoenix, Arizona.

Enquist, C. A. F., E. H. Girvetz, and D. F. Gori. 2008. A climate change vulnerability assessment for biodiversity in New Mexico, Part II: Conservation implications of emerging moisture stress due to recent climate changes in New Mexico. The Nature Conservancy. http://www.wcs.org/about-us/grants-and-opportunities/~/media/Files/pdfs/CC_report2_final.ashx. Accessed October 30, 2011.

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

Fausch, K. D., Y. Taniguchi, S. Nakano, G. D. Grossman, and C. R. Townsend. 2001. Flood disturbance regimes influence rainbow trout invasion success among five Holarctic regions. Ecological Applications 11:1438–1455.

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

Fulé, P. 2010. Interactions of climate change, fire regimes, and hydrologic regimes. Presented at the Arizona Climate Change Adaptation Workshop for Natural Resource Managers of the Four Forest Restoration Initiative Area. April 7-8, 2010. Flagstaff, Arizona.

Ganey, J. L. and S. C. Vojta. 2010. Tree Mortality in Drought-stressed Mixed-conifer and Ponderosa Pine Forests, Arizona. Unpublished abstract Presented at the Arizona Climate Change Adaptation Workshop for Natural Resource Managers of the Four Forest Restoration Initiative Area. April 7-8, 2010. Flagstaff, Arizona.

Gard, R. 1963. Insulation of a Sierra stream by snow cover. Ecology 44:194–197.

Girard, C. F. 1856. Researches upon the cyprinoid fishes inhabiting the fresh waters of the United States, west of the Mississippi Valley, from specimens in the museum of the Smithsonian Institution. Proceedings of the Academy of Natural Sciences of Philadelphia 8:165–213.

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

Griffith, J. S., and T. R. Tiersch. 1989. Ecology of fishes in Redfield Canyon, Arizona, with emphasis on *Gila robusta intermedia*. Southwestern Naturalist 34:131–134.

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

Hubbs, C. L. 1955. Hybridization between fish species in nature. Systematic Zoology 4:1–20.

Hurst, T. P. 2007. Causes and consequences of winter mortality in fishes. Journal of Fish Biology 71:315–345.

Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for Policymakers. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H. L. Miller, editor. Cambridge University Press, Cambridge, United Kingdom.

http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf. Accessed October 30, 2011.

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

Kundzewicz, Z. W., L. J. Mata, N. W. Arnell, P. Döll, P. Kabat, B. Jiménez, K.A. Miller, T. Oki, Z. Sen and I. A. Shiklomanov. 2007. Freshwater resources and their management. Pages 173–210 in M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, editors. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter3.pdf. Accessed October 30, 2011.

Lenart, M., G. Garfin, B. Colby, T. Swetnam, B. J. Morehouse, S. Doster and H. Hartmann. 2007. Global warming in the Southwest: Projections, observations, and impacts. Climate Assessment for the Southwest, University of Arizona. Tucson, Arizona. http://www.u.arizona.edu/~mlenart/gwsw/GWSouthwest.pdf. Accessed November 16, 2011.

Leopold, A .L. 1921. A plea for recognition of artificial works in forest erosion control policy. Journal of Forestry 19:267273.

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

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

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

Marsh and Associates, LLC. 2009. Trip Report: Eagle Creek, Arizona, 15-17 June 2009.

Marsh, P. C., Brooks, J. E., Hendrickson, D. A. and W. L. Minckley. 1991. Fishes of Eagle Creek, Arizona, with Records for threatened spikedace and loach minnow (Cyprinidae). Journal of Arizona-Nevada Academy of Science. 23(2): 107-116.

McCullough, D. A. 1999. A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with special reference to Chinook salmon. EPA 910-R-99-010. U.S. Environmental Protection Agency. Seattle, Washington. http://www.critfc.org/tech/EPAreport.pdf. October 30, 2011.

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

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

Meffe, G. K. 1985. Predation and species replacement in American southwestern fishes: A case study. Southwestern Naturalist 30:173–187.

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

Miller, R. R. 1946. *Gila cypha*, a remarkable new species of cyprinid fish from the lower Colorado River basin, Arizona. Journal Washington Academy Science 36:206–212.

Miller, R. R. 1950. Notes on the cutthroat and rainbow bouts with the description of a new species from the Gila River, New Mexico. Occasional Papers of the Museum of Zoology, University of Michigan 529:1–43.

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

Miller, R .R., and C. H. Lowe. 1967. Fishes of Arizona, Part 2. Pages 133–151 in C. H. Lowe, editor. The vertebrates of Arizona. University of Arizona Press, Tucson, Arizona.

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

Minckley, W. L. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Region II west of the Continental Divide. Report to U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Department of Zoology, Arizona State University, Tempe, Arizona.

Minckley, W. L. 1991. Native fishes of arid lands: A dwindling resource of the desert southwest. General Technical Report RM-GTR-206. U.S. Forest Service. Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

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

Minckley, W. L., and J. E. Deacon, editors. 1991. Battle against extinction: Native fish management in the American West. The University of Arizona Press, Tucson, Arizona.

Minckley, W. L., and B. D. DeMarais. 2000. Taxonomy of chubs (Teleostei, Cyprinidae, Genus *Gila*) in the American Southwest with comments on conservation. Copeia 2000:251–256.

Minckley, W. L., and P. C. March. 2009. Inland fishes of the greater Southwest, Chronicle of a vanishing biota. The University of Arizona Press. Tucson, Arizona.

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

Montgomery, D. R., E. M. Beamer, G. R. Pess, and T. P. Quinn. 1999. Channel type and salmonid spawning distribution and abundance. Canadian Journal of Fisheries and Aquatic Science 56:377–387

Moyle, P. B., H. W. Li, and B. A. Barton. 1986. The Frankenstein effect: impact of introduced fishes on native fishes in North America. Pages 416–426 in R. H. Stroud, editor. Fish culture in fisheries management. American Fisheries Society, Bethesda, Maryland.

Nash, L. L., and P. H. Gleick. 1993. The Colorado River Basin and climatic change. EPA 230-R-93-009. U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Climate Change Division. Oakland, California. http://wwa.colorado.edu/colorado_river/docs/Nash_Gleick_EPA-1993.pdf. Accessed October 30, 2011

Nelson B. 1993. Spawning characteristics of Gila chub (*Gila intermedia*) in Cienega Creek, Pima County, Arizona. Report for Bureau of Land Management, Tucson Resource Area, Tucson, Arizona.

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

New Mexico Office of the State Engineer (State of New Mexico). 2005. Potential Effects of Climate Change on New Mexico. Agency Technical Workgroup. Santa Fe, New Mexico. http://www.nmenv.state.nm.us/aqb/cc/Potential_Effects_Climate_Change_NM.pdf. Accessed October 30, 2011.

New Mexico Office of the State Engineer (State of New Mexico). 2006. The impact of climate change on New Mexico's water supply and ability to manage water resources. Santa Fe, New Mexico. http://www.ose.state.nm.us/ClimateChangeImpact/completeREPORTfinal.pdf. Accessed October 30, 2011.

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

Parmesan, C., and H. Galbraith. 2004. Observed impacts of global climate change in the U.S. Pew Center on Global Climate Change. http://www.pewclimate.org/docUploads/final_ObsImpact.pdf. Accessed November 16, 2011.

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

Pearsons, T. N., H. W. Li, and G. A. Lamberti. 1992. Influence of habitat complexity on resistance to flooding and resilience of stream fish assemblages. Transactions of the American Fisheries Society 121:427–436.

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

Pollard, K. and M. Mather. 2010. 2010 Census counts nearly 309 Million Americans. http://www.prb.org/Articles/2010/2010-unitedstates-census.aspx?p=1, Accessed November 15, 2011.

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

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

Rahel F. J., B. Bierwagen, and Y. Taniguchi. 2008. Managing aquatic species of concern in the face of climate change and invasive species. Conservation Biology 22:551–561.

Rauscher, S. A., J. S. Pal, N. S. Diffenbaugh, and M. M. Benedetti. 2008. Future changes in snowmelt-driven runoff timing over the western US. Geophysical Research Letters 35L16703:1–5.

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

Rhodes, J. J. 2007. Watershed impacts of forest treatments to reduce fuels and modify fire behavior. Prepared for: Pacific Rivers Council. Eugene, Oregon.

Rich, J. L. 1911. Recent stream trenching in the semi-arid portion of southwestern New Mexico, a result of removal of vegetation cover. American Journal of Science 32:237–245.

Rinne, J. N. 1975. Changes in minnow populations in a small desert stream resulting from natural and artificially induced factors. Southwest Naturalist 20:185–195.

Rinne, J. N. 1976. Cyprinid fishes of the genus *Gila* from the lower Colorado River basin. Wasmann Journal Biology 34:65–107.

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

Rinne, J. N. 2004. Forests, fish and fire: Relationships and management implications for fishes in the southwestern USA. Pages 151–156 in G. J. Scrimgeour, G. Eisler, B. McCulloch, U. Silins and M. Monita, editors. Forest Land–Fish Conference II – Ecosystem Stewardship through Collaboration. Proceedings of the Forest-Land-Fish Conference II, April 26-28, 2004, Edmonton, Alberta.

Rinne, J. N., and W. L. Minckley. 1970. Native Arizona fishes: Part III - chubs. Wildlife Views 17:12–19.

_____. 1991. Native fishes of arid lands: A dwindling resource of the desert Southwest. General Technical Report RM-206. U.S. Forest Service, Rocky Mountain Forest and Range-Experiment Station, Fort Collins, Colorado.

Rixon, T. F. 1905. Forest conditions in the Gila River Forest Reserve, New Mexico. U.S. Geological Survey Professional Paper No. 39.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Inc. Pagosa Springs, Colorado.

Ruppert, J. B., R. T. Muth, and T. P. Nesler. 1993. Predation on fish larvae by adult red shiner, Yampa and Green Rivers, Colorado. Southwestern Naturalist 38:397–399.

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

Schrank, A. J., F. J. Rahel, and H. C. Johnstone. 2003. Evaluating laboratory-derived thermal criteria in the filed: An example involving Bonneville cutthroat trout. Transactions of the American Fisheries Society 132:100–109.

Schultz, A. A., and S. A. Bonar. 2007. Spawning and culture of Gila chub. Fisheries Research Report 02-07. Arizona Cooperative Fish and Wildlife Research Unit. Tucson, Arizona.

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

Seager, R., T. Mingfang, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, N. Harnik, A. Leetmaa, N. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. Science 316:1181–1184.

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

Spencer, C. N. and F. R. Hauer. 1991. Phosphorus and nitrogen dynamics in streams during a wildfire. Journal of the North American Benthological Society 10:24–30.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward earlier streamflow timing across Western North America. Journal of Climate 18:1136–1155.

Stout, G. G., E. C. Bloom, and J. K. Glass. 1970. The fishes of Cave Creek, Maricopa County, Arizona. Journal Arizona Academy Science 6:109–113.

Swanston, D. N. 1991. Natural processes. Pages 139-179 in W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, Maryland.

Swetnam, T. W. 1990. Fire history and climate in the southwestern United States. Pages 6–17 in J. S. Krammes, technical coordinator. Effects of the fire management on southwestern natural resources. General Technical Report RM-191. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Swetnam, T. W., and C. H. Baisan. 1996. Historical fire regime patterns in southwestern United States since A.D. 1700. Pages 11–32 in C. D. Allen, technical editor. Fire effects in southwestern forests: proceedings of the second La Mesa fire symposium. General Technical Report RM-GTR-286. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Swetnam, T. W., and J. H. Dieterich. 1985. Fire history of ponderosa pine forests in the Gila Wilderness, New Mexico. Pages 390-397 in J. E. Lotan, et al., technical coordinators. Proceedings: symposium and workshop on wilderness fire. General Technical Report INT 182. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

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

General Technical Report INT-320. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Trenberth, K. E., P. D. Jones, P. Ambenje, R. Bojariu, D. Easterling, A. Klein Tank, D. Parker, F. Rahimzadeh, J. A. Renwick, M. Rusticucci, B. Soden, and P. Zhai. 2007. Observations: surface and atmospheric climate change. Pages 235–335 in Climate Change 2007: The Physical Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller, editors. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html. Accessed January 21, 2011.

Udall, B. 2007. Recent research on the effects of climate change on the Colorado River. The Intermountain West Climate Summary. May 2007:1–6.

University of Nebraska-Lincoln. 2010. U.S. Drought Monitor. http://www.drought.unl.edu/. Accessed October 15, 2010.

U.S. Bureau of Reclamation and U.S. Bureau of Land Management. 2010. Biological assessment on the effects of rotenone application and related native fish management actions to federally-listed fishes in Bonita Creek, Graham County, Arizona. Bureau of Reclamation, Phoenix Area Office, Glendale, Arizona, and Bureau of Land Management, Safford Field Office, Safford, Arizona.

U.S. Census Bureau. 2005. Florida, California and Texas to Dominate Future Population Growth, Census Bureau Reports. Web page: http://www.census.gov/Press-Release/www/releases/archives/population/004704.html accessed 12 October 2005.

U.S. Climate Change Science Program (CCSP). 2008. Abrupt climate change. Synthesis and assessment report, Summary and Findings. U.S. Geological Survey, Reston, Virginia. http://www.climatescience.gov/Library/sap/sap3-4/final-report/. Accessed November 14, 2011.

U.S. Environmental Protection Agency. 2011. Arizona Water Facts. Webpage: http://epa.gov/watersense/water_efficiency/arizona.html#climate accessed 15 November 2011.

U.S. Fish and Wildlife Service (FWS). 2002. Endangered and threatened wildlife and plants; proposal to determine endangered status of the Gila chub. Federal Register 67:51,948–51,985.

_____. 2005a. Endangered and threatened wildlife and plants; Final rule listing the Gila chub as endangered with critical habitat. Federal Register70:66,664–66,721.

_____. 2006. Endangered and threatened wildlife and plants; 12-month finding on a petition to list a Distinct Population Segment of the roundtail chub in the lower Colorado River basin and to list the headwater chub as endangered or threatened with critical habitat. Federal Register 71:26,007–26,017.

_____. 2009. Endangered and threatened wildlife and plants; 12-Month finding on a petition to list a Distinct Population Segment of the roundtail chub (*Gila robusta*) in the Lower Colorado River Basin. Federal Register 74:32,352–32,387.

U.S. Forest Service (Forest Service). 2011a. Email from Jerry Monzingo confirming species composition in Turkey Creek during survey in 2010. Silver City, New Mexico.

Unmack, P., G. W. Knowles, and M. Baltzly. 2003. Green sunfish impacts on Gila chub, a natural experiment thanks to a waterfall. Abstract. November 20-23, 2003. Desert Fishes Council Meeting, Furnace Creek, Death Valley National Park, California.

Varela-Romero, A., J. Campoy-Favela, and L. Juarez-Romero. 1992. Fishes of the rios Mayo and Fuerte basins, Sonora and Sinaloa, Mexico. Proceedings Desert Fishes Council 22 (1990): 70-71.

Weedman, D., A. L. Girmendonk, and K. Young. 1996. Status review of Gila chub, *Gila intermedia*, in the United States and Mexico. Technical Report 91, Nongame and Endangered Wildlife Program, Arizona Game and Fish Department. Phoenix, Arizona.

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

Williams, J. E., and D. W. Sada. 1985. America's desert fishes: increasing their protection under the Endangered Species Act. Endangered Species Bulletin 10:8–14.

Gila topminnow

Arizona Department of Transportation (ADOT). 2000. Safe Harbor Agreement for the Gila topminnow (*poeciliopsis occidentalis occidentalis*) and desert pupfish (*Cyprinodon macularius*) on state lands managed by the Arizona Department of Transportation (ADOT). Arizona Department of Transportation, Natural Resource Section, Phoenix, Arizona.

Bisson, P.A., T.P. Quinn, G.H. Reeves, and S.V. Gregory. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest river systems. Pp. 1-542. *In*: Watershed management; balancing sustainability and environmental change. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Brooks, J. E. 1986. Status of natural and introduced Sonoran topminnow (*Poeciliopsis o. occidentalis*) populations in Arizona through 1985. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 19+pp.

Carlson, C. A., and R. Muth. 1989. The Colorado River: Lifeline of the American southwest. Pages 220-239 *in* D. P. Dodge, ed., Proc. of the International Large River Symposium. Canadian Special Publication of Fisheries and Aquatic Sciences 106.

Constanz, G. D. 1980. Energetics of viviparity in the Gila topminnow (Pisces: Poeciliidae). Copeia 1980:676-678.

_____. 1981. Life history patterns of desert fishes. Paes 237-290 in R.J. Naiman and D.L. Soltz (editors), Fishes in North American Deserts. John Wiley & Sons, Incorporated, New York.

Deacon, J. E., and W. L. Minckley. 1974. Desert fishes. Pages 385-488 *in* G. W. Brown, Jr., ed., Desert Biology, Vol.2. Academic Press, New York.

Ellison, L. 1960. Influence of grazing on plant succession of rangelands. Botanical Review 26(1):1-77.

Erman, D.C., J.D. Newbold, and K.B. Roby. 1977. Evaluation of streamside bufferstrips for protecting aquatic organisms. California Water Resources Center, Univ. of California, Davis, CA. 48 pp.

Fernandez, P. J., and P. C. Rosen. 1996. Effects of the introduced crayfish *Orconectes virilis* on native aquatic herpetofauna in Arizona. Rept. to Heritage Prog., Ariz. Game and Fish Dept., Phoenix. IIPAM Proj. No. I94054. 57+pp.

Fleischner, T.L. 1994. Ecological costs of livestock grazing in western North America. Conservation Biology 8(3):629-644.

Forrest, R. E. 1992. Habitat use and preference of Gila topminnow. MS. Thesis, University of Arizona, Tucson. 84pp.

Gerking, S.D., and D.V.J. Plantz. 1980. Size-based predation by the Gila topminnow, *Poeciliopsis occidentalis* (Baird and Girard). Hydrobiologia 72: 179-191.

Gifford, G.F., and R.H. Hawkins. 1978. Hydrologic impact of grazing on infiltration: a critical review. Water Resources Research. 14:305-313.

Rosen, P.C., and C.R. Schwalbe. 1996. Bullfrog impacts on sensitive wetland herpetofauna and herpetology of San Bernadino National Wildlife Refuge. Final report to Arizona Game and Fish Department Hertiage Program IIPAM Grant #I92036, Phoenix.

Harper, K.T. and J.R. Marble. 1988. A role for nonvascular plants in management of arid and semiarid rangelands. Pp. 137-169. *In*: Vegetation science applications for rangeland analysis and management. Tueller, P.T., Ed. Kluwer Academic Publishers, Boston, MA.

Heath, W.G. 1962. Maximum temperature tolerance as a function of constant temperature acclimation of the Gila topminnow, *Poecililiopsis occidentalis*. Ph.D. Disseration, University of Arizona, Tucson.

Hendrickson, D.A. and W.L. Minckley. 1985. Cienegas – vanishing climax communities of the American southwest. Desert Plants 6(1984): 131-175.

Johnson, J. E., and C. Hubbs. 1989. Status and conservation of poeciliid fishes. Pages 301-331 *in* G. K. Meffe, and F. F. Snelson, eds., Ecology and Evolution of Livebearing Fishes (Poeciliidae). Prentice Hall, Englewood Cliffs, New Jersey. 453pp.

Johnson, K.L. 1992. Management for water quality on rangelands through best management practices: the Idaho approach. Pp. 415-441. *In*: Watershed management; balancing sustainability and environmental change. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Klemmedson, J.D. 1956. Interrelationships of vegetation, soils, and range conditions induced by grazing. Journal of Range Management 9:134-138.

Mahoney, D.L. and D.C. Erman. 1984. The role of streamside bufferstrips in the ecology of aquatic biota. California Riparian Systems Conference, Sept. 17-19, 1984.

Marlow, C.B. and T.M. Pogacnik. 1985. Time of grazing and cattle-induced damage to streambank. Pp. 279-284. *In*: Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference. April 16-18, 1985, Tucson, AZ.

Marrs, R.H., A. Rizand, and A.F. Harrison. 1989. The effects of removing sheep grazing on soil chemistry, above-ground nutrient distribution, and selected aspects of soil fertility in long-term experiments at Moor House National Nature Preserve. Journal of Applied Ecology 26:647-661.

Marsh, P. C., and W. L. Minckley. 1990. Management of endangered Sonoran topminnow at Bylas Springs, Arizona: description, critique, and recommendations. Great Basin Naturalist 50(3):265-272.

Martin, S.C. 1975. Ecology and management of southwestern semidesert grass-shrub ranges. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station, Research Paper RM-156, Ft. Collins, CO. 39 pp.

McClaran, M.P. and M.E. Anable. 1992. Spread of introduced Lehman lovegrass along a grazing intensity gradient. Journal of Applied Ecology 29:92-98.

Meehan, W.R. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19, Bethesda, Maryland. 751 pp.

Megahan, W.F., J.P. Potyondy, and K.A. Seyedbagheri. 1992. Best management practices and cumulative effects from sedimentation in the South Fork Salmon River: an Idaho case study. Pp. 401-414. *In*: Watershed Management. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Meffe, G. K. 1983. Attempted chemical renovation of an Arizona springbrook for management of the endangered Sonoran topminnow. North American J. Fisheries Management 3:315-321.

_____. 1985. Predation and species replacement in American Southwestern stream fishes: A case study. Southwest Nat. 30:173-187.

_____, D. A. Hendrickson, W. L. Minckley, and J. N. Rinne. 1983. Factors resulting in decline of the endangered Sonoran topminnow *Poeciliopsis occidentalis* (Atheriniformes: Poeciliidae) in the United States. Biological Conserv. 25:135-159.

Menke, J.W. 1988. Report on range status and expected responses to absence of domestic livestock grazing in the Coso Geothermal area. Department of Agronomy & Range Science, University of California, Davis. June 16, 1988.

Minckley, W. L. 1969. Native Arizona fishes, part I— livebearers. Arizona Wildlife Views 16:6-8.

_____. 1973. Fishes of Arizona. Ariz. Fish and Game Dept. Sims Printing Company, Inc., Phoenix. 293pp.

_____. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Region II west of the Continental Divide. Rept. to U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Dept. of Zoology, Ariz. State Univ., Tempe. 158pp.

_____, J. N. Rinne, and J. E. Johnson. 1977. Status of the Gila topminnow and its co-occurrence with mosquitofish. USDA Forest Service, Research Paper RM-198, Rocky Mtn. For. & Range Exp. Stn., Ft. Collins, Colorado. 8pp.

Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11:72-82.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4):693-727.

Orodho, A.B., M.J. Trlica, and C.D. Bonham. 1990. Long-term heavy grazing effects on soil and vegetation in the four corners region. The Southwestern Naturalist 35(1):9-15.

Osborne, L.L. and D.A. Kovacic. 1993. Riparian vegetated buffer strips in water-quality restoration and stream management. Freshwater Biology 29:243-258.

Patte, O.H., Fellows,V.L. and Bounds, D.L. 2003. Animal Species Endangerment: The Role of Environmental Pollution. Handbook of Ecotoxicology, Second Edition edited by David J. Hoffman, Barnett A. Rattner, G. Allen Burton, Jr. and John Cairns, Jr.

Platts, W.S. 1990. Managing fisheries and wildlife on rangelands grazed by livestock. Nevada Department of Wildlife, Reno, NV. 462 pp.

Popolizio, C.A., H. Goetz, and P.L. Chapman. 1994. Short-term response of riparian vegetation to four grazing treatments. Journal of Range Management 47(1):48-53.

Rand, G.M., Wells, P.G., and McCarty, L.S. 1995. Fundamentals of Aquatic Toxicology: Effects, Environmental Fate, and Risk Assessment, Second Edition edited by Gary M. Rand, Ph.D.

Schlesinger, W.H., J.F. Reynolds, G.L. Cunningham, L.F. Huenneke, W.M. Jarrell, R.A. Virginia, and W.G. Whitford. 1990. Biological feedbacks in global desertification. Science 246:1043-1048.

Schoenherr, A. A. 1974. Life history of the topminnow *Poeciliopsis occidentalis* (Baird and Girard) in Arizona and an analysis of its interaction with the mosquitofish *Gambusia affinis* (Baird and Girard). Ph.D. Diss., Ariz. State Univ., Tempe.

Schultz, T.T. and W.C. Leininger. 1990. Differences in riparian vegetation structure between grazed areas and exclosures. Journal of Range Management 43(4):295-299.

Simmons, L.H., D.A. Hendrickson, and D. Papoulias. 1989. Recovery of the Gila topminnow: a success story? Conservation Biology 3(1): 11-15.

Stefferud, J. A., and S. E. Stefferud. 1994. Status of Gila topminnow and results of monitoring of the fish community in Redrock Canyon, Coronado National Forest, Santa Cruz County, Arizona, 1979-1993. Pages 361-369 *in* L. F. DeBano, P. F. Ffolliott, A. Ortega-Rubio, G. J. Gottfried, R. H. Hamre, and C. B. Edminster, tech. coords., Biodiversity and Management of the Madrean Archipelago: The Sky Islands of Southwestern United States and Mexico. USDA Forest Service, Gen. Tech. Rept. RM-GTR-264, Rocky Mtn. For. & Range Exp. Stn., Ft. Collins, Colorado. 669pp.

U.S. Fish and Wildlife Service. 1967. Native Fish and Wildlife. Endangered Species. Federal Register 32(48):4001.

_____. 1984. Sonoran topminnow recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 56pp.

Vallentine, J.F. 1990. Grazing management. Academic Press, Inc., San Diego, CA. 533 pp.

Waters, T.F. 1995. Sediment in streams. Sources, biological effects, and control. American Fisheries Society, Monograph 7, Bethesda, MD. 251 pp.

Webb, R.H., and S.S. Stielstra. 1979. Sheep grazing effects on Mohave Desert vegetation and soils. Environmental Management 3:517-529.

Weedman, D. A, and K. L. Young. 1997. Status of the Gila topminnow and desert pupfish in Arizona. Ariz. Game and Fish Dept., Nongame and Endangered Wildl. Prog. Tech. Rept. 118, Phoenix. 141

Weltz, M. and M.K. Wood. 1994. Short-duration grazing in central New Mexico: effects on sediment production. Journal of Soil and Water Conservation 41:262-266.

Williams, K.E., J.E. Johnson, D.A. Hendrickson, S. Contreras-Balderas, J.D. Williams, M. Navvaro-Mendoza, D.E. McAllister, and J.E. Deacon. 1989. Fished of North American endangered, threatened, or of special concern. Fisheries 14(6):2-20.

Wood, D.J., S.G. Fisher, and N.B. Grimm. 1990. Pools in desert streams: limnology and response to disturbance. Journal of the Arizona-Nevada Academy of Science 26(2):171-182.

Gila trout

Arizona Game and Fish Department (AZGFD). 2011. Correspondence regarding the 5-year review for Gila trout in Arizona. Arizona Game and Fish Department, Phoenix, Arizona.

Beamis, R. J., and R. R. Miller. 1977. Cytotaxonomic study of the Gila trout, Salmo gilae. Colorado Cooperative Fishery Unit, Colorado State University, Fort Collins, Colorado.

Behnke, R. J., and M. Zarn. 1976. Biology and management of threatened and endangered western trouts. General Technical Report GT-TM-28. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. American Fisheries Society, Bethesda, Maryland.

Behnke, R. J. 2002. Trout and salmon of North America. The Free Press. New York.

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

Bjornn, T. C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 in W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, Maryland.

Blue Earth Ecological Consultants. 2002. Environmental Assessment for the Gila Trout Restoration in the Upper West Fork Gila River, Catron, County, New Mexico. U.S. Forest Service, Gila National Forest, Wilderness Ranger District, New Mexico.

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

Brown, D. K., A. A. Echelle, D. L. Propst, J. E. Brooks, and W. L. Fisher. 2001. Catastrophic wildfire and number of populations as factors influencing risk of extinction for Gila trout (*Oncorhynchus gilae*). Western North American Naturalist 61:139–148.

Burns, D. C. 1991. Cumulative effect of small modifications to habitat. Fisheries 16:12–17.

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

Christensen, N. S., A. W. Wood, N. Voisin, D. P. Lettenmaier, and R. N. Palmer. 2004. The effects of climate change on the hydrology and water resources of the Colorado River Basin**.** Climatic Change 62:337–363.

Christensen, N. S., and D. P. Lettenmaier. 2006. A multimodel ensemble approach to assessment of climate change impacts on the hydrology and water resources of the Colorado River Basin. Hydrology and Earth System Sciences Discussion 3:1417–1434.

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

Cushing, C. E., Jr., and P. A. Olson. 1963. Effects of weed burning on stream conditions. Transactions of the American Fisheries Society 92:303–305.

David, R. E. 1976. Taxonomic analysis of Gila and Gila x rainbow trout in southwestern New Mexico. Unpublished M.S. Thesis, New Mexico State University, Las Cruces, New Mexico.

Dowling, T. E., and M. R. Childs. 1992. Impact of hybridization on a threatened trout of the southwestern United States. Conservation Biology 6:355–364.

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

Enquist, C. A. F., E. H. Girvetz, and D. F. Gori. 2008. A climate change vulnerability assessment for biodiversity in New Mexico, Part II: Conservation implications of emerging moisture stress due to recent climate changes in New Mexico. The Nature Conservancy. http://www.wcs.org/about-us/grants-and-opportunities/~/media/Files/pdfs/CC_report2_final.ashx. Accessed October 30, 2011.

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

Fausch, K. D., Y. Taniguchi, S. Nakano, G. D. Grossman, and C. R. Townsend. 2001. Flood disturbance regimes influence rainbow trout invasion success among five Holarctic regions. Ecological Applications 11:1438–1455.

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

Gard, R. 1963. Insulation of a Sierra stream by snow cover. Ecology 44:194–197.

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

Hanson, J. N. 1971. Investigations on Gila trout, *Salmo gilae* Miller, in southwestern New Mexico. M.S. Thesis. New Mexico State University, Las Cruces, New Mexico.

Harig, A. L., and K. D. Fausch. 2002. Minimum habitat requirements for establishing translocated cutthroat trout populations. Ecological Applications 12:535–551.

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

Hurst, T. P. 2007. Causes and consequences of winter mortality in fishes. Journal of Fish Biology 71:315–345.

Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for Policymakers. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H. L. Miller, editor. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf. Accessed November 16, 2011.

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

Kennedy, T. L., D. S. Gutzler, and R. L. Leung. 2009. Predicting future threats to the long-term survival of Gila trout using a high-resolution simulation of climate change. Climatic Change 94:503–515.

Kundzewicz, Z. W., L. J. Mata, N. W. Arnell, P. Döll, P. Kabat, B. Jiménez, K.A. Miller, T. Oki, Z. Sen and I. A. Shiklomanov. 2007. Freshwater resources and their management.

Pages 173–210 in M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, editors. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter3.pdf. Accessed November 16, 2011.

Leary, R. F., and F. W. Allendorf. 1998. Genetic issues in the conservation and restoration of the endangered Gila trout. Wild Trout and Salmon Genetics Laboratory Report 98/1. Division of Biological Sciences, University of Montana, Missoula, Montana.

Lee, R. M., and J. N. Rinne. 1980. Critical thermal maxima of five trout species in the southwestern United States. Transactions of the American Fisheries Society 109:632–635.

Lenart, M., G. Garfin, B. Colby, T. Swetnam, B. J. Morehouse, S. Doster and H. Hartmann. 2007. Global warming in the Southwest: Projections, observations, and impacts. Climate Assessment for the Southwest, University of Arizona. Tucson, Arizona. http://www.u.arizona.edu/~mlenart/gwsw/GWSouthwest.pdf. Accessed November 16, 2011.

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

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

Loudenslager, E. J., J. N. Rinne, G. A. E. Gall, and R. E. David. 1986. Biochemical genetic studies of native Arizona and New Mexico trout. Southwestern Naturalist 31:221–234.

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

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

McCullough, D. A. 1999. A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with special reference to Chinook salmon. EPA 910-R-99-010. U.S. Environmental Protection Agency. Seattle, Washington. http://www.critfc.org/tech/EPAreport.pdf. Accessed January 21, 2011.

McHenry, M. L. 1986. A test of the habitat quality index in forested headwater streams of the Gila National Forest, New Mexico. M.S. Thesis, New Mexico State University, Las Cruces, New Mexico.

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

Medina, A. L., and S. C. Martin. 1988. Stream channel and vegetation changes in sections of McKnight Creek, New Mexico. Great Basin Naturalist 48:373–381.

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

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

Mello, R., and P. R. Turner. 1980. Population status and distribution of Gila trout in New Mexico. Endangered Species Report No. 6, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Miller, R. R. 1950. Notes on the cutthroat and rainbow bouts with the description of a new species from the Gila River, New Mexico. Occasional Papers of the Museum of Zoology, University of Michigan 529:1–43.

Minshall, G. W. 1984. Aquatic insect-substratum relationships. Pages 358–400 in V. H. Resh and D. M. Rosenberg, editors. The Ecology of Aquatic Insects. Praeger Publishers, New York.

Minshall, G. W., C. T. Robinson, and D. E. Lawrence. 1997. Postfire responses of lotic ecosystems in Yellowstone National Park. U.S.A. Canadian Journal of Fisheries and Aquatic Sciences 54:2509–2525.

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

Montgomery, D. R., E. M. Beamer, G. R. Pess, and T. P. Quinn. 1999. Channel type and salmonid spawning distribution and abundance. Canadian Journal of Fisheries and Aquatic Science 56:377–387

Nankervis, J. M. 1988. Age, growth and reproduction of Gila trout in a small headwater stream in the Gila National Forest. M.S. Thesis, New Mexico State University, Las Cruces, New Mexico.

Nash, L. L., and P. H. Gleick. 1993. The Colorado River Basin and climatic change. EPA 230-R-93-009. U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Climate Change Division. Oakland, California. http://wwa.colorado.edu/colorado_river/docs/Nash_Gleick_EPA-1993.pdf. Accessed November 16, 2011

National Research Council (NRC). 2007. Colorado River Basin water management: evaluating and adjusting to hydroclimatic variability. Committee on the scientific bases of Colorado River Basin water management water science and technology board. National Academic Press. Washington D.C. http://www.nap.edu/catalog.php?record_id=11857. Accessed November 16, 2011.

Needham, P. R., and A. C. Jones. 1959. Flow, temperature, solar radiation, and ice in relation to activities of fishes in Sagehen Creek, California. Ecology 40:465–474.

New Mexico Office of the State Engineer (State of New Mexico). 2005. Potential Effects of Climate Change on New Mexico. Agency Technical Workgroup. Santa Fe, New Mexico. http://www.nmenv.state.nm.us/aqb/cc/Potential_Effects_Climate_Change_NM.pdf. Accessed November 16, 2011.

New Mexico Office of the State Engineer (State of New Mexico). 2006. The impact of climate change on New Mexico's water supply and ability to manage water resources. Santa Fe, New Mexico. http://www.ose.state.nm.us/ClimateChangeImpact/completeREPORTfinal.pdf. Accessed November 16, 2011.

Nielsen, J. L., M. C. Fountain, J. Campoy Favela, K. Cobble, and B. L. Jensen. 1998. *Oncorhynchus* at the southern extent of their range: a study of mtDNA control-region sequence with special reference to an undescribed subspecies of *O. mykiss* from Mexico. Environmental Biology of Fishes 51:7–23.

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

Parmesan, C., and H. Galbraith. 2004. Observed impacts of global climate change in the U.S. Pew Center on Global Climate Change. http://www.pewclimate.org/docUploads/final_ObsImpact.pdf. Accessed November 16, 2011.

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

Paroz, Y. M., and D. L. Propst. 2008. Conservation and Management of Gila trout. 1 July 2007- 30 June 2008. Annual Report to U.S. Fish and Wildlife Service, Albuquerque, New Mexico. New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Pearsons, T. N., H. W. Li, and G. A. Lamberti. 1992. Influence of habitat complexity on resistance to flooding and resilience of stream fish assemblages. Transactions of the American Fisheries Society 121:427–436.

Pittenger, J. S. 1986. Invertebrate drift before and after trout removal from a southwestern stream. M.S. Thesis. Montana State University, Bozeman, Montana.

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

Platts, W. S., and M. L. McHenry. 1988. Density and biomass of trout and char in western streams. General Technical Report INT-241. U.S. Forest Service, Rocky Mountain Forest and Range-Experiment Station, Fort Collins, Colorado.

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

Propst, D. L. 1994. The status of Gila trout. New Mexico Wildlife, November/December 1994:23–28.

Propst, D. L., and J. A. Stefferud. 1997. Population dynamics of Gila trout in the Gila River drainage of the south-western United States. Journal of Fish Biology 51:1137–1154.

Rauscher, S. A., J. S. Pal, N. S. Diffenbaugh, and M. M. Benedetti. 2008. Future changes in snowmelt-driven runoff timing over the western US. Geophysical Research Letters 35(L16703.):1–5.

Regan, D. M. 1966. Ecology of Gila trout in Main Diamond Creek in New Mexico. U.S. Department of the Interior, Fish and Wildlife Service, Technical Papers of the Bureau of Sport Fisheries and Wildlife No. 5., Washington, D.C.

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

Rich, J. L. 1911. Recent stream trenching in the semi-arid portion of southwestern New Mexico, a result of removal of vegetation cover. American Journal of Science 32:237–245.

Ricklefs, R. E. 1990. Ecology. 3rd edition. W. H. Freeman and Company, New York, New York.

Riddle, B. R., D. L. Propst, and T. L. Yates. 1998. Mitochondrial DNA variation in Gila trout, *Oncorhynchus gilae*: implications for management of an endangered species. Copeia 1998:31–39.

Rinne, J. N. 1978. Development of methods of population estimation and habitat evaluation for management of the Arizona and Gila trouts. Pages 113-125 in J. R. Moring, editor.

Proceedings of the wild trout-catchable trout symposium, Oregon Department of Fish and Wildlife, Corvallis, Oregon.

Rinne, J. N. 1980. Spawning habitat and behavior of Gila trout, a rare salmonid of the southwestern United States. Transactions of the American Fisheries Society 109:83–91.

Rinne, J. N. 1981. Stream habitat improvement and native southwestern trouts. Research Note RM-409. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Rinne, J. N. 1982. Movement, home range, and growth of a rare southwestern trout in improved and unimproved habitats. North American Journal of Fisheries Management 2:150–157.

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

Rixon, T. F. 1905. Forest conditions in the Gila River Forest Reserve, New Mexico. U.S. Geological Survey Professional Paper No. 39. Washington D.C.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Inc. Pagosa Springs, Colorado.

Roy, A. H., A. D. Rosemond, D. S. Leigh, M. J. Paul, and J. B. Wallace. 2003. Habitat-specific responses of stream insects to land cover disturbance: biological consequences and monitoring implications. Journal of the North American Benthological Society 22:292–307.

Savage, M., and T. W. Swetnam. 1990. Early and persistent fire decline in a Navajo ponderosa pine forest. Ecology 70:2374–378.

Schrank, A. J., F. J. Rahel, and H. C. Johnstone. 2003. Evaluating laboratory-derived thermal criteria in the filed: An example involving Bonneville cutthroat trout. Transactions of the American Fisheries Society 132:100–109.

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

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H-P. Huang, N. Harnik, A. Leetmaa, N-C. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in SW North America. Science 316:1181–1184.

Shuter, B. J., and J. D. Meisner. 1992. Tools for assessing the impact of climate change on freshwater fish populations. GeoJournal 28:7–20.

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

Spencer, C. N., and F. R. Hauer. 1991. Phosphorus and nitrogen dynamics in streams during a wildfire. Journal of the North American Benthological Society 10:24–30.

Stefferud, J. A. 1994. Use of habitat typing to estimate potential for re-establishment of Gila trout in White Creek, New Mexico. Pages 14–22 in G. K. Cheng, J. L. Kershner, and D. Fuller, editors. Application of basin-wide fish population and habitat surveys. Utah State University, Logan, Utah.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward earlier streamflow timing across Western North America. Journal of Climate 18:1136–1155.

Swanston, D. N. 1991. Natural processes. Pages 139-179 in W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, Maryland.

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

Swetnam, T. W., and C. H. Baisan. 1996. Historical fire regime patterns in southwestern United States since A.D. 1700. Pages 11–32 in C. D. Allen, technical editor. Fire effects in southwestern forests: proceedings of the second La Mesa fire symposium. General Technical Report RM-GTR-286. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Swetnam, T. W., and J. H. Dieterich. 1985. Fire history of ponderosa pine forests in the Gila Wilderness, New Mexico. Pages 390-397 in J. E. Lotan, et al., technical coordinators. Proceedings: symposium and workshop on wilderness fire. General Technical Report INT 182. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

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

Trenberth, K. E., P. D. Jones, P. Ambenje, R. Bojariu, D. Easterling, A. Klein Tank, D. Parker, F. Rahimzadeh, J. A. Renwick, M. Rusticucci, B. Soden, and P. Zhai. 2007. Observations: surface and atmospheric climate change. Pages 235–335 in Climate Change 2007: The Physical Basis. Contribution of Working Group I to the Fourth

Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller, editors. Cambridge University Press, Cambridge, United Kingdom. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html. Accessed November 16, 2011.

Turner, P. R., and M. L. McHenry. 1985. Population ecology of the Gila trout with special emphasis on sport fishing potential. Final report to New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Turner, P. R. 1986. Restoration of the endangered Gila trout. Proceedings of the Annual Conference of the Western Association of Fish and Wildlife Agencies 66:122–133.

Turner, P. R. 1989. Annual and seasonal changes in populations of Gila trout in headwater streams. Final report to the New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Udall, B. 2007. Recent research on the effects of climate change on the Colorado River. The Intermountain West Climate Summary. May 2007:1–6.

University of Nebraska-Lincoln. 2010. U.S. Drought Monitor. http://www.drought.unl.edu/. Accessed November 16, 2011.

U.S. Fish and Wildlife Service (FWS). 1967. Native fish and wildlife, endangered species. Federal Register 32:4001.

_____. 1987. Endangered and threatened wildlife and plants; proposed reclassification of the Gila trout (*Salmo gilae*) from endangered to threatened, proposed rule. Federal Register 52:37,424–37,427.

_____. 1991. Endangered and threatened wildlife and plants; withdraw of proposed rule to reclassify the Gila trout (*Oncorhynchus gilae*) from endangered to threatened. Federal Register 56:46,400–46,401.

_____. 2002. Trip Report by Jim Brooks: Evaluation of Cub fire impacts on Whiskey Creek and Upper West Fork Gila River. Albuquerque, New Mexico.

_____. 2003. Gila trout recovery plan (third revision). U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 2005. Endangered and threatened wildlife and plants; reclassification of the Gila trout (*Oncorhynchus gilae*) from endangered to threatened with regulations. Federal Register 70:24,750–24,764.

_____. 2006a. Endangered and threatened wildlife and plants; withdraw of proposed rule to reclassify the Gila trout (*Oncorhynchus gilae*) from endangered to threatened; special rule for Gila Trout in New Mexico and Arizona. Federal Register 71:40,657–40,674.

_____. 2006b. Emergency evacuation procedures for Gila trout. New Mexico Fishery Resources Office. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 2009. Email from Dustin Myers with summary of South Diamond population sampling effort in 2007. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 2010. Notes recorded by Dustin Myers for the Gila trout and Chihuahua chub recovery team meeting. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 2011a. Email from Angela James, regarding a PowerPoint presentation in July 2009, rearing wild fish in a naturalized rearing system in Mora National Fish Hatchery and Technology Center. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 2011b. Email from Jim Brooks, confirming the number of relict and replicate populations of Gila trout with known mileage of occupied habitat. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Forest Service (USFS). 2011a. Email from Jerry Monzingo regarding active and inactive allotments near occupied Gila Trout streams. Gila National Forest, Silver City, New Mexico.

_____. 2011b. Biological assessment for re-initiation of consultation on the continued implementation of the Land and Resource Management Plans for the eleven National Forests and National Grasslands of the Southwestern Region. U.S. Forest Service, Southwestern Region, Albuquerque, New Mexico.

Utter, F. M., and F. W. Allendorf. 1994. Phylogenetic relationships among species of *Oncorhynchus*: a consensus view. Conservation Biology 8:864–867.

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

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

Wiederholm, T. 1984. Responses of aquatic insects to environmental pollution. Pages 508–557 in V. H. Resh and D. M. Rosenberg, editors. The Ecology of Aquatic Insects. Praeger Publishers, New York.

Loach Minnow

Abarca, F.J. 1987. Seasonal and diet patterns of feeding in loach minnow (Tiaroga cobitis Girard). Proceedings of the Desert Fishes Council 20:20.

Arizona State University (ASU). 2002. Lower Colorado Basin fish database. Produced for the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service by Arizona State University, Tempe, AZ.

Bagley, B. and P. Marsh 1997. Eagle Creek, Greenlee County, Arizona fisheries survey June 23 – 25, 1997. Arizona State University, Tempe, Arizona. 4 pages.

Bahm, J. and A. Robinson. 2009. Spikedace and loach minnow survey in Eagle Creek, Greenlee and Graham counties, July – August 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona.7 pages.

Barber, W.E. and W.L. Minckley. 1966. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. The Southwestern Naturalist 11(3):313-324.

Britt, K.D., Jr. 1982. The reproductive biology and aspects of life history of Tiaroga cobitis in southwestern New Mexico. Unpublished M.S. thesis. New Mexico State University, Las Cruces. 56 pp.

Carter, C. 2005. Upper Blue River loach minnow summary 2004 and 2005. Arizona Game and Fish Department, Phoenix, Arizona.

Carter, C. 2007a. Three Forks loach minnow survey, August 28-30, 2007. Arizona Game and Fish Department. Phoenix, Arizona. 6 pages.

Carter, C.D. 2007b. Fossil Creek spikedace and loach minnow stocking, November 2, 2007. Arizona Game and Fish Department, Phoenix, Arizona.

Carter, C. 2008. March 28, 2008, email transmission from Codey D. Carter, Arizona Game and Fish Department, to K. McMillan, U.S. Forest Service re: Blue River loach minnow collection.

Carter, C., J. Chapman, D. Seidner, and J. Gamble. 2007. Upper Eagle Creek loach minnow and spikedace survey, May 8-9, 2007. Arizona Game and Fish Department. Phoenix, Arizona. 11 pages.

Carter, C. 2008a. March 28, 2008, email transmission from Codey D. Carter, Arizona Game and Fish Department, to K. McMillan, U.S. Forest Service re: Blue River loach minnow collection.

Carter, C. 2008b. Fossil Creek loach minnow supplemental stocking, May 21, 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona.

Clarkson, R.W., P.C. Marsh, J.A. Stefferud, and B.R. Kesner. 2008. Fishery survey of lower Blue River, Greenlee County, Arizona, May 19-22, 2008. 5 pages.

Crowder, C. 2010. November 1, 2010 email transmission from C. Crowder, Arizona Game and Fish Department, to Robert W. Clarkson, Bureau of Reclamation and others re: last weeks (sic) successful stocking of native fish into Fossil Creek.

Gurtin, S. 2004. July 8, 2004, email transmission from S. Gurtin, Arizona Game and Fish Department, to Leslie Ruiz, U.S. Fish and Wildlife Service, and others, re: 3-Forks loach minnow salvage for week of July 5-9.

Knowles, G. 1994. Fisheries surveys of the Apache-Sitgreaves National Forests, first through fourth trip reports covering May through August 1994.

Leon, S.C. 1989. Trip Report: East Fork White River, 26 May 1989. U.S. Fish and Wildlife Service, Pinetop, Arizona. 1 page.

Lopez, M. 2000. August 30, 2000, email transmission from M. Lopez, Arizona Game and Fish Department, to P. Marsh, Arizona State University re: TICO surveys.

Marsh, P.C., B.E. Bagley, G.W. Knowles, G. Schiffmiller, and P.A. Sowka. 2003. New and rediscovered populations of loach minnow, *Tiaroga cobitis* (Cyprinidae) in Arizona. The Southwestern Naturalist 48(4):666 – 669.

Miller, D. 1998. Fishery survey report, Negrito Creek within the Gila National Forest New Mexico, 29 and 30 June 1998. Western New Mexico University, Biology Department, for the Gila National Forest. Silver City, New Mexico. 6 pages.

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

Minckley, W.L. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Service Region II west of the continental divide. Final Report for U.S. Fish and Wildlife Service, Albuquerque, NM. Arizona State University, Tempe. 150 pp.

Paroz, Y.M. and D.L. Propst. 2007. Distribution of spikedace, loach minnow, and chub species in the Gila River Basin, New Mexico, 1908-2007. Submitted to the U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation. New Mexico Department of Game and Fish, Conservation Services Division, Santa Fe, New Mexico. 23 pages.

Propst, D.L. 2007. Systematic investigations of warmwater fish communities. Performance Report FW-17-R-34, 1 July 2006 – 30 June 2007. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 27 pages.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1988. Distribution, status, biology, and conservation of the loach minnow (Tiaroga cobitis) in New Mexico. Endangered Species Report No. 17. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 75 pp.

Propst, D.L. and K.R. Bestgen. 1991. Habitat and biology of the loach minnow, Tiaroga cobitis, in New Mexico. Copeia 1991(1):29-38.

Propst, D.L., Y.M. Paroz, S.M. Carman, and N.D. Zymonas. 2009. Systematic investigations of warmwater fish communities. Performance Report FW-17-R-36, 1 July 2008 – 30 June 2009. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 26 pages.

Rinne, J.N. 1989. Physical habitat use by loach minnow, Tiaroga cobitis (Pisces:Cyprinidae), in southwestern desert streams. The Southwestern Naturalist 34(1):109-117.

Robinson, A. 2008a. Muleshoe Cooperative Management Area native fish repatriations, one-year post-stocking monitoring and first augmentation September 15-17 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 23 pages.

Robinson, T. 2008b. October 16, 2008, email transmission from T. Robinson, Arizona Game and Fish Department, to M. Richardson, U.S. Fish and Wildlife Service re: Bonita – The Natives Have Been Returned!

Robinson, A. 2009. Acquisition of loach minnow from Blue River on June 1, 2009. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 5 pages.

Robinson, A., D. Orabutt, and C. Crowder. 2009. Loach minnow survey of East Fork Black River and tributaries during July 2009. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 6 pages.

Robinson, A., R. Timmons, D. Boyarski, and C. Crowder. 2010a. Muleshoe Cooperative Management Area native fish restoration monitoring and stocking during 2009. Arizona Game and Fish Department, Phoenix, Arizona. 21 pages.

Robinson, A., R. Timmons, and C. Crowder. 2010b. *Draft.* Muleshoe Cooperative Management Area native fish restoration monitoring and stocking during 2010. Arizona Game and Fish Department, Phoenix, Arizona. 22 pages.

Schreiber, D.C. 1978. Feeding interrelationships of fishes of Aravaipa Creek, Arizona. Arizona State University, Tempe, Arizona. 312 pages.

Stefferud, S.E. and P.N. Reinthal. 2005. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. Literature review and history of research and monitoring. Report to U.S. Bureau of Land Management, Safford, Arizona. Cooperative Agreement AAA000011, Task Order AAF030025. University of Arizona, Tucson, Arizona. 80 pages.

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 393 pp.

Tibbets, C.A. 1993. Patterns of genetic variation in three cyprinid fishes native to the American southwest. MS Thesis, Arizona State University, Tempe, Arizona. 127 pages.

U.S. Fish and Wildlife Service (FWS). 1986. Endangered and threatened wildlife and plants; determination of threatened status for the loach minnow. Federal Register 51(208):39468-39478. October 28, 1986.

_____. 1991. Loach minnow recovery plan. Albuquerque, New Mexico. 38 pp.

_____. 1994. Notice of 90-day and 12-month findings on a petition to reclassify spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis) from threatened to endangered. Federal Register 59(131):35303-35304. July 11, 1994.

_____. 2000. Endangered and threatened wildlife and plants; final designation of critical habitat for the spikedace and loach minnow. Federal Register 65(80):24328-24372.

_____. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Spikedace (Meda fulgida) and the Loach Minnow (Tiaroga cobitis). Federal Register 72(54):13356-13422.

_____. 2012. Endangered and threatened wildlife and plants; Endangered status and designations of critical habitat for spikedace and loach minnow. Federal Register 77(36): 10810-10932.

Vives, S.P. and W.L. Minckley. 1990. Autumn spawning and other reproductive notes on loach minnow, a threatened cyprinid fish of the American southwest. The Southwestern Naturalist 35(4):451-454.

Sonora chub

Bell, G. 1984. Sonora chub, Sycamore Canyon. Memo, USDA Forest Service, Coronado National Forest, Nogales, AZ. 13pp.

Brooks, J.E. 1982. Sycamore creek survey – *Gila ditaenia*. Inter-office memo, Arizona Game and Fish Department, Phoenix. 2pp.

Carpenter, J. 1982. Summer habitat use of Sonora chub in Sycamore Creek, Santa Cruz County, Arizona. M.S. Thesis, University of Arizona, Tucson. 83pp.

Curran, N.L. 1973. Goodding Research Natural Area. Report, USDA Forest Service, Coronado National Forest, Nogales, AZ. 30pp.

Gooding, L.N. 1961. Why Sycamore Canyon in Santa Cruz County should be preserved as a nature sanctuary or natural area. Journal of the Arizona Academy of Science 1:113-115.

Hendrickson, D.A., and L. Juarez-Romero. 1990. Los peces de la cuenca del Rio de la Concepcion, Sonora, Mexico, y el estatus del charalito sonorense, *Gila ditaenia*, una especie en amenaza de extinction. Southwest Naturalists 35:177-187.

Hale, S.F. and Jarchow, J.L. 1988. Status of the Tarahumara frog (*Rana tarahumarae*) in the United States and Mexico: part II. Report to the Arizona Game and Fish Department, Phoenix

Holcheck, J.L. 1983. Considerations concerning grazing systems. Rangelands 5(5): 208-211.

Jackson, W., T. Martinez, and P. Cuplin. 1987. Assessment of water conditions and management opportunities in support of riparian values: BLM San Pedro River Properties, Arizona. Project Completion Report. USDI Bureau of Land Management, Service Center, Denver, CO. 151pp. +appendices.

Miller, L. 1949. Field notes on the minnow, *Gila ditaenia*, in southern Arizona. Copeia 1949:148-150.

Miller, R.R. 1945. A new cyprinid fish from southern Arizona and Sonora, Mexico, with a description of a new subgenus of *Gila* and review of related species. Copeia 1945:104-110.

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

Minckley, W.L. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Service Region II west of the Continental Divide. Report, U.S. Fish and Wildlife Service, Albuquerque. Department of Zoology, Arizona State University, Tempe. 158pp.

Minckley, W.L., and J.E. Brooks. 1985. Transplantations of native Arizona fishes: Records through 1980. Journal of the Arizona-Nevada Academy of Science 20:73-90.

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

Minckley, W.L., and G.K. Meffe. 1987. Differential selection by flooding in stream-fish communities of the arid American southwest. Pp. 93-104. *In*: W.J. Matthews and D.C. Hines (eds.), Community and Evolutionary Ecology of North American Stream Fishes. University of Oklahoma Press, Norman.

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

Smith, E.L. 1984. Gooding Research Natural Area. *In:* Established natural areas in Arizona, a guidebook for scientists and educators. Arizona Academy of Sciences. Planning Division, Economic Planning and Development Office, Office of the Governor, Phoenix.

U.S. Fish and Wildlife Service. 1986. Endangered and threatened wildlife and plants; final rule to determine the Sonora chub to be a threatened species and to determine its critical habitat. Federal Register 51:16042-16047.

_____. 1999. Biological Opinion for Southwestern Region U.S. Forest Service, Ongoing Livestock Grazing Activities on Allotments, Final January 15, 1999.

_____. 1992. Recovery Plan for the Sonora chub (*Gila ditaenia*). Albuquerque, New Mexico. 50pp.

U.S. Forest Service. 1988a. Coronado National Forest Plan. USDA Forest Service, Coronado National Forest, Tucson AZ. Pp. 130.

_____. 1988b. Establishment record for Goodding Research Natural Area within the Coronado National Forest Plan, Santa Cruz County, Arizona. USDA Forest Service, Coronado National Forest, Tucson, Arizona. Pp. 17 + appendices.

Spikedace

Anderson, R.M. 1978. The distribution and aspects of the life history of Meda fulgida in New Mexico. MS Thesis. New Mexico State University, Las Cruces. 62 pp.

Anderson, A.A. and D.A. Hendrickson. 1994. Geographic variation in the morphology of spikedace, Meda fulgida, in Arizona and New Mexico. The Southwestern Naturalist 39(2):148-155.

Arizona Game and Fish Department (AGFD). 2004. Heritage Database Management System. Phoenix, Arizona.

Arizona State University (ASU). 2002. Lower Colorado Basin fish database. Produced for the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service by Arizona State University, Tempe, Arizona.

Barber, W.E. and W.L. Minckley. 1966. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. The Southwestern Naturalist 11(3):313-324.

Barber, W.E. and W.L. Minckley. 1983. Feeding ecology of a southwestern Cyprinid fish, the spikedace, Meda fulgida Girard. The Southwestern Naturalist 28(1):33-40.

Barber, W.E., D.C. Williams, and W.L. Minckley. 1970. Biology of the Gila spikedace, Meda fulgida, in Arizona. Copeia 1970(1):9-18.

Blasius, H. 2008. October 16, 2008, email transmission from H. Blasius, U.S. Bureau of Land Management, to M. Richardson, U.S. Fish and Wildlife Service re: Bonita.

Boyarski, D.E., A.T. Robinson, and C.D. Crowder. 2010. Repatriation of native fishes to Fossil Creek: annual summary of monitoring and stocking during 2009. Arizona Game and Fish Department. Phoenix, Arizona. 18 pages.

Brouder, M. 2002. July 25, 2002 e-mail to Marianne Meding from Mark Brouder re: Verde River survey info.

Carter, C.D. 2007. Fossil Creek spikedace and loach minnow stocking, November 2, 2007. Arizona Game and Fish Department, Phoenix, Arizona.

Carter, C. 2008. Fossil Creek loach minnow supplemental stocking, May 21, 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona.

Carter, C., J. Chapman, D. Seidner, and J. Gamble. 2007. Upper Eagle Creek loach minnow and spikedace survey, May 8-9, 2007. Arizona Game and Fish Department. Phoenix, Arizona. 11 pages.

Douglas, M.E., P.C. Marsh, and W.L. Minckley. 1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: Meda fulgida (Cyprinidae) as a case study. Copeia 1994(1):9-19.

Jakle, M. 1992. Memo February 26, 1992 - Summary of fish and water quality sampling along the San Pedro River from Dudleyville to Hughes Ranch near Cascabel, October 24 and 25, 1992, and the Gila River from Coolidge Dam to Ashurst/Hayden Diversion Dam, October 28 - 31, 1991. U.S. Bureau of Reclamation, Phoenix, Arizona. 11 pp.

Knowles, G.W. 1994. Fisheries survey of the Apache-Sitgreaves National Forests, third trip report: Eagle Creek, June 05 - 07 and August 02, 1994. Arizona State University, Tempe, Arizona. 6 pp.

Lachner, E.A., C.R. Robins, and W.R. Courtenay, Jr. 1970. Exotic fishes and other aquatic organisms introduced into North America. Smithsonian Contributions to Ecology 59:1-29.

Marsh, P.C. 1996. 1996 monitoring and status of fishes in Eagle Creek, Arizona. U.S. Bureau of Reclamation, Phoenix, Arizona. 15 pages.

Marsh, P.C., F.J. Abarca, M.E. Douglas, and W.L. Minckley. 1989. Spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis) relative to introduced red shiner (Cyprinella lutrensis). Arizona Game and Fish Department, Phoenix, Arizona. 116 pp.

Marsh, P.C., J.E. Brooks, D.A. Hendrickson, and W.L. Minckley. 1990. Fishes of Eagle Creek, Arizona, with records for threatened spikedace and loach minnow (Cyprinidae). Journal of the Arizona-Nevada Academy of Science 23(2):107-116.

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

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

Minckley, W.L. and P.C. Marsh. 2009. Inland fishes of the greater southwest. Chronicle of a vanishing biota. The University of Arizona Press, Tucson, Arizona. 426 pages.

Moyle, P.B. 1986. Fish introductions into North America: patterns and ecological impact. Pages 27-43 *In* H.A. Mooney and J.A. Drake, Editors. Ecology of biological invasions of North America and Hawaii. Springer Verlag, New York.

Moyle, P.B., H.W. Li, and B.A. Barton. 1986. The Frankenstein effect: impact of introduced fishes on native fishes in North America. Pages 415-425 *In* R.H Stroud (Editor). Fish culture in fisheries management. American Fisheries Society, Bethesda, Maryland.

New Mexico Department of Game and Fish (NMDGF). 2008. Gila rare species collections database. Provided by Y. Paroz, New Mexico Department of Game and Fish to M. Richardson, U.S. Fish and Wildlife Service.

Ono, R.D., J.D. Williams, and A. Wagner. 1983. Vanishing fishes of North America. Stone Wall Press, Washington, D.C. 257 pages.

Orabutt, D. 2009. October 29, 2009, email transmission from D. Orabutt, Arizona Game and Fish Department, to A. Karam, Arizona State University, and others, re: Muleshoe area fish stockings: October 28, 2009.

Paroz, Y.M., D.L. Propst, and J.A. Stefferud. 2006. Long-term monitoring of fish assemblages in the Gila River drainage, New Mexico. New Mexico Department of Game and Fish, Santa Fe, NM. 74 pages.

Propst, D. 2010. February 8, 2010, email transmission from D. Propst, New Mexico Department of Game and Fish, to M. Richardson, U.S. Fish and Wildlife Service re: San Francisco spikedace.

Propst, D.L. 2007. Systematic investigations of warmwater fish communities. Performance Report FW-17-R-34, 1 July 2006 – 30 June 2007. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 27 pages.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1986. Distribution, status, biology, and conservation of the spikedace (Meda fulgida) in New Mexico. Endangered Species Report No. 15. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 93 pp.

Propst, D.L., Y.M. Paroz, S.M. Carman, and N.D. Zymonas. 2009. Systematic investigations of warmwater fish communities. Performance Report FW-17-R-36, 1 July 2008 – 30 June 2009. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 26 pages.

Reinthal, P. 2009. 2009 spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis) update. University of Arizona, Department of Ecology and Evolutionary Biology, Tucson, Arizona. 2 pages.

Reinthal, P. 2008. Multiple survey reports from 2005 to 2008. University of Arizona, Department of Ecology and Evolutionary Biology, Tucson, Arizona.

Rinne, J.N. 1999. The status of spikedace (Meda fulgida) in the Verde River, 1999: implications for management and research. Hydrology and Water Resources of Arizona and the Southwest. Proceedings of the 1999 meetings of the hydrology section, Arizona-Nevada Academy of Science, Volume 29.

Rinne, J.N., and E. Kroeger. 1988. Physical habitat use by spikedace, Meda fulgida, in Aravaipa Creek, Arizona. Proceedings of the Western Association of Fish and Wildlife Agencies Agenda 68:1-10.

Robinson, A. 2008a. Muleshoe Cooperative Management Area native fish repatriations, one-year post-stocking monitoring and first augmentation September 15-17 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 23 pages.

Robinson, T. 2008b. September 18, 2008, email transmission from T. Robinson, Arizona Game and Fish Department, to R. Clarkson, U.S. Bureau of Reclamation, and others, re: congratulations on the second successful Muleshoe Ecosystem native fish stockings.

Robinson, A. 2009a. Muleshoe Cooperative Management Area native fish repatriations, one-year post-stocking monitoring and first augmentation stocking September 15-17, 2008. Arizona Game and Fish Department, Phoenix, Arizona. 24 pages.

Robinson, A.T. 2009b. Repatriation of native fishes to Fossil Creek: monitoring and stocking during 2008. Arizona Game and Fish Department, Phoenix, Arizona. 17 pages.

Robinson, A.T., C. Carter, D. Ward, and H. Blasius. 2009a. Bonita Creek native fish restoration: native aquatic species salvage, chemical renovation and repatriation of native aquatic species. Arizona Game and Fish Department. Phoenix, Arizona.

Robinson, A., R. Timmons, D. Boyarski, and C. Crowder. 2010a. Muleshoe Cooperative Management Area native fish restoration monitoring and stocking during 2009. Arizona Game and Fish Department, Phoenix, Arizona. 21 pages.

Robinson, A., R. Timmons, and C. Crowder. 2010b. *Draft.* Muleshoe Cooperative Management Area native fish restoration monitoring and stocking during 2010. Arizona Game and Fish Department, Phoenix, Arizona. 22 pages.

Schreiber, D.C. 1978. Feeding interrelationships of fishes of Aravaipa Creek, Arizona. Arizona State University, Tempe, Arizona. 312 pp.

Stefferud, S.E. and P.N. Reinthal. 2005. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. Literature review and history of research and monitoring. Report to U.S. Bureau of Land Management, Safford, Arizona. Cooperative Agreement AAA000011, Task Order AAF030025. University of Arizona, Tucson, Arizona. 80 pages.

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 393 pp.

Tibbets, C.A. 1992. Allozyme variation in populations of the spikedace Meda fulgida and the loach minnow Tiaroga cobitis. Proceedings of the Desert Fishes Council 24:37.

Tibbets, C.A. 1993. Patterns of genetic variation in three cyprinid fishes native to the American southwest. MS Thesis. Arizona State University, Tempe, Arizona. 127 pp.

U.S. Fish and Wildlife Service (FWS). 1986. Endangered and threatened wildlife and plants; determination of threatened status for the loach minnow. Federal Register 51(208):39468-39478. October 28, 1986.

_____. 1994. Notice of 90-day and 12-month findings on a petition to reclassify spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis) from threatened to endangered. Federal Register 59(131):35303-35304. July 11, 1994.

_____. 2000. Endangered and threatened wildlife and plants; final designation of critical habitat for the spikedace and loach minnow. Federal Register 65(80):24328-24372.

_____. 2007. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Spikedace (Meda fulgida) and the Loach Minnow (Tiaroga cobitis). Federal Register 72(54):13356-13422.

_____. 2012. Endangered and threatened wildlife and plants; Endangered status and designations of critical habitat for spikedace and loach minnow. Federal Register 77(36): 10810-10932.

Williams, J.E., D.B. Bowman, J.E. Brooks, A.A. Echelle, R.J. Edwards, D.A. Hendrickson, and J.J. Landye. 1985. Endangered aquatic ecosystems in North American deserts with a list of vanishing fishes of the region. Journal of the Arizona-Nevada Academy of Science 20(1):1-62.

Yaqui catfish

Arizona Game and Fish Department. 2001. *Gila purpurea*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Campoy-Favela, J., A. Varela-Romero, and L. Juarez-Romero. 1989. Observaciones sobre la ictiofauna native de la cuenca del Rio Yaqui, Sonora, Mexico. Ecologica 1:1-13.

Cheremisinoff, P. N., and A. C. Morresi. 1976. Geothermal energy technology assessment. Technomic Publishing, Westport, Connecticut.

Gehlbach, F. R. 1981. Mountain islands and desert seas: A natural history of the U.S.-Mexican borderlands. Texas A&M University Press, College Station, Texas.

Hahman, W. R. 1979. Geothermal reservoir site evaluation in Arizona. Bureau of Geology and Mineral Technology, Geological Survey Branch, Geothermal Group, Tucson, Arizona.

Haynes, L., and S. Schuetze. 1997. A sampler of Arizona's threatened and endangered wildlife. A Cooperative Project between Arizona Game and Fish Department and Arizona Department of Agriculture.

Hendrickson, D. A. 1984. Distribution records of native and exotic fishes in Pacific drainages of northern Mexico. Journal of the Arizona-Nevada Academy of Science 18:33-38.

_____, and W. L. Minckley. 1985. Cienegas: Vanishing climax communities of the American Southwest. Desert Plants 6(1984):131-175.

_____, _____, R. R. Miller, D. J. Siebert, and P. H. Minckley. 1980. Fishes of the Rio Yaqui basin, Mexico and United States. Journal of the Arizona-Nevada Academy of Science 15(3): 65-106.

Humphrey, R. R. 1986. Ninety years and 535 miles: Vegetation changes along the Mexican border. University of New Mexico Press, Albuquerque, New Mexico.

Jensen, B. L. 1992. Annual report, Dexter National Fish Hatchery and Technology Center, Dexter New Mexico. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1993. Annual report, Dexter National Fish Hatchery and Technology Center, Dexter New Mexico. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Lanning, D. V. 1981. Vertebrates of San Bernardino Ranch, Cochise County, Arizona. Rept. FWS, Off. Endang. Spec., Arizona Natural Heritage Program, Tucson, Arizona.

Lundberg, J. G. 1992. The phylogeny of ictalurid catfishes: a synthesis of recent work. Pages 392-420 *in* R. L. Mayden, editor. Systematics, historical ecology, and North American

freshwater fishes. Stanford University Press, Stanford, Calfiornia.

Marrs-Smith, G. 1983. Vegetation and flora of San Bernardino Ranch, Cochise County, Arizona. Thesis, Arizona State University, Tempe, Arizona.

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

_____. 1985. Native fishes and natural aquatic habitats of U.S. Fish and Wildlife Service Region II, west of the Continental Divide. Final Report to U.S. Fish and Wildlife Service , Arizona State University Interagency Personal Act Agreement, Arizona State University, Tempe, Arizona.

Propst, D. L., and J. A. Stefferud. 1994. Distribution and status of the Chihuahua chub (Teleostei: Cyprinidae: Gila nigrescens), with notes on its ecology and associated species. Southwestern Naturalist 39(3):224-234.

Regan, C. T. 1906-1908. Pisces. *In* Biologia Centrali-Americana VIII.

Reilly, J., and R. Lochmann. 2000. Comparative aspects of feed and feedstuff utilization by Yaqui catfish and channel catfish. North American Journal of Aquaculture 62:279-284.

Rieman, B., and D. Isaak. 2010. Climate change, aquatic ecosystems and fishes in the Rocky Mountain West: implications and alternatives for management. USDA Forest Service, Rocky Mountain Research Station, GTR-RMRS-250, Fort Collins, CO.

Rutter, C. 1896. Notes on the fresh water fishes of the Pacific slope of North America. Proceedings of the California Academy of Sciences 6:245-267.

Schoenherr, A. A. 1973. Life history of the topminnow *Poeciliopsis occidentalis* (Baird & Girard) in Arizona and an analysis of its interaction with the mosquitofish *Gambusia affinis* (Baird & Girard). Dissertation, Arizona State University, Tempe, Arizona.

Smith, M. L., and R. R. Miller. 1986. The evolution of the Rio Grande Basin as inferred from its fish fauna. Pages 457-486 *in* C. H. Hocutt and E. O. Wiley, editors. Zoogeography of North American Freshwater Fishes. Wiley and Sons, New York.

U.S. Fish and Wildlife Service. 1984. Final rule to determine the Yaqui chub to be an endangered species with critical habitat, and to determine the beautiful shiner and the Yaqui catfish to be threatened species with critical habitat. Federal Register 49(171):34490-34497.

_____. 1994. Yaqui fishes recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1998. Environmental Assessment and Habitat Conservation Plan for issuance of an Endangered Species Act Section 10(a)(1)(B) Permit for incidental take of Yaqui chub (*Gila purpurea*) and other Rio Yaqui fishes for ranching and related activities on El Coronado Ranch and associated grazing allotments on West Turkey Creek, Cochise County, Arizona. U.S. Fish and Wildlife Service, Phoenix, Arizona.

Wagoner, J. J. 1960. Overstocking the ranges in southern Arizona during the 1870's and 1880's. Arizonian 2:23-27.

Yaqui chub

Arizona Game and Fish Department. 2001. *Gila purpurea*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Campoy-Favela, J., A. Varela-Romero, and L. Juarez-Romero. 1989. Observaciones sobre la ictiofauna native de la cuenca del Rio Yaqui, Sonora, Mexico. Ecologica 1:1-13.

DeMarais, B. D. 1991. Gila eremica, a new cyprinid fish from northwester Sonora, Mexico. Copeia 1991:178-189.

Gehlbach, F. R. 1981. Mountain islands and desert seas: A natural history of the U.S.-Mexican borderlands. Texas A&M University Press, College Station, Texas.

Girard, C. 1857. Researches upon the cyprinoid fishes inhabiting the fresh waters of the United States of America, west of the Mississippi Valley, from specimens in the museum of the Smithsonian Institution. Proceedings of the National Academy of Sciences 8(1856): 165-213.

Hahman, W. R. 1979. Geothermal reservoir site evaluation in Arizona. Bureau of Geology and Mineral Technology, Geological Survey Branch, Geothermal Group, Tucson, Arizona.

Hendrickson, D.A., and W. L. Minckley. 1985. Cienegas: Vanishing climax communities of the American Southwest. Desert Plants 6(1984):131-175.

_____, _____, R. R. Miller, D. J. Siebert, and P. H. Minckley. 1980. Fishes of the Rio Yaqui basin, Mexico and United States. Journal of the Arizona-Nevada Academy of Science 15(3): 65-106.

Humphrey, R. R. 1986. Ninety years and 535 miles: Vegetation changes along the Mexican border. University of New Mexico Press, Albuquerque, New Mexico.

Lanning, D. V. 1981. Vertebrates of San Bernardino Ranch, Cochise County, Arizona. Rept. FWS, Off. Endang. Spec., Arizona Natural Heritage Program, Tucson, Arizona.

Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American freshwater fishes. North Carolina State Museum of Natural History.

Maes, R. A. 1995. Habitat use by fishes of the San Bernardino National Wildlife Refuge. Thesis, University of Arizona, Tucson, Arizona.

Marrs-Smith, G. 1983. Vegetation and flora of San Bernardino Ranch, Cochise County, Arizona. Thesis, Arizona State University, Tempe, Arizona.

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

_____. 1980. *Gilapwpurea* (Girard), Yaqui Chub. p. 171, In, Atlas of North American Freshwater Fishes. Eds., D. S. Lee, *et al.*, NC State Mus. Nat. list., Raleigh.

_____ and D.E. Brown. 1983. Part 6. Wetlands. Pp. 222-287, 333-351, + Literature cited, in David E. Brown, editor, *Biotic Communities of the American Southwest.* Desert Plants (Boyce Thompson Arboretum, Superior, AZ) 4(1-4; 1982).

Rieman, B., and D. Isaak. 2010. Climate change, aquatic ecosystems and fishes in the Rocky Mountain West: implications and alternatives for management. USDA Forest Service, Rocky Mountain Research Station, GTR-RMRS-250, Fort Collins, CO.

Rutter, C. 1896. Notes on the fresh water fishes of the Pacific slope of North America. Proceedings of the California Academy of Sciences 6:245-267.

Schoenherr, A. A. 1973. Life history of the topminnow *Poeciliopsis occidentalis* (Baird & Girard) in Arizona and an analysis of its interaction with the mosquitofish *Gambusia affinis* (Baird & Girard). Dissertation, Arizona State University, Tempe, Arizona.

Silvey. W. 1975. Fishes of Leslie Creek, Cochise County, Arizona. Statewide Fisheries Investigations. Statewide Survey of Aquatic Resources Federal Aid Project F-7-R-17, Arizona Game and Fish Department, Phoenix, Arizona.

U.S. Fish and Wildlife Service (FWS). 1984. Final rule to determine the Yaqui chub to be an endangered species with critical habitat, and to determine the beautiful shiner and the Yaqui catfish to be threatened species with critical habitat. Federal Register 49(171):34490-34497.

_____. 1994. Yaqui fishes recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1995. San Bernardino and Leslie Canyon national wildlife refuges. Comprehensive management plan, 1995-2015. Includes the environmental assessment under separate cover. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1998. Environmental Assessment and Habitat Conservation Plan for issuance of an Endangered Species Act Section 10(a)(1)(B) Permit for incidental take of Yaqui chub (*Gila purpurea*) and other Rio Yaqui fishes for ranching and related activities on El Coronado Ranch and associated grazing allotments on West Turkey Creek, Cochise County, Arizona. U.S. Fish and Wildlife Service, Phoenix, Arizona.

_____. 1999. Biological opinion to the USDA Forest Service, Coronado National Forest: West Turkey Creek Native Fish Habitat Renovation Project. U.S. Fish and Wildlife Service, Phoenix, Arizona.

Varela-Romero, A., J. Campoy-Favela, and L. Juarez-Romero. 1992. Fishes of the Rios Mayo and Fuerte Basins, Sonora and Sinaloa, Mexico. Proceedings of the Desert Fishes Council 22:70-71.

Wagoner, J. J. 1960. Overstocking the ranges in southern Arizona during the 1870's and 1880's. Arizonian 2:23-27.

Chiricahua leopard frog

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, USA 95:9031-9036.

Blaustein, A.R, and P. T. J. Johnson. 2010. When an infection turns lethal. Nature 465:881-882.

Bradford, D.F. 1989. Allotopic distribution of native frogs and introduced fishes in high Sierra Nevada lakes of California; Implications of the negative effect of fish introductions. Copeia 1898:775-778.

Bradford, D.F., F. Tabatabai, and D.M. Graber. 1993. Isolation of remaining ppopulations of the native frog, *Rana muscosa*, by introduced fishes in Sequioa and Kings Canyon national Parks, California. Conservation Biology 7(4):882-888.

Bradley, G.A., P.C. Rosen, M.J. Sredl, T.R. Jones, and J.E. Longcore. 2002. Chytridomycosis in native Arizona frogs. Journal of Wildlife Diseases 38(1):206-212.

Campbell, J.A. 1998. Amphibians and Reptiles of northern Guatemala, the Yucatan, and Belize. University of Oklahoma Press, Norman, Oklahoma.

Carey, C., N. Cohen, and L. Rollins-Smith. 1999. Amphibian declines: an immunological perspective. Developmental and Comparative Immunology 23:459-472.

Carey, C., W.R. Heyer, J. Wilkinson, R.A. Alford, J.W. Arntzen, T. Halliday, L. Hungerford, K.R. Lips, E.M. Middleton, S.A. Orchard, and A.S. Rand. 2001. Amphibian declines and environmental change: use of remote sensing data to identify environmental correlates. Conservation Biology 15(4):903-913.

Collins, J.P., J.L. Brunner, V. Miera, M.J. Parris, D.M. Schock, and A. Storfer. 2003. Ecology and evolution of infectious disease. Pages 137-151 *in* R.D. Semlitsch, Amphibian Conservation. Smithsonian Books, Washington D.C.

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.

Crother, B.I. (ed.). 2008. Scientific and Common Names for Amphibians and Reptiles of North America North of México. Society for the Study of Amphibians and Reptiles, Herpetological Circular No. 37:1-84

Dahms, C.W., and B.W. Geils (tech. eds). 1997. An assessment of forest ecosystem health in the Southwest. General Technical Report RM-GTR-295. Fort Collins, CO, US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Danzer, S.R., C.H. Baisan, and T.W. Swetnam. 1997. The influence of fire and land-use history on stand dynamics in the Huachuca Mountains of southeastern Arizona. Appendix D *in* Robinett, D., R.A. Abolt, and R. Anderson, Fort Huachuca Fire Management Plan. Report to Fort Huachuca, AZ.

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, NY.

Davidson, D., Pessier, A.P., J.E. Longcore, M. Parris, J. Jancovich, J. Brunner, D. Schock, and J.P. Collins. 2000. Chytridiomycosis in Arizona (USA) tiger salamanders. Page 23 *in* Conference and Workshop Compendium: Getting the Jump! On amphibian diseas. Cairns, Australia, August 2000.

DeBano, L.F., and D.G. Neary. 1996. Effects of fire on riparian systems. Pages 69-76 *in* P.F. Ffolliott, L.F. DeBano, M.B. Baker, G.J. Gottfried, G. Solis-Garza, C.B. Edminster, D.G Neary, L.S. Allen, and R.H Hamre (tech. coords.). Effects of fire on Madrean province ecosystems, a symposium proceedings. USDA Forest Service, General Technical Report RM-GTR-289.

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

Diaz, J.V., and G.E.Q. Diaz. 1997. Anfibios y reptiles de Aguascalientes. Grupo Impressor Mexico, Aguascalientes, Aguascalientes, Mexico.

Dole, J.W. 1968. Homing in leopard frogs, *Rana pipiens*. Ecology 49:386-399.

Dole, J.W. 1971. Dispersal of recently metamorphosed leopard frogs, *Rana pipiens*. Copeia 1971:221-228.

Dole, J.W. 1972. Evidence of celestial orientation in newly-metamorphosed *Rana pipiens*. Herpetologica 28:273-276.

Fellers, G.M., D.E. Green, and J.E. Longcore. 2001. Oral chytridiomycosis in the mountain yellow-legged frog (*Rana muscosa*). Copeia 2000(4):945-953.

Fellers, G.M., L.L. McConnell, D. Pratt, and S. Datta. 2004. Pesticides in mountain yellow-legged frogs (*Rana muscosa*) from the Sierra Nevada Mountains of California, USA. Environmental Toxicology and Chemistry 23(9):2170-2177.

Fellers, G.M., K.L. Pope, J.E. Stead, M.S. Koo, and H.H. Welsh, Jr. 2007. Turning population trend monitoring into active conservation: Can we save the Cascades frog (*Rana cascadae*) in the Lassen region of California. Herpetological Conservation and Biology 3(1):28-39.

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, AZ.

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

Fernandez, P.J. and P.C. Rosen. 1998. Effects of introduced crayfish on the Chiricahua leopard frog and its stream habitat in the White Mountains, Arizona. Page 5 *in* abstracts of the Fourth Annual Meeting of the Declining Amphibian Populations Task Force, Phoenix, AZ.

Frost, J.S., and J.T. Bagnara. 1977. Sympatry between *Rana blairi* and the southern form of leopard frog in southeastern Arizona (Anura: Ranidae). The Southwestern Naturalist 22(4):443-453.

Gingrich, R.W. 2003. The political ecology of deforestation in the Sierra Madre Occidental of Chihuahua. Online publication.

Green, D.E., and C.K. Dodd, Jr. 2007. Presence of amphibian chytrid fungus *Batrochochytrium dendrobatidis* and other amphibian pathogens at warm-water fish hatcheries in southeastern North America. Herpetological Conservation and Biology 2(1):43-47.

Hale, S.F. 2001. The status of the Tarahumara frog in Sonora, Mexico based on a re-survey of selected localities, and search for additional populations. Report to the U.S. Fish and Wildlife Service, Phoenix, Arizona.

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

Jennings, R.D. 1987. The status of *Rana berlandieri*, the Rio Grande leopard frog, and *Rana yavapaiensis*, the lowland leopard frog, in New Mexico. Report to New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Jennings, R.D. 1995. Investigations of recently viable leopard frog populations in New Mexico: *Rana chiricahuensis* and *Rana yavapaiensis*. New Mexico Game and Fish Department, Santa Fe.

Knapp, R.A., and K.R. Mathews. 2000. Nonnative fish introductions and the decline of the Mountain yellow-legged frog from within protected areas. Conservation Biology 14(2):428-438.

Lemos-Espinal, J.A., and H.M. Smith. 2007. Anfibios y Reptiles del Estado de Chihuahua, México/Amphibians and Reptiles of the State of Chihuahua, México. Universidad Nacional Autonoma de México y CONABIO, México D.F.

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

Mazzoni, R., A.A. Cunninghan, P. Daszak, A. Apolo, E. Perdomo, and G. Speranza. 2003. Emerging pathogen of wild amphibians in frogs (*Rana catesbeiana*) farmed for international trade. Emerging Infectious Diseases 9(8):3-30.

Morehouse, E.A., T.Y. James, A.R.D. Ganley, R. Vilgalys, L. Berger, P.J. Murphys, and J.E. Longcore. 2003. Multilocus sequence typing suggests the chytrid pathogen of amphibians is a recently emerged clone. Molecular Ecology 12:395-403.

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

Painter, C.W. 2000. Status of listed and category herpetofauna. Report to US Fish and Wildlife Service, Albuquerque, NM. Completion report for E-31/1-5.

Picco, A.M., and J.P. Collins. 2008. Amphibian commerce as a likely source of pathogen pollution. Conservation Biology 22(6):1582-1589.

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 J.S. Mecham. 1984. *Rana chiricahuensis*. Catalogue of American Amphibians and Reptiles 347.1.

Pounds, J.A., and M.L. Crump. 1994. Amphibian declines and climate disturbance: the case of the golden toad and the harlequin frog. Conservation Biology 8(1)72-85.

Reaser, J.K., and D.S. Pilliod. 2005. *Rana luteiventris* Thompson 1913. Columbia spotted frog. Pp. 559-563 *in* M.J. Lannoo (ed), Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley.

Rorabaugh, J.C. 2005. *Rana berlandieri* Baird, 1854(a), Rio Grande leopard frog. Pages 530-532 *in* M.J. Lannoo (ed), Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley.

Rorabaugh, J.C. 2008. An introduction to the herpetofauna of mainland Sonora, México, with comments on conservation and management. Journal of the Arizona-Nevada Academy of Science 40(1):20-65.

Rosen, P.C., and C. Melendez. 2006. Observations on the status of aquatic turtles and ranid frogs in northwestern Mexico. Pp. 104-106 *in* Extended Abstracts, Proceedings of the Sizth Conference on Research and Resource Management in the Southwestern Deserts. USGS Southwest Biological Science Center, Sonoran Desert Research Station, Tucson, AZ.

Rosen, P.C., and C.R. Schwalbe. 1998. Using managed waters for conservation of threatened frogs. Pages 180-202 *in* Proceedings of Symposium on Environmental, Economic, and Legal Issues Related to Rangeland Water Developments. November 13-15, 1997, Tempe, AZ.

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 (tech. coords.), 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.

Seburn, C.N.L., D.C. Seburn, and C.A. Paszkowski. 1997. Northern leopard frog (*Rana pipiens*) dispersal in relation to habitat. Herpetological Conservation 1:64-72.

Sinsch, U. 1991. Mini-review: the orientation behaviour of amphibians. Herpetological Journal 1:541-544.

Skerratt, L.F., L. Berger, and R. Speare. 2007. Natural history of *Bd*. Abstract in Program for the Conference, Amphibian Declines and Chytridomycosis: Translating Science into Urgent Action, Tempe, AZ.

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, AZ.

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, Nongame Branch, Phoenix, AZ.

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, Nongame and Endangered Wildlife Program, Technical Report 121.

Sredl, M.J., and R.D. Jennings. 2005. *Rana chiricahuensis*: Chiricahua leopard frogs. Pages 546-549 *in* M.J. Lannoo (ed), Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley.

Stebbins, R.C. 2003. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company, Boston, MA.

Swetnam, T.W., and C.H. Baisan. 1996. Fire histories of montane forests in the Madrean Borderlands. Pages 15-36 *in* P.F. Ffolliott *et al.* (Tech. Coord.), Effects of fire on Madrean Province ecosystems. USDA Forest Service, General Technical Report, RM-GTR-289.

U.S. Fish and Wildlife Service. 2007. Chiricahua leopard frog (*Rana chiricahuensis*) recovery plan. Region 2, U.S. Fish and Wildlife Service, Albuquerque, NM.

_____. 2009. Endangered and threatened wildlife and plants; partial 90-day finding on a petition to list 475 species in the Southwestern United States as threatened or endangered with critical habitat; proposed rule. Federal Register 74(240):66866-66905.

_____. 2011a. Endangered and threatened wildlife and plants; listing and designation of critical habitat for the Chiricahau leopard frog: proposed rule. Federal Register 76(50):14126-14207.

_____. 2011b. Endangered and threatened wildlife and plants; listing and designation of critical habitat for the Chiricahau leopard frog: proposed rule; reopening of comment period. Federal Register 76(183):58441-58455.

_____. 2012. Endangered and threatened wildlife and plants; listing and designation of critical habitat for the Chiricahua leopard frog: final rule. Federal Register 77(54):16324-16424.

Vredenburg, V., G.M. Fellers, and C. Davidson. 2005. *Rana muscosa* Camp 1917b. Mountain yellow-legged frog. Pp. 563-566 *in* M.J. Lannoo (ed), Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley.

Vredenburg, V. T., Knapp, R. A., Tunstall, T. S. & Briggs, C. J. 2010. Dynamics of an emerging disease drive large-scale amphibian population extinctions. Proc. Natl Acad. Sci. USA 107:9689–9694.

Wallace, E. 2003. Status assessment of lowland leopard frogs in mountains of Coronado National Forest – Santa Catalina Ranger District. Purchase Order 43-8197-3-0058. Coronado national Forest, Tucson, AZ.

Weldon, C., L.H. du Preez, A.D. Hyatt, R. Muller, and R. Speare. 2004. Origin of the amphibian chytrid fungus. Emerging Infectious Diseases 10(12):3-8.

Witte, C.L., M.J. Sredl, A.S. Kane, and L.L. Hungerford. 2008. Epidemiological analysis of factors associated with local disappearances of native ranid frogs in Arizona. Conservation Biology 22:375-383.

New Mexican Ridge-nosed Rattlesnake

Bureau of Land Management. 2004. Proposed Arizona Statewide Land Use Plan Amendment for fire, fuels, and air quality management, Finding of No Significant Impact (FONSI) and Environmental Assessment. U.S. Department of the Interior, Bureau of Land Management, Arizona State Office, Phoenix, Arizona.

Helbing, G. L. 2004. Baker II Rx Status/Monitoring Report. Douglas Ranger District. Coronado National Forest. Douglas, Arizona. December 15, 2004. File Code: 2630, 2670.

Holycross, A. T., and L. J. Smith. 2001. A map of potential core habitat for *Crotalus willardi obscurus* on the Coronado National Forest Lands in the Peloncillo Mountains. A Report to the Malpai Borderlands Group. Arizona State University, Biology Department, Tempe, Arizona.

Smith, L. J., A. T, Holycross, C. W. Painter, and M. E. Douglas. 2001. Montane rattlesnakes and prescribed fire. Southwestern Naturalist 46:54–61

U.S. Fish and Wildlife Service. 1985. New Mexico ridgenose rattlesnake recovery plan. Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 1999. Biological opinion on the on-going and long-term grazing on the Coronado National Forest. 2-21-98-F-399. Arizona Ecological Services Field Office, Phoenix, Arizona.

U.S. Fish and Wildlife Service. 2001. Final biological opinion on the proposed Baker prescribed fire in the Peloncillo Mountains on the Coronado National Forest. 2-21-01-F-070. Arizona Ecological Services Field Office, Phoenix, Arizona.

U.S. Fish and Wildlife Service. 2002. Final Biological and Conference Opinion: Reinitiation of biological opinion on the continuation of livestock grazing on the Coronado National Forest. 2-21-98-F-399-R1. Arizona Ecological Services Field Office, Phoenix, Arizona.

U.S. Fish and Wildlife Service. 2005a. Programmatic Biological Opinion and Conference Opinion, Continued Implementation of the Land and Resource Management Plans for the Eleven National Forests and National Grasslands of the Southwestern Region. 2-22-03-F-366. Southwest Regional Office, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 2005b. Peloncillo Programmatic Fire Management Plan on the Coronado National Forest. 02-21-04-F-0474. Arizona Ecological Services Field Office, Phoenix, Arizona.

U.S. Fish and Wildlife Service. 2008. Biological Opinion on the Re-Authorization of Ongoing and Long-Term Grazing on the Deer Creek, Graves, Juniper Basin, Outlaw Mountain, Skull Canyon, Skeleton Canyon, and Fairchild Grazing Allotments in the Peloncillo Mountains. 22410-2008-F-0369. Arizona Ecological Services Field Office, Phoenix, Arizona.

U.S. Forest Service. 1986. Coronado National Forest Land Resource Management Plan. Coronado National Forest, Supervisor's Office, Tucson, Arizona.

U.S. Forest Service. 2004a. Biological assessment on eleven land and resource management plans. Southwestern Region, Albuquerque, New Mexico.

U.S. Forest Service. 2004b. Biological assessment and evaluation for Peloncillo Programmatic Fire Management Plan. Coronado National Forest, Tucson, Arizona.

U.S. Forest Service. 2009. Programmatic Biological Opinion on the Land and Resource Management Plans for the 11 National Forests in the USDA Forest Service Southwestern Region. Annual Report (June 10, 2005 – June 10, 2007). Southwestern Region, Albuquerque, New Mexico.

U.S. Forest Service. 2010. Programmatic Biological Opinion on the Land and Resource Management Plans for the 11 National Forests in the USDA Forest Service Southwestern Region. Annual Report Calendar Year 2009. Southwestern Region, Albuquerque, New Mexico.

Sonora tiger salamander

Abbate, D. 1998. Arizona Game and Fish Department 1997 Sonora tiger salamander surveys. Presentation to the Fourth Annual Meeting of the Southwestern Working Group of the Declining Amphibian Populations Task Force, Phoenix, Arizona.

Arizona Game and Fish Department. 1996. Species of Special Concern. Arizona Game and Fish Department, Phoenix, Arizona.

Anderson, J. D. 1961. The life history and systematics of *Ambystoma rosaceu*m. Copeia 1961:371-377.

Behler, J. L., and F. W. King. 1980. The Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf, New York.

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.

Blanchard, C. L., and M. Stromberg. 1987. Acidic precipitation in southeastern Arizona: sulfate, nitrate, and trace metal deposition. Atmospheric Environment 21:2375-2381.

Brown, D. E. 1994. Biotic Communities: Southwestern United States and northwestern Mexico. University of Utah Press, Salt Lake City, Utah.

Collins, J. P. 1979. Sexually mature larvae of the salamanders *Ambystoma rosaceum* and *A. tigrinum velasci* from Chihuahua, Mexico: Taxonomic and ecological notes. Journal of Herpetology 13:351-354.

_____. 1996. Final report: A status survey of three species of endangered/sensitive amphibians in Arizona. Report to Arizona Game and Fish Department, Phoenix, Arizona. Heritage Fund - IIPAM #I92014.

_____. 1999. J. P. Collins Lab, 1999 Sonoran tiger salamander report. Report to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____, J. L. Brunner, V. Miera, M. J. Parris, D. Schock, and A. Storfer. 2003. Ecology and

evolution of infectious disease. Pages 137-151 *in* R. D. Semlitsch. Amphibian Conservation. Smithsonian Books, Washington D.C.

_____, E. W. Davidson, J. E. Longcore, A. P. Pessier, M. J. Perris, and A. T. Storfer. 2001. Pages 20-21 *in* Abstracts of the Annual Conference of The Western Section of The Wildlife Society, Sacramento, California, 22-24 February 2001.

_____, and J. R. Holomuzki. 1984. Intraspecific variation in diet within and between trophic morphs in larval tiger salamanders (*Ambystoma tigrinum nebulosu*m). Canadian Journal of Zoology 62:168-174.

_____, J. K. Jancovich, E. W. Davidson, V. G. Chinchar, and collaborators. 2000. The current status of salamander ranaviruses in Western North America. Abstract for Scientific Conference - Getting the Jump! On Amphibian Diseases, Cairns, Australia, 26-30 August 2000.

_____, and T. R. Jones. 1987. Report on the status of the Sonora tiger salamander, *Ambystoma tigrinum stebbinsi* Lowe. Department of Zoology, Arizona State University, Tempe, Arizona.

_____, _____, and H. J. Berna. 1988. Conserving genetically distinctive populations: The case of the Huachuca tiger salamander (*Ambystoma tigrinum stebbinsi* Lowe). Pages 45-53 *in* R. C. Szaro, K. C. Severson, and D. R. Patton, editors. Management of amphibians, reptiles, and small mammals in North America. U.S. Forest Service GTR-RM-166, Fort Collins, Colorado.

Davidson, E. W., M. Parris, J. P. Collins, J. E. Longcore, A. P. Pessier, and J. Brunner. 2003. Pathogenicity and transmission of chytridiomycosis in tiger salamanders (*Ambystoma tigrinum*). Copeia 2003(3):601-607.

_____, A. P. Pessier, J. E. Longcore, M. Perris, J. Jancovich, D. Schock, and J. P. Collins. 2000. Chytridiomycosis in Arizona (USA) tiger salamanders. Abstract for Scientific Conference - Getting the Jump! On Amphibian Diseases, Cairns, Australia, 26-30 August 2000.

DeBano, L. F., and D. G. Neary. 1996. Effects of fire on riparian systems. Pages 69-76 *in* P. F. Ffolliott, L. F. DeBano, M. B. Baker, G. J. Gottfried, G. Solis-Garza, C. B. Edminster, D. G. Neary, L. S. Allen, and R. H. Hamre, technical coordinators. Effects of fire on Madrean province ecosystems, a symposium proceedings. U.S. Forest Service, General Technical Report RM-GTR-289.

Docherty, D .E., C. U. Meteyer, J. Wang, J. Mao, S. T. Case, and V. G. Chinchar. 2003. Diagnostic and molecular evaluation of three iridovirus-associated salamander mortality events. Journal of Wildlife Diseases 39(3):556-566.

Douglas, M. E., and B. L. Monroe. 1981. A comparative study of topographical orientation in *Ambystoma* (Amphibia:Caudata). Copeia 1981:460-463.

Fernandez, P. J., and P. C. Rosen. 1996. Effects of the introduced crayfish *Orconectes virilis* on native aquatic herpetofauna in Arizona. Heritage Program, IIPAM Project No. 194054, Arizona Game and Fish Department, Phoenix, Arizona.

Gamradt, S. C., and L. B. Kats. 1996. Effect of introduced crayfish and mosquitofish on California newts. Conservation Biology 10:1155-1162.

Gehlbach, F. R., Kimmel, J. R., and W. A. Weems. 1969. Aggregations and body water relationships in tiger salamanders (*Ambystoma tigrinum*) from the Grand Canyon rims, Arizona. Physiological Zoology 42:173-182.

Gruberg, E. R., and R. V. Stirling. 1972. Observations on the burrowing habits of the tiger salamander (*Ambystoma tigrinum*). Herpetological Review 4:85-89.

Hadley, D., and T. E. Sheridan. 1995. Land use history of the San Rafael Valley, Arizona (1540-1960). General Technical Report GM-GTR-269. USDA Forest Service, Fort Collins, Colorado.

Hendrickson, D. A., and W. L. Minckley. 1984. Cienegas - vanishing climax communities of the American Southwest. Desert Plants 6(3):131-175.

Holomuzki, J. R. 1986. Variation in microhabitat use and trophic patterns of larval tiger salamanders *(Ambystoma tigrinum nebulosu*m) in Arizona. Dissertation, Arizona State University, Tempe, Arizona.

Jancovich, J. K., E. W. Davidson, J. F. Morado, B. L. Jacobs, and J. P. Collins. 1997. Isolation of a lethal virus from the endangered tiger salamander *Ambystoma tigrinum stebbins*i. Diseases of Aquatic Organisms 31:161-167.

_____, _____, A. Seiler, B. L. Jacobs, and J. P. Collins. 2001. Transmission of the *Ambystoma tigrinum* virus to alternative hosts. Diseases of Aquatic Organisms 46:159-163.

Jones, T. R., J. P. Collins, T. D. Kocher, and J. B. Mitton. 1988. Systematic status and distribution of *Ambystoma tigrinum stebbinsi* Lowe (Amphibia:Caudata). Copeia 1988:6216-6235.

_____, E. J. Routman, D. J. Begun, and J. P. Collins. 1995. Ancestry of an isolated subspecies of salamander, *Ambystoma tigrinum stebbinsi* Lowe: The evolutionary significance of hybridization. Molecular Phylogenetics and Evolution 4:194-202.

Kiesecker, J. M., and A. R. Blaustein. 1997. Population differences in responses of red-legged frogs *(Rana auror*a) to introduced bullfrogs. Ecology 78:1752-1760.

Kupferberg, S. J. 1997. Bullfrog *(Rana catesbeiana*) invasion of a California river: The role of larval competition. Ecology 78:1736-1751.

Lefcort, H., K. A. Hancock, K. M. Maur, and D. C. Rostal. 1997. The effects of used motor oil, silt, and the water mold *Saprolegnia parasitica* on the growth and survival of mole salamanders (Genus *Ambystoma*). Archives of Environmental Contamination and Toxicology 32:383-388.

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

Lowe, C. H. 1954. A new salamander (genus *Ambystoma*) from Arizona. Proceedings of the Biological Society of Washington 67:243-245.

Madison, D. M. 1997. The emigration of radio-implanted spotted salamanders, *Ambystoma maculatum*. Journal of Herpetology 31:542-551.

_____, and L. Farrand III. 1998. Habitat use during breeding and emigration in radio-implanted tiger salamanders, *Ambystoma tigrinu*m. Copeia 1998:402-410.

Petranka, J. W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington D.C.

Platz, J. E. 1989. *Rana subaquavocalis*: Conservation Assessment/Conservation Strategy. Article prepared in satisfaction of U.S. Forest Service Agreement CCS - 95 - 0006.

Reed, C. A. 1951. Larval ambystomatid salamanders from southern Arizona and Sonora. Chicago Academy of Sciences, Natural History Miscellanea 79:1-3.

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

_____, and D. G. Neary. 1996. Fire effects on aquatic habitats and biota in Madrean-type ecosystems: Southwestern United States. Pages 135-145 *in* P. F. Ffolliott, L. F. DeBano, M. B. Maker, Jr., G. J. Gottfried, G. Solis-Garza, C. B. Edminster, D. G. Neary, L. S. Allen, and R. H. Hamre, technical coordinators.. Effects of fire on Madrean Province ecosystems, a symposium proceedings. U.S. Forest Service, General Technical Report RM-GTR-289.

Roby, K. B., and D. L. Azuma. 1995. Changes in a reach of a Northern California stream following fire. Environmental Management 19(4):591-600.

Rosen, P. C., and C. R. Schwalbe. 1996. Status of native and introduced species of aquatic herpetofauna at San Bernardino National Wildlife Refuge. Report to Arizona Game and Fish Department Heritage Program, IIPAM 195045, Phoenix, Arizona.

Semlitsch, R. D. 1981. Terrestrial activity and summer home range of the mole salamander *(Ambystoma talpoideu*m). Canadian Journal of Zoology 59:315-322.

_____. 1983. Burrowing ability and behavior of salamanders in the genus *Ambystoma*. Canadian Journal of Zoology 61:616-620.

Shaffer, H. B. 1983. Biosystematics of Ambystoma rosaceum and A. tigrinum on Northwestern New Mexico. Copeia 1983: 67-78.

Shannon, F. A. 1951. Notes on a herpetological collection from Oaxaca and other localities in Mexico. Proceedings of the United States National Museum 101:465-484.

Shoop, C. R. 1965. Orientation of *Ambystoma maculatu*m: Movements to and from breeding ponds. Science 149:558-559.

_____. 1968. Migratory orientation of *Ambystoma maculatu*m: Movements near breeding ponds and displacements of migrating individuals. Biological Bulletin 135:230-238.

_____, and T. L. Doty. 1972. Migratory orientation by marbled salamanders *(Ambystoma opacu*m) near a breeding area. Behavioral Biology 7:131-136.

Snyder, J. D. 1998. Ecology, management, and intellectual history of native and introduced species. Thesis, Arizona State University, Tempe, Arizona.

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

Spencer, C. N., and F. R. Hauer. 1991. Phosphorus and nitrogen dynamics in streams during a wildfire. Journal of the North American Benthological Society 10(1):24-30.

State of Arizona. 1990. Final report and recommendations of the Governor's riparian habitat taskforce. Executive Order 89-16, Streams and Riparian Resources, Phoenix, Arizona.

Stebbins, R. C. 2003. A field guide to western reptiles and amphibians, Third Edition. Houghton Mifflin, Boston, Massachusetts.

_____, and N. W. Cohen. 1995. A natural history of amphibians. Princeton University Press, Princeton, New Jersey.

Storfer, A. 2003. Emerging disease and amphibian declines. Pages 42-43 *in* Program Book for the 2003 Joint Meeting of Icthyologists and Herpetologists, Manaus, Amazonas, Brazil (abstract).

_____, J. P. Collins, and J. Snyder. 1999. Molecular genetic status of tiger salamanders on the Fort Huachuca Military Reservation. Report to Fort Huachuca, Arizona, contract #DABT63-99-P-0087.

Taylor, E. H. 1941. Two new ambystomatid salamanders from Chihuahua. Copeia 1941:143-146.

U.S. Fish and Wildlife Service. 1997a. Determination of endangered status for three wetland species found in southern Arizona and northern Sonora, Mexico. Federal Register 62(3):665-689.

_____. 1997b. Biological opinion and conference opinion, land and resource management plans, as amended, for eleven National Forests and National Grasslands in the Southwestern Region. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1999a. Biological opinion, ongoing and long-term grazing on the Coronado National Forest. U.S. Fish and Wildlife Service, Phoenix, Arizona.

_____. 1999b. Biological opinion and conference opinion, Coronado National Forest Lone Mountain Prescribed Fire, Cochise County, Arizona. U.S. Fish and Wildlife Service, Phoenix, Arizona.

_____. 2002a. Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) recovery plan. U.S. Fish and Wildlife Service, Phoenix, Arizona.

_____. 2002b. Biological opinion, continuation of livestock grazing on the Coronado National Forest. U.S. Fish and Wildlife Service, Phoenix, Arizona.

U.S. Forest Service. 2004. Biological Assessment on eleven land and resource management plans, USDA Forest Service, Southwestern Region.

Varela-Romero, A., C. Galindo-Duarte, E. Saucedo-Monarque, L. S. Anderson, P. Warren, S. Stefferud, J. Stefferud, S. Rutman, T. Tibbits, and J. Malusa. 1992. Re-discovery of *Gila intermedia* and *G. purpurea* in northern Sonora, Mexico. *In* D. A. Hendrickson, editor. Proceedings of the Desert Fishes Council. Volumes XXII and XXIII, 1990 and 1991 Annual Symposia, and Index for Volumes XVI Through XXIII, Desert Fishes Council, Bishop, California.

Whiteman, H. H., S. A. Wissinger, and A. J. Bohonak. 1994. Seasonal movement patterns in a subalpine population of the tiger salamander, *Ambystoma tigrinum nebulosum*. Canadian Journal of Zoology 72:1780-1787.

Ziemba, R. E., A. T. Storfer, J. Warren, and J. P. Collins. 1998. A survey of genetic variation among populations of the Sonora tiger salamander *(Ambystoma tigrinum stebbins*i). Report to Arizona Game and Fish Department Heritage Program, Phoenix, Arizona.

Huachuca Water Umbel

Affolter, J.M. 1985. A monograph of the genus *Lilaeopsis* (Umbelliferae). Systematic Botany Monographs 6:1-140.

Anderson, Greta. 2006. Huachuca water umbel in the Upper San Pedro watershed of Sonora, Mexico. A Section 6 Research Project for the US Fish and Wildlife Service in cooperation with the University of Arizona. Final Report to FWS.

Arizona Department of Water Resources. 1994. Upper San Pedro River case study. Pages 147-208 *in* Arizona Riparian Protection Program, legislative report. Arizona Department of Water Resources, Phoenix, Arizona, USA.

Arizona Game and Fish Department. 1997. Lilaeopsis schaffneriana ssp. recurva. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona, USA.

ASL Hydrologic and Environmental Services. 1998. Monitoring program and design report and groundwater modeling evaluation for Sierra Vista Water reclamation facility. Report to the city of Sierra Vista, Arizona, USA.

Bahre, C.J. 1991. A legacy of change: Historic human impact on vegetation of the Arizona borderlands. University of Arizona Press, Tucson, Arizona, USA.

Bryan, K. 1925. Date of channel trenching (arroyo cutting) in the arid southwest. Science 62:338-344.

Dobyns, H.F. 1981. From fire to flood: historic human destruction of Sonoran Desert riverine oases. Ballena Press, Socorro, New Mexico, USA.

EEC 2001 Final report – Huachuca water umbel surveys Cienega Creek Preserve, Bingham Cienega Preserve, La Cebadilla property Pima County, Arizona. Prepared for Pima County Flood Control District July 2001. 15 pages + appendices.

EEC 2004. Huachuca Water Umbel (*Lilaeopsis schaffneriana recurva*), Fort Huachuca Monitoring and San Pedro Riparian National Conservation Area; Directorate of Installation Support, U.S. Army Garrison, Fort Huachuca, Arizona, Environmental and Natural Resources Division; Engineering and Environmental Consultants, Inc., Tucson, Arizona.

Falk, D. and P.L. Warren. 1994. Rare plants of the Coronado National Forest: Population studies and monitoring recommendations. Report to the Coronado National Forest, Tucson, Arizona, USA.

Geraghty and Miller, Inc. 1995. Historical flows and conditions in the San Pedro River. Report to the Water Action Task Force, Sierra Vista Economic Development Foundation, Project No. AZ0473.001.

Gori, D.F., P.L. Warren, and L.S. Anderson. 1990. Population studies of sensitive plants of the Huachuca, Patagonia, and Atascosa Mountains, Arizona. Unpublished report. Forest Service, Coronado National Forest, Tucson, USA.

Haas, S. K and R. J Frye. 1997.Hydrology and water quality effects on Lilaeopsis schaffneriana ssp. recurva. ITALIC – check throughout - Project Report submitted to Wildlife Office, Fort Huachuca, Arizona and the Arizona Department of Agriculture by University of Arizona, Tucson, Arizona. 18pp

Hastings, J.R.and R.M. Turner. 1980. The changing mile. University of Arizona Press, Tucson, Arizona, USA.

Hendrickson, D.A., and W.L. Minckley. 1984. Cienegas - vanishing climax communities of the American southwest. Desert Plants 6(3):131-175.

Hereford, R. 1993. Geomorphic evolution of the San Pedro River channel since 1900 in the San Pedro Riparian National Conservation Area, southeast Arizona. Open File Report 92-339, U.S. Geological Survey.

Hill, A.W. 1926. The genus *Lilaeopsis*: A study in geographical distribution. Botanical Journal of Linnean Society 67:525-551.

Johnson, K., P.L. Warren, D.F. Gori and E.S. Monarque. 1992. Species management evaluation, cienega false-rush (Lilaeopsis schaffneriana ssp. recurva). Unpublished report prepared by The Nature Conservancy, Tucson, Arizona, USA.

Martin, S.C. 1975. Ecology and management of southwestern semidesert grass-shrub ranges: the status of our knowledge. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, USA.

McLaughlin, S. P. 2006. Vascular floras of Sonoita Creek State Natural Area and San Rafael State Park: Arizona's first natural area parks. Sida 22 (1): 661-704.

Saucedo-Monarque, E. 1990. Proyecto: Prospeccion de plantas raras en el norte de Sonora. Centro Ecologico de Sonora, Subdireccion de Investigacion, Area de Ecologia Terrestre, Hermosillo, Sonora, Mexico. 65 pp.

Shafer, C.L. 1990. Nature reserves, island theory and conservation practice. Smithsonian Institution Press, Washington D.C., USA.

Sheridan, T.E. 1986. Los Tucsonenses: The Mexican community in Tucson, 1854-1941. University of Arizona Press, Tucson, Arizona, USA.

Stromberg, J.C., and M.K. Chew. 1997. Herbaceous exotics in Arizona’s riparian ecosytems. Desert Plants 1997(2):11-17.

Titus, J.H. and P.J. Titus. 2006. Letter to Doug Ruppel, Manager of Babacomari Ranch, summarizing the results of a survey of the ranch for Huachuca water umbel conducted on September 29, 2006. Letter dated October 10, 2006.

Titus, P.J. and J.H. Titus. 2008. Ecological monitoring of the endangered Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*: Apiaceae). Southwestern Naturalist 53:458-465.

Titus and Titus pers com. 2011. E-mail correspondence with Priscilla and John Titus, September 19-20, 2011.

U.S. Fish and Wildlife Service. 1997. Endangered and threatened wildlife and plants; determination of endangered status for three wetland species found in southern Arizona and Northern Sonora, Mexico. Federal Register 62(3):665-689.

_____. 1999. Endangered and threatened wildlife and plants; designation of critical habitat for the Huachuca water umbel, a plant. Federal Register 64(132):37441-37453.

_____. 2004. Biological opinion on research and transplant efforts for Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *Recurva*) on the Leslie Canyon National Wildlife Refuge. Arizona Ecological Services Field Office. Phoenix, Arizona.

_____. 2008. Leslie Canyon Watershed (Bar Boot Ranch /99 Bar Ranch) Safe Harbor Agreement. Leslie Canyon National Wildlife Refuge, Douglas, Arizona and Arizona Ecological Services Office, Phoenix, Arizona. (AESO/SE 22410-2006-R-0724). 33 pp.

Warren, P.L., L.S. Anderson, and P.B. Shafroth. 1989. Population studies of sensitive plants of the Huachuca and Patagonia Mountains, Arizona. Unpublished report. Coronado National Forest, Tucson, Arizona. 99 pp.

_____, D.F. Gori, L.S. Anderson, and B.S. Gebow. 1991. Status report for *Lilaeopsis schaffneriana* ssp. *recurva*. US Fish and Wildlife Service, Arizona Ecological Services State Office, Phoenix, Arizona, USA.

_____, and F.R. Reichenbacher. 1991. Sensitive plant survey of Fort Huachuca, Arizona. Unpublished Report for the US Army, Fort Huachuca, Arizona, USA.

Webb, R.H., and J.L. Betancourt. 1992. Climatic variability and flood frequency of the Santa Cruz River, Pima County, Arizona. Water-supply Paper 2379. U.S. Geological Survey.

Wilcox, B.A., and D.D. Murphy. 1985. Conservation strategy: The effects of fragmentation on extinction. American Naturalist 125:879-887.

Pima pineapple cactus

Arizona Rare Plant Committee. 2001. Arizona rare plant field guide: A collaboration of agencies and organizations. U.S. Fish and Wildlife Service, Phoenix, Arizona, USA.

Benson, L. 1982. The Cacti of the United States and Canada. Stanford University Press, Stanford, California.

Davis, T. 2001. Developers buy ‘credits’ to build in similar habitat; land bank aims to protect cactus. AzStarNet (http://www.sahba.org/regaffairs10.htm).

Mills, G.S. 1991. Miscellaneous notes on Coryphantha scheeri var. robustispina. Unpublished report. U.S. Fish and Wildlife Service, Arizona Ecological Services Office, Phoenix, Arizona, USA.

U.S. Fish and Wildlife Service (FWS). 1993. Final rule to list the Pima pineapple cactus as an endangered species. Federal Register 58:49875-49879.

_____. 2002. News release: Arizona’s first private endangered species conservation bank approved. U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office, Phoenix, Arizona, USA.

_____. 2004. Biological opinion on proposed issuance of a Section 404 permit under the Clean Water Act to construct four road crossings in unnamed washes along an approximately 4,100 foot extension of Camino de la Canoa to reach the 96 acre Canoa Hills Estates, 02-21-03-F-0374. U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office, Phoenix, Arizona, USA.

_____. 2007. Five-year Status Review for the Pima pineapple cactus, 70 FR 5460. U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office, Phoenix, Arizona, USA.

_____. 2011. Biological opinion on the Proposed Reconfiguring of the Existing Traffic Interchange Ramp Connections between I-19 and Sahuarita Road 22410-2011-F-0343. U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office, Phoenix, Arizona, USA.

Appendix A: Not Likely to Adversely Affect Determinations

Appendix A documents our concurrence with your determination of "may affect, is not likely to adversely affect" for the species listed below. In addition, the FWS has provided a brief reasoning for these concurrences.

Jaguar (*Panthera onca*)
The FWS concurs with your determination that the continued implementation of the S&Gs within the Coronado NF LRMP may affect, but is not likely to adversely affect the jaguar for the following reasons:

1. Numerous photographs have been taken that document jaguars in southern Arizona; however, it is believed that few individuals utilize Arizona as part of their home range. Jaguar presence on the Coronado NF is extremely rare, and, therefore, we believe that adverse effects are extremely unlikely to occur and, thus, discountable.
2. Overall, the Coronado NF LRMP and its implementing S&Gs are positive for the long-term conservation and recovery of the jaguar.
3. The Coronado NF has low total miles and a low road density standard and there is no cross country travel allowed on the NF, which is positive for large carnivores such as the jaguar. Therefore, we believe effects related to travel and recreation are insignificant.
4. The Coronado NF also has the most land of any NF in the Region withdrawn from mineral entry. Therefore, we believe impacts related to mineral extraction are insignificant.
5. In addition the Coronado NF is a long standing member of the Jaguar Conservation Team, and the NF participates in the remote camera census program for jaguar detection along the international border with Mexico. This allows Coronado NF to be aware of and implement appropriate management activities related to the most up-to-date information pertaining to the status of the jaguar.

Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*) & Mexican long-nosed bat (*Leptonycteris nivalis*)
The FWS concurs with your determination that the continued implementation of the S&Gs within the Coronado NF LRMP may affect, but is not likely to adversely affect the lesser long-nosed bat (LLNB) and the Mexican long-nosed bat (MLNB) for the following reasons:

1. The 2005 BO/CO identified 83 S&Gs that were analyzed as having beneficial effects on the LLNB and 71 having beneficial effects on the MLNB. For the five S&Gs that received negative rankings, we concur with your belief that the potential negative effects are substantially less and less likely to occur than was previously understood. These five S&Gs are discussed below.
    a. Standard & Guideline 665, which was ranked as having sub-lethal effects to the LLNB and the MLNB in 2005, authorizes the collection of yucca, cactus, ocotillo, and other plants on a permit basis. Over the past three years, however, only ten agave plants have been harvested across the entire Coronado NF and State law generally prevents permitting the harvest of saguaro cactus. The USFS anticipates that the number of harvested agave plants for the entire Coronado NF

will similarly remain below ten plants for the duration of the LRMP. This low number of harvested plants coupled with the mobility and resourcefulness of the LLNB and the MLNB represents an insignificant effect on the available forage resources for the LLNB and the MLNB. Therefore, we believe that this S&G will result in immeasurable, and thus insignificant, effects.

b. Within the Forestry and Forest Health Program, S&G 697 states that chemicals may be used within guidelines approved by other agencies for the following purposes of using insecticides and rodenticides in recreation areas and administrative sites. Although this S&G allows for the use of insecticide or rodenticide which was previously considered sub-lethal to the long-nosed bats, such products are not expected to be used in LLNB and MLNB foraging habitat, or MLNB and LLNB known and potential roosts and are not identified as a threat to either bat species; in the rare instance that these chemicals would be used, however, the Coronado NF will follow approved guidelines including the FWS's *Recommended Protection Measures for Pesticide Applications in Region 2* (FWS 2007). Therefore, we believe that this S&G will not result in adverse effects to the LLNB or MLNB.

c. Standard & Guideline 702 from the Lands and Minerals Program allows for cyanide leaching as part of mining operations. As stated in the LRMP BA, there have been no permits for projects that use this approach on the Coronado NF in at least 20 years; further, in the rare instance that cyanide leaching may be used, other S&Gs and policies would provide for LLNB and MLNB protection by preventing contact between the species and the leaching agent. Therefore, it is extremely unlikely that adverse effects will occur as a result of this S&G, and we believe this S&G will result in discountable effects.

d. Two S&Gs (762 and 805) from the Rangeland Management Program were previously determined to have sub-lethal effects to the LLNB and the MLNB because of their effect on flowering agaves, a primary food source for these bats. Since 2004, however, the Coronado NF has moved to an adaptive range management approach that provides for a variety of acceptable tools and management actions to be used to achieve desired resource conditions. Site-specific section 7 consultations are conducted for each allotment-specific plan. After several years of monitoring agave herbivory on grazed versus non-grazed allotments, it appears that the effects of grazing on the long-nosed bats and their habitat are insignificant under the existing adaptive rangeland management direction due to the inclusion of strategies that insure periodic rest or deferment during the growing season, thus ensuring that only a small percentage of pastures supporting flowering agaves are grazed during any single growing season. These adaptive management measures will allow the Coronado NF to avoid any adverse effects to either bat species.

2. There has been no incidental take of LLNB or the MLNB on the Coronado NF since the 2004 BA and 2005 BO/CO.
3. The MLNB is not believed to occur in Arizona, and the only confirmed occurrences of the species on the Coronado NF were from 1963 and 1967 in Hidalgo County, New Mexico (FWS 2005). It is speculated that the MLNB forages on the Douglas Ranger

District of the Coronado NF; however, there are currently no known roosts on the Coronado NF.

4. The Coronado NF implements CMs that provide for the protection of roost sites and potential roost sites. Measures such as pre-project surveys, installation of gates, and temporal and spatial restrictions, are likely mitigate most risks to the LLNB.

Ocelot (*Leopardus pardalis*)

The FWS concurs with your determination that the continued implementation of the S&Gs within the Coronado NF LRMP may affect, but is not likely to adversely affect the ocelot for the following reasons:

1. Overall, the S&Gs in the Coronado NF LRMP provide for the long-term conservation and recovery of the ocelot. Positive aspects include a focus on restoration ecology and maintaining areas of limited disturbance that ocelots may use.
2. Vehicle use on the Coronado NF may disturb ocelots, but the Coronado NF has a low road density standard and no cross country travel allowed, which will limit this disturbance. Considering the low density of ocelots we expect on the Coronado NF, we believe effects related to vehicle use are unlikely to occur and, thus, discountable.
3. Effects to ocelot habitat from fire/fuel management, including prescribed fire, may result in reducing some cover for ocelots in some areas, but we anticipate that these effects would be insignificant because treatments would be limited in size and vegetation would respond quickly after treatment, eventually providing cover for ocelot. Fire/fuel management may also have indirect benefits to the ocelot by improving prey base habitat productivity through increased plant vigor.
4. The Coronado NF has the third highest recreation use in the Southwestern Region, and effects to ocelots resulting from recreation activities may include avoidance, habituation, displacement, habitat modification or loss, and a potential for illegal shooting; however, considering the low density of ocelots we expect on the Coronado NF, we believe these effects are extremely unlikely to occur and, thus, discountable.
5. Ocelot presence on the Coronado NF is extremely rare, and, therefore, we believe that adverse effects are extremely unlikely to occur and, thus, discountable.

Northern aplomado falcon (*Falco femoralis septentrionalis*) Non-essential experimental §10(j) Experimental population

The FWS concurs with your determination that the continued implementation of the S&Gs within the Coronado NF LRMP is not likely to jeopardize the continued existence of the §10(j) non-essential, experimental population of the northern aplomado falcon for the following reasons:

1. No nesting or foraging northern aplomado falcons are known to occur on NFS lands in the Region, including the Coronado NF. This is based on a lack of observations during breeding bird surveys and nest surveys.
2. Currently, moderately suitable foraging and nesting habitat occurs on the Coronado NF; however, this area is located approximately 60 miles from the recently successful nest site near Deming, New Mexico.
3. Due to the presence of moderately suitable habitat on the Coronado NF, there is the potential that habitat on the Forest could be colonized over the next five to 10 years.

Provisions for dealing with northern aplomado falcons, including conducting surveys and protecting nesting and foraging habitats would be implemented if the species is found on USFS lands. If aplomado falcons are found on the Coronado NF during the life of the plan, this consultation would be re-evaluated and reinitiation would occur if needed.

4. By definition, a nonessential experimental population is not essential to the continued existence of the species; therefore, no proposed action impacting the experimental, nonessential population so designated under the ESA §10(j) could lead to a jeopardy determination for the entire species.

Yaqui catfish Critical Habitat

The FWS concurs with your determination that the continued implementation of the S&Gs within the Coronado NF LRMP is not likely to destroy or adversely affect the CH for the Yaqui catfish for the following reasons:

1. Critical habitat for the Yaqui catfish occurs 10 to 15 miles down intermittent channels from the NFS boundaries. Any potential effects to CH would likely be insignificant or discountable due to the linear separation and intermittency of draws between NFS lands and CH for the Yaqui catfish.
2. Indirect effects associated with activities should also be avoided by implementation of S&G 676, which allows other resource activities to occur only to the extent that they benefit or do not adversely affect Yaqui catfish. This includes effects to CH and PCEs.

Yaqui chub Critical Habitat

The FWS concurs with your determination that the continued implementation of the S&Gs within the Coronado NF LRMP is not likely to destroy or adversely affect the CH for the Yaqui chub for the following reasons:

1. Critical habitat for the Yaqui chub occurs 10 to 15 miles down intermittent channels from the NFS boundaries. Any potential effects to CH would likely be insignificant or discountable due to the linear separation and intermittency of draws between NFS lands and CH for the Yaqui chub.
2. Indirect effects associated with activities should also be avoided by implementation of S&G 676, which allows other resource activities to occur only to the extent that they benefit or do not adversely affect Yaqui chub. This includes effects to CH and PCEs.

Canelo Hills Ladies'-Tresses

The FWS concurs with your determination that the continued implementation of the S&Gs within the Coronado NF LRMP may affect, but is not likely to adversely affect the Canelo Hills ladies'-tresses for the following reasons:

1. As was the case during the 2005 BO/CO, there is only one location of this species on the Coronado NF, and that area is protected by a fence and excluded from livestock grazing.
2. Suitable habitat that may be present on the Coronado NF is protected by the S&Gs that give priority to managing these areas (Management Area 7a) to protect the productivity and diversity of riparian-dependent resources.
3. The Coronado NF has protective S&Gs in place to mitigate the effects of Forest activities on occupied habitat of listed species

Appendix B: Abbreviations and Acronyms

AGFD – Arizona Game and Fish Department

ATV – *Ambystoma tigrinum* virus

AZ - Arizona

BA – Biological Assessment

BLM – Bureau of Land Management

BMPs – Best Management Practices

BO – Biological Opinion

BO/CO – Biological/Conference Opinion

BRW – Basin and Range West Recovery Unit

CA – Consultation Agreement

CH - Critical Habitat

CLF – Chiricahua leopard frog

CMs – Conservation Measures

CO – Conference Opinion

EMU – Ecosystem Management Unit

ESA – Endangered Species Act

ft. - feet

FWS – U.S. Fish and Wildlife Service

GIS – Geographical Information Systems

HCP – Habitat Conservation Plan

LAA – May Affect, Likely to Adversely Affect

LLNB – lesser long-nose bat

LRMP – Land and Resource Management Plans (Forest Plans)

MA – Management Area

MGRS – Mount Graham red squirrel

mi. – miles

MSO – Mexican spotted owl

NA – Not Applicable

NE – No Effect

NF – National Forests

NEPA – National Environmental Policy Act

NFMA – National Forest Management Act of 1976

NFS – National Forest System

NG – National Grasslands

NLAA – May Affect, Not Likely to Adversely Affect

NLDAM – Not Likely to Destroy or Adversely Modify

NLJ – Not Likely to Jeopardize

NM – New Mexico

NMGFD – New Mexico Game and Fish Department

NMRNR – New Mexico ridge-nosed rattlesnake

NWR – National Wildlife Refuge

OHV – Off Road Vehicle

PAC – Protected Activity Center

PCE – Primary Constituent Element

PEM – Pinaleno Ecosystem Management

PERP – Pinaleno Ecosystem Restoration Project

RD – Ranger District

S&Gs – Standards and Guidelines

Sq - square

STS – Sonora Tiger Salamander

TNC – The Nature Conservancy

U.S. – United States

U.S.D.A. – U.S. Department of Agriculture

USFS – U.S. Forest Service

WFRP – Wildlife, Fish, and Rare Plants Program

WUI – Wildland Urban Interface