United States Department of the Interior

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In Reply Refer To:
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April 1, 2008

To: Regional Director, Fish and Wildlife Service, Albuquerque, New Mexico
(Attn: L. Roberts)

From: Field Supervisor

Subject: Intra-Service Biological and Conference Opinion - Issuance of a Section 10(a)(1)(B) Permit to Salt River Project for Incidental Take of Threatened and Endangered Species Associated With Operation of Horseshoe and Bartlett Reservoirs

This biological and conference opinion responds to the request for consultation with the Arizona Ecological Services Office pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act). At issue are impacts that may result from issuance of a permit in accordance with section 10(a)(1)(B) (permit) of the Act for incidental take of threatened and endangered species associated with operation of Horseshoe and Bartlett dams and reservoirs by Salt River Project (SRP) in Maricopa and Yavapai counties, Arizona. Issuance of the permit may affect the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (flycatcher) and its critical habitat, the threatened bald eagle (*Haliaeetus leucocephalus*), the threatened spikedace (*Meda fulgida*), the threatened loach minnow (*Tiaroga cobitis*), the endangered razorback sucker (*Xyrauchen texanus*) and its critical habitat, the endangered Gila topminnow (*Poeciliopsis occidentalis*), and the section 10(j) experimental, non-essential population of endangered Colorado pikeminnow (*Ptychocheilus lucius*).

Consistent with our policies concerning intra-service consultations and for the purposes of this opinion, we also consider the other affected species: candidate yellow-billed cuckoo (*Coccyzus americanus*) (cuckoo), roundtail chub (*Gila robusta*), Sonora sucker (*Catostomus insignis*), desert sucker (*Catostomus clarki*), longfin dace (*Agosia chrysogaster*), speckled dace (*Rhinichthys osculus*), lowland leopard frog (*Rana yavapaiensis*), narrow-headed gartersnake (*Thamnophis rufipunctatus*), and northern Mexican gartersnake (*Thamnophis eques megalops*) as if they were proposed to be listed as threatened or endangered.

Hereinafter, the spikedace, loach minnow, razorback sucker, Gila topminnow, Colorado pikeminnow, roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, and northern Mexican gartersnake will be referred to as "aquatic species" due to the similarities with respect to effects of the action and the associated mitigation and minimization actions, unless otherwise specified.

This biological opinion was prepared using information from the following sources: the Fish and Watershed Committee Report (Fish and Watershed Committee 2006), the final habitat conservation plan (HCP) (ERO 2008), final environmental impact statement (EIS) (USFWS 2008), and information in our files. We actively participated in the preparation of the Committee Report, HCP, and EIS; and those documents provide additional detail and supporting information for this biological and conference opinion and are hereby incorporated by reference. A complete administrative record of this consultation is on file in our office.

CONSULTATION HISTORY

- March 31, 2003: Informal consultation on this project began with a meeting among staff from this office and SRP. Initial meeting discussions focused on how SRP's future operation of Horseshoe and Bartlett reservoirs may result in the incidental take of flycatcher, bald eagle, and cuckoo.

- April – June 2003: Interagency meetings were held to discuss effects to other aquatic and semi-aquatic species.

- July 15, 2003: A public scoping meeting was held for the purpose of announcing our intention of preparing an EIS to evaluate the impacts of, and alternatives to, the issuance of an incidental take permit (ITP) to SRP authorizing incidental take of threatened and endangered species associated with operation of Horseshoe and Bartlett dams over a fifty-year period.

- July 25, 2007: We published a Notice of Availability of Draft Environmental Impact Statement, Section 10 Permit Application, Draft Horseshoe-Bartlett Habitat Conservation Plan, and Draft Implementing Agreement for Incidental Take by SRP, and Notice of a Public Hearing for the purpose of soliciting public comments on these documents.

- September 11, 2007: A public hearing presented project information and background material and received both oral and written comment from the public on the draft EIS and HCP.

- 2003-2007: Numerous meetings were held to develop the habitat conservation plan and the accompanying environmental impact statement. Meeting participants included representatives from SRP, their contractor (ERO Resources Corporation) (ERO), the City of Phoenix (who owns entitlements to conservation space in Horseshoe Reservoir), the Arizona Game and Fish Department (AGFD), the Arizona Department of Water Resources (ADWR), and us[1].

[1] Meeting records are maintained in our files and available upon request.

- 2003-2007: An Advisory Group was formed in 2003 and met on several occasions. This group consisted of state and Federal agencies, Indian tribes, cities, recreational groups, and environmental groups.

- March 7, 2008: A draft biological opinion was provided for stakeholder review.

- March 21, 2008: Comments were received on the draft biological opinion.

- March 28, 2008: A revised draft biological opinion was provided for stakeholder review.

- March 31, 2008: Additional comments on the draft biological opinion were received from SRP and its contractors, and incorporated.

BIOLOGICAL AND CONFERENCE OPINION

DESCRIPTION OF PROPOSED ACTION

The proposed action is issuance of a permit to SRP by Region 2 of the Fish and Wildlife Service, in accordance with section 10(a)(1)(B) of the Act, for incidental take of flycatcher, bald eagle, spikedace, loach minnow, razorback sucker, Gila topminnow, and Colorado pikeminnow associated with the modified operations of Horseshoe and Bartlett dams. The cuckoo and the remaining aquatic species would also be covered by the permit if listed in the future.

The permit would be issued with mandatory conditions, which are also part of the proposed action. The actions that would cause the incidental take - modified operation of both Horseshoe and Bartlett and their respective storage space at elevations 2026 feet and 1798 feet, and measures proposed to minimize, mitigate, and monitor the take - are not actions proposed by us. Operation of the dams as proposed, together with implementation of the proposed minimization, mitigation and monitoring measures, are indirect effects of the proposed action and by regulation (50 C.F.R. § 402.02), must be evaluated herein. Permit conditions, operation of the dams, and mitigation, minimization, and monitoring measures are described below. Additional details about the proposed action and related activities can be found in ERO (2008) and U.S. Fish and Wildlife Service (2008a).

Permit Conditions:

The complete text of the permit conditions appear in Appendix 11 of ERO (2008). Key provisions include:

1) the duration of the permit is 50 years,

2) the permit is in effect for currently listed species on the date the permit is signed and will be in effect for the cuckoo and the remaining aquatic species upon the date any one or more of these species is listed (if listed),

3) take of listed species is permitted (generally indexed to unavailability/loss of, or adverse effects to habitat) as follows:

a. Flycatcher and cuckoo: not to exceed 200 acres averaged annually (or up to 400 acres averaged annually with adaptive management),

b. Aquatic species: 33.9 river miles,

c. Bald eagle – loss of eggs or fledglings due to inundation of nest trees within the conservation space of Horseshoe or Bartlett reservoirs.

4) the permit may be suspended if the permittee is not in compliance with the conditions of the permit or applicable Federal law or regulations,

5) the permit may be revoked in accordance with applicable regulations and policies,

6) changed circumstances are defined and measures are described that would be taken if such circumstances occur during the life of the permit,

7) required notifications and procedures in the event of unforeseen circumstances are defined, including the no surprises policy, and

8) procedures for amending and renewing the permit are set forth.

Optimum Operation of Horseshoe and Bartlett:

Horseshoe and Bartlett would continue to be operated by SRP in a manner consistent with their purpose as water storage reservoirs and to minimize spills of water past Granite Reef Dam. Under the Optimum Operation Alternative (ERO 2008), two main objectives would be added to the historical operations: 1) maintain tall dense vegetation in Horseshoe, and 2) manage Horseshoe water levels to minimize impacts to covered aquatic species. The addition of those two objectives will ensure the following conditions for Horseshoe and Bartlett:

1) Maintain the safety and integrity of the dams.

2) Maintain sufficient storage to meet water delivery obligations.

3) Optimize reservoir storage within the reservoir system.

4) Maintain adequate carryover storage in case of low runoff.

5) Conjunctively manage groundwater pumping given reservoir storage and projected runoff and demand.

6) Maximize hydrogeneration.

7) Permit necessary facility maintenance.

8) Support stands of tall dense vegetation at the upper end of Horseshoe.

9) Manage Horseshoe water levels to minimize impacts to covered aquatic species.

To accomplish item # 8, SRP will modify reservoir operations to maintain riparian vegetation at higher elevations in the reservoir (see Subchapter II.B.3 of the HCP). After two successive years of low water levels due to drought, Horseshoe will be filled ahead of Bartlett, if feasible, to provide water to tall dense vegetation at the upper elevations of Horseshoe. To accomplish item # 9, the goal is for the earlier and more rapid drawdown of Horseshoe (whenever feasible in the spring) to reduce impacts on native fish, frog, and gartersnake species by decreasing nonnative fish production. These drawdowns also will minimize impacts on flycatchers and cuckoos by making more habitat available early in the breeding season. Combined with the normal cycle of reservoir levels, which serve to establish and maintain riparian habitat in the reservoir, the modified reservoir operations will minimize impacts on flycatcher and cuckoo habitat, as well as impacts on covered aquatic species.

SRP operates Horseshoe and Bartlett on the Verde River in conjunction with the Salt River reservoirs and a small reservoir on upper East Clear Creek in the Little Colorado River watershed, which has a trans-basin diversion to the East Verde River. SRP manages the entire SRP reservoir system, as well as ground water pumping and short-term CAP supplies, to meet water demands in its service area, to minimize releases of water downstream of Granite Reef Diversion Dam, and to meet other operational objectives (dam safety, water right obligations, etc.) summarized in ERO (2008).

A number of factors affect SRP's operation of Horseshoe and Bartlett, including the amount and timing of Verde River runoff, water demand in the SRP service area, the amount of runoff and storage on the Salt River side of the system, and balancing of the various operational objectives. Historically, when runoff on the Verde has resulted in Horseshoe storage, SRP releases that water first in order to minimize evaporation losses and to make room for additional runoff. Likewise, a high percentage of Bartlett stored water is used each year because that use creates additional storage space to capture Verde runoff. Thus, much of the SRP water demand during the winter and early spring is met from Horseshoe and Bartlett. SRP typically shifts most of its water releases to the Salt River reservoirs in late April or early May to meet the larger summer water demands and to generate hydropower. However, a year-round minimum release of 100 cfs is maintained from Bartlett under an agreement with the Fort McDowell Yavapai Nation (FMYN) (ERO 2008).

Under SRP's proposed Optimum Operation Alternative, accomplishment of the two additional operational objectives (to support tall dense riparian vegetation and minimize impacts to covered aquatic species) can be affected by the amount and timing of Salt and Verde runoff, water demand in the SRP service area, and the other operational objectives. For example, temporarily storing water in Horseshoe Reservoir during a drought to support riparian vegetation depends on having adequate runoff to store water; and Horseshoe Reservoir draw down would be delayed when high Salt River runoff fills the SRP space on that part of the system (ERO 2008).

Mitigation, Minimization, Monitoring, and Adaptive Management Measures:

<u>Southwestern Willow Flycatcher & Western Yellow-billed Cuckoo</u>

Mitigation for the cuckoo and flycatcher are addressed in combination because on-site and off-site minimization and mitigation measures will benefit both species equally as habitat requirements for cuckoos and flycatchers overlap to a large degree, with both species requiring blocks of tall dense riparian vegetation near open water for foraging and nesting. SRP will purchase mitigation lands as part of the off-site mitigation for these species. The subtle differences in habitat requirements and use between the two species include: 1) flycatchers tend to use nest sites that are closer to water than cuckoos; 2) cuckoos do not nest as closely together as flycatchers; and 3) cuckoos appear to prefer at least 10-acre blocks of habitat for nesting and foraging, and generally do not use more narrow strips of habitat.

SRP will use the following selection criteria in acquiring mitigation lands for these species:

1) Cuckoos benefit from the creation or protection of riparian areas composed of dense riparian woodlands.

2) For cuckoos, riparian woodlands should be at least 10 acres in size.

3) Riparian woodlands should be provided in blocks rather than in strips.

4) To the degree feasible, riparian habitat should be located in areas that favor a natural succession of vegetation so that there will be periodic establishment of dense riparian vegetation patches, which would provide high complexity of habitats available for breeding season needs of both cuckoo and flycatcher. Dense riparian habitat appears to be an important factor in nest site selection (FWS 2001a).

Horseshoe Reservoir Operation to Benefit Flycatcher and Cuckoo

SRP will modify reservoir operations to make riparian habitat available earlier in the nesting season and to maintain riparian vegetation at higher elevations in the reservoir whenever possible. Earlier and more rapid drawdown of Horseshoe whenever feasible in the spring minimizes impacts on flycatchers and cuckoos by making more habitat available early in the breeding season. As stated previously, after two successive years of low water levels due to drought, Horseshoe will be filled ahead of Bartlett, if feasible, to provide water to tall dense vegetation at the upper elevations of Horseshoe where the majority of occupied flycatcher habitat occurs. Combined with the normal cycle of reservoir levels, which serve to establish and maintain riparian habitat in the reservoir, these modified reservoir operations are designed to minimize impacts on flycatcher and cuckoo habitat.

Mitigation Habitat Acquisition and Management

The maximum amount of occupied flycatcher and cuckoo habitat that is anticipated to be unavailable due to the operation of Horseshoe and Bartlett under the Optimum Operation Alternative is 200 acres on average. These 200 acres are not expected to be permanently lost and the actual amount from year to year in Horseshoe will vary spatially and temporally in the reservoir.

At least 200 acres of mitigation habitat will be acquired and managed in perpetuity to provide permanent habitat for flycatchers and cuckoos. The acquired lands will have either currently occupied flycatcher and cuckoo habitat, or habitat that is expected to support flycatchers and cuckoos in the future through improved management. In addition, SRP will fund and implement a program to protect the water supply for the mitigation habitat.

The habitat acquisition process and subsequent management will involve three components: 1) acquisition of suitable riparian habitat and/or placement of conservation easements for habitat protection in perpetuity; 2) establishment and implementation of permanent management strategies for that habitat; and 3) water supply protection for the mitigation lands. Priority in habitat acquisition will be given to properties that are currently not protected but used as migration or nesting habitat which are adjacent to existing mitigation lands acquired for the Roosevelt HCP, within the Verde Management Unit for flycatcher critical habitat, or in known migratory and nesting corridors as recommended in the flycatcher recovery plan (FWS 2002a). Therefore, SRP has identified mitigation property of up to 50 acres along the Verde River within the Verde Valley, at least 150 acres in the Safford Valley along the Gila River, and the balance of habitat along the San Pedro River (or other identified river reaches necessary to reach 200 acres, or up to 400 acres if adaptive management is necessary). Other considerations for selecting mitigation habitat include 1) properties where stresses to riparian habitat such as water diversions, grazing and adverse recreational uses, and stream channelization are minimized as much as possible; and, 2) properties that are spatially disjunct from one another to avoid risk of risk of simultaneous catastrophic loss.

Adaptive management will be employed to address increases in impacts greater than 200 acres, if they occur. Increased impacts will be detected through monitoring (described below), and additional mitigation and minimization measures will be implemented for up to 200 acres of additional habitat impacted to address these changed circumstances.

Within 1 year of the effective date of the signed Permit, SRP has proposed to have secured at least 150 acres of occupied or suitable flycatcher mitigation habitat; and within 10 years of Permit issuance, SRP will pursue another 50 acres of mitigation habitat with a focus on purchasing suitable habitat in the Verde Valley. If 50 acres cannot be purchased in the Verde Valley, other alternatives will be evaluated.

Adaptive Management

SRP proposes three types of adaptive management: 1) acquisition of additional habitat if impacts at Horseshoe are predicted to exceed the 200-acre threshold; 2) additional management measures on mitigation properties in response to changed circumstances; and, 3) brown-headed cowbird (*Molothrus ater*) (cowbird) management.

Additional acquisition of mitigation land will be implemented by SRP if monitoring indicates that the weighted average amount of occupied flycatcher habitat expected to be unavailable in future years at Horseshoe would exceed 200 acres with the assistance of predictive modeling based on all available information on Horseshoe inflows, vegetation, and flycatcher occupation. Specifically in such case, SRP will acquire and manage additional mitigation land within 5 years to address impacts for up to an additional 200 acres of unavailable occupied habitat, for a total of 400 acres.

SRP will employ adaptive management to address age-class diversity, cottonwood-willow overstory, invasive species, fire, or other threats to the acquired habitat (Appendix 7 of the HCP).

Lastly, SRP will adaptively manage for cowbird parasitism that may adversely affect the nest success of flycatchers or cuckoos on mitigation lands. SRP will base this decision to initiate cowbird management (trapping, etc.) on mitigation properties on a number of site-specific factors including the host population's current size, recent population trend, parasitism rate, amount of suitable habitat, and the extent of the losses attributable to cowbird parasitism (Rothstein et al. 2003). Parasitism rates of flycatchers, and the combined rate of parasitism on flycatcher and surrogate species will be reported as the number of flycatcher parasitized nests/number of flycatcher nests and as the number of all parasitized nests/number all nests, annually. The adaptive management threshold for parasitism will be initially set at 20-30 percent, but may be adjusted in coordination with agency personnel and according to future research findings.

Detailed information on proposed activities regarding flycatcher and cuckoo mitigation, minimization, monitoring, and adaptive management measures can be found in ERO (2008).

Bald Eagle

Adaptive Management

SRP will minimize impacts if bald eagle nests are established in Horseshoe or Bartlett. SRP will discuss with agency personnel the need to rescue eggs or chicks threatened by inundation for subsequent reintroduction into the original nest after the water subsides or introduction into a foster nest in another territory if a bald eagle establishes a nest below the high water mark of the reservoirs, which is found during monitoring.

SRP will cooperatively develop a coordinated plan to identify when rescue actions would be required and the process to rescue any bald eagles, bald eagle eggs, or nestlings at Horseshoe or Bartlett. The plan will include triggers for winter monitoring at appropriate effort and frequency to determine if a nest has been built in the conservation space of the reservoir and the likelihood that the nest would be impacted by spring storage.

The plan will be complete within one year of Permit issuance, implementation will begin within two years of Permit issuance, and the plan will last for the duration of the Permit. If a bald eagle nest is built below the high water mark within the footprint of the reservoirs during the life of the Permit, SRP will construct an alternative nest structure in the immediate area and maintain such structure for the remaining duration of the Permit, which was successful at Horseshoe in the late 1970s and 1980 (Ohmart and Sell 1980; Grubb 1980).

Monitoring for Avian Species

SRP will monitor compliance with the terms and conditions of the permit and the effectiveness of minimization and mitigation measures throughout the permit's 50-year duration. The goal for monitoring efforts is to assess the population status, trends, and habitat condition. Specific monitoring goals include:

1) Vegetation: At Horseshoe, the goal is to monitor the condition and distribution of riparian vegetation to assist in predicting future impacts to flycatcher and cuckoo habitat. At mitigation sites, the goal is to monitor the status of riparian and other vegetation to determine if management measures need to be implemented or modified.

2) Flycatchers: At Horseshoe, the goal is to monitor habitat occupied by flycatchers to ensure compliance with the Permit, including whether adaptive management is required, and to detect long-term trends in population. At mitigation sites, the goals are to monitor species status and population trends, and cowbird parasitism.

3) Cuckoos: At Horseshoe, the goal is to monitor long-term trends in populations. At mitigation sites, the goals are to monitor species status and population trends, and cowbird parasitism.

4) Bald Eagles: The goal is to monitor potential bald eagle nesting in Horseshoe and Bartlett.

Specific monitoring plans for avian species are outlined in ERO (2008) and incorporated herein by reference.

Aquatic Species

SRP has proposed a minimization and mitigation package for aquatic species that focuses on three main objectives to offset adverse effects to 33.9 river miles from reservoir operations and/or improve the environmental baseline for these species in the action area:

1. Minimizing or reducing nonnative fish reproduction, recruitment, and movement at Horseshoe;

2. Augmenting/increasing native fish populations, distribution, and relative abundance; and

3. Working to maintain water flows in the Verde River above Horseshoe through watershed management activities.

To accomplish the above objectives, SRP has proposed the following activities as mitigation and minimization measures:

Rapid Drawdown

The rapid drawdown component of the Optimum Operation Alternative will reduce adverse impacts on native fish by adversely affecting the recruitment and growth of nonnative predators and competitors. As specified previously, this operational strategy minimizes the habitat available for reproduction and recruitment of nonnative fish species that utilize Horseshoe Reservoir during the spring and early summer months of each year when the majority of nonnative species are engaged in reproductive behaviors. The hastened drawdown of Horseshoe Reservoir each spring (when water storage is not intentionally maintained to improve or sustain flycatcher and cuckoo habitat) should also adversely affect eggs that may have been previously deposited, depending on the species and the temperature of the water. Rapid drawdown has been allocated 21.4 river miles of mitigation credit.

Stocking of Native Fish Species into Horseshoe or Elsewhere

SRP will provide funding support for stocking native fish species, such as razorback suckers in Horseshoe when recruitment conditions may be favorable. For razorback suckers in their critical habitat, these stocking measures likely will be implemented in the winter months, every 3 to 4 years on average, during high water years and in years when the flycatcher habitat maintenance goal is in effect. For other native species, stocking efforts will target appropriate times of the year and in appropriate areas within the Verde River watershed, dependent on the habitat requirements of the species considered, as to provide maximum conservation benefit as well as survivorship of stocked fish. Stocking decisions will be made collaboratively in cooperation with appropriate agencies and partners. Fish stocking has also been allocated 21.4 river miles of mitigation credit.

Install and Maintain a Fish Barrier on Lime Creek

SRP will pay 100 percent of the cost of construction and maintenance of a fish barrier on Lime Creek (a tributary to the Verde River on Tonto National Forest lands that drains directly into Horseshoe Reservoir) to directly benefit the Gila topminnow, longfin dace, and lowland leopard frog by preventing upstream movements of nonnative species from the reservoir into Lime Creek. Installing this fish barrier has been allocated 3.4 river miles of mitigation credit.

Bubbling Ponds Native Fish Hatchery Improvements and Support

SRP will provide $500,000 in funding and in-kind support for planning, design, engineering, and fund-raising to improve and expand AGFD's Bubbling Ponds Native Fish Hatchery. This hatchery is located along lower Oak Creek near the community of Sedona and will used to produce native fish species in cooperation with this project and other native fish recovery projects implemented by the AGFD. The northern Mexican gartersnake and lowland leopard frog may also directly benefit from expanded operational capacity at Bubbling Ponds by increasing the amount of habitat available to these species which is free of nonnative predators as well as providing further opportunities for propagation and head-starting activities. The mitigation credit for this component is 15.7 river miles.

Watershed Management Efforts

SRP will continue, and expand where feasible, watershed management efforts to maintain or improve stream flows of the Verde River to help ensure adequate flow in future years. In recent years, these efforts have included the following activities, as examples:

> 1) Aerial Photos: Aerial photos of the Verde watershed are flown approximately every five years. These photos can be used for various management and monitoring purposes. For example, photos were recently made available to Scott Bonar and his graduate students at the University of Arizona for their study of native and nonnative fish and their habitats (Bonar et al. 2004).
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> 2) GIS Data: GIS coverages and data files are developed and updated for land and water uses in the Verde watershed, which are used for management and monitoring.

3) Staff Time and Expenses: SRP Water Group staff, consultants, and attorneys participate in a wide variety of studies, meetings, forums, groups, legal proceedings, and other activities involving Verde River water management.

4) Funding of Watershed Initiatives and Education: SRP has funded a variety of educational programs and watershed restoration initiatives through collaborative partnerships and will seek to continue similar funding into the future.

The minimization and mitigation credit for future watershed management efforts has been allocated at 8.0 river miles.

The cumulative mitigation credit for aquatic species assigned to the proposed SRP mitigation measures discussed above totals nearly 70 river miles (200 percent above the total river miles estimated to be affected by reservoir operations).

Monitoring for Aquatic Species

Monitoring of aquatic species and the effectiveness of the minimization and mitigation measures will be accomplished by periodic surveys in Horseshoe, and at several locations on the Verde above and below Horseshoe and Bartlett. Different strategies will be employed for native fish than for gartersnakes and the leopard frog to accomplish the goals and objectives for each.

The goal of native fish monitoring is to assess fish communities, including species composition and age-class structure, with an emphasis on detecting movement of nonnative fish from Horseshoe. To evaluate fish movement, monitoring efforts will be focused on the area within and immediately upstream of Horseshoe Reservoir during the initial five years of the project. Nonnative fish that are large enough will be tagged or marked to provide data on survivorship and movement patterns, in order to assess the effectiveness of the minimization and mitigation measures.

The goal of the gartersnake and leopard frog monitoring is to collect gross data on species status and general population trends. Ideally, these data can be combined with other monitoring data collected by other parties to provide better insight into long term population trends of these rare and difficult to monitor species within the action area. Fish community monitoring efforts described above will also assess the effectiveness of the minimization and mitigation measures on reducing nonnative predation on and competition with the frog and gartersnake species.

Exact monitoring locations and dates will be cooperatively planned by the AGFD, SRP, and us on an annual basis. Monitoring activities proposed for all covered aquatic species are described in greater specificity in ERO (2008) and incorporated herein by reference.

Adaptive Management for Aquatic Species

SRP has proposed to address potential changes of circumstances for aquatic species as follows:

a. If efforts to improve and expand the Bubbling Ponds Native Fish Hatchery are unsuccessful for any reason, SRP will provide remaining funds and fund-raising support for improvements and operation of another native fish hatchery, or such other measures designated by us in consultation with AGFD.

b. If we, in cooperation with AGFD, determine that a different location(s) in the action area or Verde River watershed should be stocked with razorback suckers or other listed species covered by the HCP, and those locations are found to be of equal or greater conservation benefit to the species, SRP's funding support would be redirected to that effort.

c. If we, in coordination with SRP and AGFD, determine that the minimization and mitigation actions are proving to be ineffective in achieving the desired result of mitigating impacts on native fish, SRP will provide remaining funds for nonnative fish control efforts in select mainstem reaches or tributaries in the Verde watershed or such other measures designated by us in consultation with AGFD.

d. If it is not feasible to construct a barrier on Lime Creek, funding would be redirected toward construction of a barrier on another Verde River tributary, which would be selected in consultation with us, SRP, AGFD, and other interested agencies.

e. If monitoring efforts find nonnative fish have invaded from downstream to the area above the barrier in Lime Creek, SRP will fund rehabilitation of upper Lime Creek or contribute the same amount of funding to rehabilitation of another tributary.

f. If monitoring associated with this project or other monitoring efforts detect a Horseshoe-tagged fish within the action area above Beasley Flat (Reach 5), monitoring locations will be prioritized in subsequent year(s) to focus sampling in both Reach 5 of the Verde mainstem and at other sites near the boundaries of the action area. If either 1) more than one Horseshoe-tagged fish is found in any one year in Reach 5; or, 2) a single Horseshoe-tagged fish is found in Reach 5 in two successive annual surveys, SRP will initiate adaptive management. Such adaptive management will include SRP providing a 10 percent increase in funding to hatchery and stocking efforts or redirecting those funds to other native fish projects (e.g., renovations, etc.) in the Verde basin, in coordination with us and AGFD.

If a Horseshoe-tagged fish is detected in two successive years or more than one Horseshoe-tagged fish is detected in any one year, outside of the action area, a Permit amendment will be sought.

SRP Management, Coordination, and Reporting

SRP proposes to establish and maintain a half-time staff position in its Environmental Services Department to manage and coordinate implementation of this HCP. The person filling this position will be required to have previous experience with management of biological resource issues. The primary responsibility for this staff position will be to ensure that the HCP is fully implemented including all adaptive management, monitoring and reporting measures. The following tasks will be included in the job description:

1) Manage the acquisition of mitigation lands including identification, purchase, start-up activities (e.g., environmental clean-up if needed and fence construction), preparation of management plans, and providing for ongoing management.

2) Coordinate with SRP reservoir operators on optimum reservoir operations.

3) Implement native fish, frog, and gartersnake mitigation measures in coordination with FWS and AGFD.

4) Conduct vegetation monitoring at Horseshoe.

5) Contract for native fish, frog, and gartersnake monitoring, and population surveys for flycatchers and cuckoos at Horseshoe and on mitigation properties as specified in the HCP.

6) Coordinate with Tonto National Forest personnel on population surveys, the construction and maintenance of the Lime Creek fish barrier, and enforcement and management efforts for covered species at Horseshoe.

7) Coordinate implementation of adaptive management and monitoring measures for bald eagles with FWS, AGFD, and the Tonto National Forest if such action is necessary.

8) With AGFD, coordinate to the extent possible with FMYN on fish population surveys.

9) Prepare annual reports to be submitted to FWS.

10) Prepare budget recommendations and perform other administrative tasks related to the implementation of the HCP, including maintaining the monitoring and management activities.

11) Identify and implement adaptive management measures as necessary.

An annual meeting will be held on or before November 30 of each year among us, SRP, City of Phoenix, Tonto National Forest representatives, AGFD, and mitigation property managers to review the past year's information and to make decisions for the upcoming year regarding monitoring and management. In addition to a discussion of the general status of HCP implementation, specific decisions will be made with respect to activities for the upcoming year.

SRP will provide an annual report to both our office and Region 2, as well as to AGFD, Phoenix, and the Tonto National Forest describing all HCP activities occurring during the previous year including all management activities, monitoring results, status reports and future action items on mitigation properties, and other activities associated with implementation of the HCP. A draft of the annual report will be sent to FWS prior to the annual meeting. It will be finalized by February 1 of the following year. The report will include a summary of the past year in terms of reservoir operations, vegetation monitoring, fish, frog, and gartersnake survey data, mitigation measure implementation, and data collected on listed and candidate species. All field data collected by SRP or their contractors at Horseshoe and at the monitoring and mitigation locations will be appended to the report. The annual report also will describe the past year's monitoring and management activities at mitigation sites, issues that have developed, adaptive management efforts that have been implemented, and proposed monitoring and management efforts for the next year. The final annual report will include the specific monitoring and management activities for the upcoming year, which are agreed to by us and SRP.

Additional Assurances, Changed and Unforeseen Circumstances

Contingencies for changed circumstances are described in Table V-4 of ERO (2008) and incorporated herein by reference. Unforeseen circumstances are those which could not reasonably have been anticipated by SRP and us, which result in a substantial and adverse change in the status of one or more covered species. In the event of unforeseen circumstances, we may work with SRP to modify their mitigation and minimization measures, but only if such measures are limited to modifications within the compensation lands conserved pursuant to the terms of the HCP or to the HCP's operating conservation program for the covered species, and maintain the original terms of the HCP to the maximum extent possible.

In addition to the numerous adaptive management measures in response to changed circumstances described in earlier sections, three scenarios were identified by us and SRP as potential changed circumstances over the 50-year life of the permit: 1) a shift in the Verde mainstem channel; 2) the reversion of title in one or more compensation lands that are acquired; and, 3) habitat loss from fire or flood scouring within Horseshoe or one or more mitigation areas.

While riparian habitat is inherently subject to changes as the result of floods, which are considered desirable as part of the natural cycle of succession on riparian lands, over time, floods could shift the channel and floodplain to such an extent that all or part of the area acquired and protected by SRP as mitigation property will no longer be within the floodplain boundaries to an extent where depth to water and natural processes will no longer create and maintain riparian habitat. In such an event, SRP will acquire equivalent replacement habitat using the principles and locations described above and in ERO (2008).

With respect to the potential for the reversion of mitigation property title(s), some of the floodplain parcels that SRP is considering purchasing for mitigation habitat may be subject to claims of title by the State of Arizona or an agency of the Federal government because of navigable stream or other issues. If title to compensation lands under the HCP reverts to a state or Federal agency, we will confer with that agency and SRP at that time and attempt to develop a plan for continued management of the property for species protection, consistent with the terms of the Permit, HCP, and Implementing Agreement. If the parties can reach agreement on management, SRP will continue to receive full mitigation credit for the land. If no agreement were reached within a period of time agreed upon by SRP and FWS, the land will be replaced with other mitigation land, and necessary measures undertaken to develop and implement a management plan for the newly acquired property within two years of acquisition.

In the event that habitat is lost at Horseshoe or at mitigation sites from fire or scouring floods, SRP will work with us, AGFD, and other agencies to evaluate habitat impacts and to restore habitat to the extent feasible as well as redirect HCP funds to emergency and monitoring efforts. SRP's contribution to the evaluation and restoration will be limited to the funds and staff time previously committed as part of the HCP.

STATUS OF THE SPECIES

Southwestern Willow Flycatcher

The flycatcher is a small grayish-green passerine bird (Family Tyrannidae) measuring approximately 5.75 inches. The song is a sneezy "fitz-bew" or a "fit-a-bew", the call is a repeated "whitt." It is one of four currently recognized willow flycatcher subspecies (Phillips 1948, Unitt 1987, Browning 1993). It is a neotropical migrant that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). The historical breeding range of the flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja) (Unitt 1987).

The flycatcher was listed as endangered, without critical habitat on February 27, 1995 (USFWS 1995a). Critical habitat was later designated on July 22, 1997 (USFWS 1997a). A correction notice was published in the Federal Register on August 20, 1997 to clarify the lateral extent of the designation (USFWS 1997b).

On May 11, 2001, the 10th Circuit Court of Appeals set aside designated critical habitat in those states under the 10th Circuit's jurisdiction (New Mexico). The FWS decided to set aside critical habitat designated for the flycatcher in all other states (California and Arizona) until it could re-assess the economic analysis.

On October 19, 2005, the FWS re-designated critical habitat for the flycatcher (USFWS 2005). A total of 737 river miles across southern California, Arizona, New Mexico, southern Nevada, and southern Utah were included in the final designation. The lateral extent of critical habitat includes areas within the 100-year floodplain.

A final recovery plan for the flycatcher was signed and released to the public in August 2002 (USFWS 2002). The recovery plan describes the reasons for endangerment, current status of the flycatcher, addresses important recovery actions, includes detailed issue papers on management issues, and provides recovery goals. Recovery is based on reaching numerical and habitat related goals for each specific Management Unit established throughout the subspecies range and establishing long-term conservation plans (USFWS 2002).

The flycatcher breeds in dense riparian habitats from sea level in California to approximately 8,500 feet in Arizona and southwestern Colorado. Historical egg/nest collections and species' descriptions throughout its range describe the flycatcher's widespread use of willow (*Salix* spp.) for nesting (Phillips 1948, Phillips et al. 1964, Hubbard 1987, Unitt 1987, San Diego Natural History Museum 1995). Currently, flycatchers primarily use Geyer willow (*S. geyeriana*), coyote willow (*S. exigua*), Goodding's willow (*S. gooddingii*), box elder (*Acer negundo*), saltcedar (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolio*), and live oak (*Quercus agrifolia*) for nesting. Other plant species less commonly used for nesting include: buttonbush (*Cephalanthus* sp.), black twinberry (*Lonicera involucrata*), cottonwood (*Populus* spp.), white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* spp.). Based on the diversity of plant species composition and complexity of habitat structure, four basic habitat types can be described for the flycatcher: monotypic willow, monotypic exotic, native broadleaf dominated, and mixed native/exotic (Sogge et al. 1997).

Tamarisk is an important component of the flycatcher's nesting and foraging habitat in Arizona and other parts of the species' range. In 2001 in Arizona, 323 of the 404 (80 percent) known flycatcher nests (in 346 territories) were built in a tamarisk tree (Smith et al. 2002). Tamarisk had been believed by some to be a habitat type of lesser quality for the flycatcher, however comparisons of reproductive performance (USFWS 2002a), prey populations (Durst 2004), and physiological conditions (Owen and Sogge 2002) of flycatchers breeding in native and exotic vegetation have revealed no difference (Sogge et al. 2005).

The flycatcher's habitat is dynamic and can change rapidly: nesting habitat can grow out of suitability; saltcedar habitat can develop from seeds to suitability in five years; heavy runoff can remove/reduce habitat suitability in a day; or river channels, floodplain width, location, and vegetation density may change over time. The flycatcher's use of habitat in different successional stages may also be dynamic. For example, over-mature or young habitat not suitable for nest placement can be occupied and used for foraging and shelter by migrating, breeding, dispersing, or non-territorial flycatchers (McLeod et al. 2005, Cardinal and Paxton 2005). That same habitat may subsequently grow or cycle into habitat used for nest placement. Flycatcher habitat can quickly change and vary in suitability, location, use, and occupancy over time (Finch and Stoleson 2000).

There were currently 275 known flycatcher breeding sites in California, Nevada, Arizona, Utah, New Mexico, and Colorado (all sites from 1993 to 2005 where a territorial flycatcher has been detected) holding an estimated 1,214 territories (Durst et al. 2006). It is difficult to arrive at a grand total of flycatcher territories since not all sites are surveyed annually. Numbers have increased since the species was listed and some habitat remains unsurveyed; however, after nearly a decade of intense surveys, the existing numbers are just past the upper end of Unitt's (1987) estimate of 20 years ago (500-1000 pairs). About 50 percent of the 1,214 territories estimated throughout the subspecies range are located at four general locations (Cliff/Gila Valley – New Mexico, Roosevelt Lake - Arizona, San Pedro River/Gila River confluence – Arizona, Middle Rio Grande, New Mexico). While numbers have significantly increased in Arizona (145 to 495 territories from 1996 to 2005) (English et al. 2006), overall distribution of flycatchers throughout the state has not changed. Currently, population stability in Arizona is believed to be largely dependent on the presence of two large populations (Roosevelt Lake and San Pedro/Gila River confluence). Therefore, the result of catastrophic events or losses of significant populations either in size or location could greatly change the status and survival of the bird. Conversely, expansion into new habitats or discovery of other populations would improve the known stability and status of the flycatcher.

The primary constituent elements of critical habitat are based on riparian plant species, structure and quality of habitat, and insects for prey. A variety of river features such as broad floodplains, water, saturated soil, hydrologic regimes, elevated groundwater, and fine sediments help develop and maintain these constituent elements (USFWS 2005). The primary constituent elements are:

1. Riparian habitat in a dynamic successional riverine environment (for nesting, foraging, migration, dispersal, and shelter) that comprises:

    a. Trees and shrubs that include, but are not limited to, willow species, box elder, tamarisk, Russian olive, cottonwood, stinging nettle, alder, ash, poison hemlock, blackberry, oak, rose, false indigo, Pacific poison ivy, grape, Virginia creeper, Siberian elm, and walnut.

    b. Dense riparian vegetation with thickets of trees and shrubs ranging in height from 6 to 98 feet [2 to 30 meters (m)]. Lower-stature thickets (6 to 13 feet tall or 2 to 4 m) are found at higher elevation riparian forests, and tall-stature thickets are found at middle- and lower-elevation riparian forests;

    c. Areas of dense riparian foliage at least from the ground level up to approximately 13 feet (4 m) above ground or dense foliage only at the shrub level, or as a low, dense tree canopy;

    d. Sites for nesting that contain a dense tree and/or shrub canopy (the amount of cover provided by tree and shrub branches measured from the ground) (*i.e.*, a tree or shrub canopy with densities ranging from 50 percent to 100 percent); or

    e. Dense patches of riparian forests that are interspersed with small openings of open water or marsh, or shorter/sparser vegetation that creates a mosaic that is not uniformly dense. Patch size may be as small as 0.25 ac (0.1 ha) or as large as 175 ac. (70 ha).

2. A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, including: flying ants, wasps, and bees; dragonflies; flies; true bugs; beetles; butterflies/moths and caterpillars; and spittlebugs.

A variety of river features such as broad floodplains, water, saturated soil, hydrologic regimes, elevated groundwater, and fine sediments help develop and maintain these constituent elements (USFWS 2005).

Since its listing in 1995, at least 159 Federal agency actions have undergone (or are currently under) formal section 7 consultation throughout the flycatcher's range. Although many recovery actions are underway, other activities continue to adversely affect the distribution and extent of all stages of flycatcher habitat throughout its range (i.e., development, urbanization, grazing, recreation, native and nonnative habitat removal, dam operations, river crossings, ground and surface water extraction). Stochastic events also continue to change the distribution, quality, and extent of flycatcher habitat.

Bald Eagle

The bald eagle south of the 40th parallel was listed as endangered under the Endangered Species Preservation Act of 1966, on March 11, 1967 (USFWS 1967), and was reclassified to threatened status on July 12, 1995 (USFWS 1995b). No critical habitat was designated for this species. The bald eagle was proposed for delisting on July 6, 1999 (USFWS 1999). The Center for

Biological Diversity (Silver 2004) petitioned the FWS in October 2004, to determine that the Sonoran Desert nesting bald eagle was a distinct population segment, uplist the population to endangered status, and designate critical habitat. The FWS responded to the petition on August 30, 2006 (USFWS 2006b). We found that the petition provided substantial information for discreteness, but did not provide substantial information with respect to significance or threats (USFWS 2006b). The bald eagle was subsequently removed from the list of threatened and endangered species on July 9, 2007, citing a 25-fold increase in the numbers of bald eagles across the country in the last 40 years (USFWS 2007a). On August 8, 2007, the removal of the bald eagle from the list of threatened and endangered species became official.

On March 5, 2008, a United States District Judge enjoined the Service's application of the July 9, 2007 (72 FR 37346), final delisting rule to the Sonoran Desert population of bald eagles pending the outcome of our status review and 12-month petition finding. The court's order requires the reinstatement of the listing of the bald eagle as a threatened species, but only with respect to the eagles that reside in the Sonoran Desert area of central Arizona. The affected area covers the following eight Arizona counties: (1) Yavapai, Gila, Graham, Pinal, and Maricopa Counties in their entirety; and (2) southern Mohave County (that portion south and east of the centerline of Interstate Highway 40 and east of Arizona Highway 95), eastern La Paz County (that portion east of the centerline of U.S. and Arizona Highways 95), and northern Yuma County (that portion east of the centerline of U.S. Highway 95 and north of the centerline of Interstate Highway 8). All bald eagles found within this area are protected as a threatened species under the Act, with a special rule under our regulations 50 CFR 17.41.

In the event that the Sonoran Desert population of bald eagles in central Arizona is delisted in the future, their protection will be regulated by the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. New regulations were proposed during the time frame when bald eagles in Arizona were recently delisted prior to reversal (USFWS 2007b) which required a permit to take bald eagles, but these regulations have not yet been finalized. The Arizona Game and Fish Department (Driscoll et al. 2006) completed a Conservation Assessment and Strategy to help guide management of bald eagles in Arizona once removed from Endangered Species Act protection and the National Bald Eagle Management Guidelines recently published also provide support (USFWS 2007c).

The bald eagle is a large bird of prey that historically ranged and nested throughout North America except extreme northern Alaska and Canada, and central and southern Mexico. The bird occurs in association with aquatic ecosystems, frequenting estuaries, lakes, reservoirs, major rivers systems, and some seacoast habitats. Generally, suitable nesting habitat for bald eagles includes those areas which provide an adequate food base (i.e. quantity, quality, continuity, accessibility) (Stalmaster 1987) of fish, waterfowl, and/or carrion, with large trees for perches and nest sites. In winter, bald eagles often congregate at specific wintering sites that are generally close to open water and offer good perch trees and protected night roosts (USFWS 1995). Bald eagles will lay between one to three eggs, typically fledging one to two eaglets. Three eaglet broods occur (i.e. Lake Mary breeding area in 2006), but are not typical.

Bald eagles have increased in number and expanded in range due to the banning of DDT and other persistent organochlorine compounds, habitat protection, and additional recovery efforts. Surveys in 1963 indicated 417 active nests in the lower 48 states with an average of 0.59 young produced per nest. Surveys in 1974 resulted in a population estimate of 791 occupied breeding areas in the lower 48 states (USFWS 1999). In 1994, 4,450 occupied breeding areas were reported with an estimated average of 1.16 young produced per occupied nest (USFWS 1995). We estimated that the breeding population exceeded 5,748 occupied breeding areas in 1998 (USFWS 1999) and may be closer to 10,000 territories in 2007 (G. Beatty, FWS, pers. comm.).

Hunt et al. (1992) summarized the earliest records from the literature for bald eagles in Arizona. Coues (1866) noted bald eagles in the vicinity of Fort Whipple (now Prescott) in 1866, and Henshaw (1875) reported bald eagles south of Fort Apache in 1875. The first bald eagle breeding information was recorded in 1890 near Stoneman Lake by S.A. Mearns. Additionally, Bent (1960) reported breeding eagles at Fort Whipple in 1866 and on the Salt River Bird Reservation in 1909. Additionally, there are reports of bald eagles along rivers in the White Mountains from 1937, and reports of nesting bald eagles along the Salt and Verde rivers as early as 1930. However, the historical distribution and abundance of bald eagles in Arizona is largely unknown (Hunt et al. 1992).

The 43 occupied bald eagle breeding areas in Arizona (Driscoll et al. 2006) are now predominantly located in the upper and lower Sonoran life zones. The Luna Lake Breeding Area, and recently discovered Crescent Lake, Canyon de Chelly, Lynx Lake, and reoccupied Lake Mary Breeding Areas, are the few territories in Arizona where bald eagles have been found nesting and foraging in coniferous forests or high elevations, as opposed to the majority of breeding areas where Sonoran vegetation communities are part of their territories. Nearly all breeding areas in Arizona are located in close proximity to a variety of aquatic habitats including reservoirs, regulated river systems, and free-flowing rivers and creeks. The alteration of natural river systems has had both beneficial and detrimental effects to the bald eagle. While large portions of riparian forests were inundated or otherwise destroyed following construction of dams and other water developments, the reservoirs created by some of these structures enhanced habitat for the waterfowl and fish species (often nonnative species) on which bald eagles prey.

Bald eagles in Arizona consume a diversity of food items. However, their primary food is fish, which are generally consumed twice as often as birds, and four times as often as mammals. Bald eagles are known to catch live prey, steal prey from other predators (especially osprey), and use carrion. Carrion constitutes a higher proportion of the diet for juveniles and subadults than it does for adult eagles. Diet varies depending on what species are available locally. This can be affected by the type of water system on which the breeding area is based (Hunt et al. 1992). Based on information from the upper Salt River, change in fish populations, specifically the decline and/or loss of native desert and Sonora suckers within breeding areas where eagles largely depend on food from rivers, has been determined to adversely affect productivity (Driscoll et al. 2006).

Continued management of the bald eagle in Arizona is important to maintain the distribution and abundance of the bird in the state due to its relatively low numbers. The importance and attention to the productivity of bald eagles and survivorship of breeding adults in Arizona is largely due to the isolation of the breeding population.

In addition to breeding bald eagles, Arizona provides habitat for wintering bald eagles, which migrate through the state between October and April each year. Bald eagles can be found statewide, and unlike some other states or areas, Arizona does not tend to have traditional concentrations of hundreds of bald eagles annually. Rather, concentrations tend to be smaller and less predictable, occurring in areas like Mormon Lake/Lake Mary, San Carlos Lake, or the Black River. The average number of wintering bald eagles counted along standardized routes since 1995 is 332 birds (Jacobsen et al. 2005). In 2005, the standardized statewide Arizona winter count totaled 224 bald eagles (Jacobsen et al. 2005).

There are seven bald eagle pairs that nest (or forage) on the Verde River between the Allen Ditch diversion and Horseshoe (one breeding area, Camp Verde, is vacant and not included in the seven pairs). One pair of bald eagles has a breeding area at Horseshoe. Ten pairs of bald eagles have nested in recent years along the Verde River from Horseshoe downstream to its confluence with the Salt River. An eleventh pair forages on the Verde River, but nests and also forages on the Salt River (USFWS 2003a).

Yellow-billed Cuckoo

The cuckoo is a candidate species under the Act (USFWS 2002f). In response to a petition to list the species submitted in February 1998, we issued a 12-month "warranted but precluded" finding (meaning that listing of the species is warranted but is precluded by higher priority listing actions) for the cuckoo western distinct population segment on July 25, 2001 (USFWS 2001a).

The cuckoo is a medium-sized, slender bird (about 12 inches in length and weighing about 2 ounces) of the Family Cucilidae, whose members are characterized in part by zygodactyl feet (meaning two toes point forward and two backward). The species has a slender, long-tailed profile, with a fairly stout and slightly down-curved bill which is blue-black with yellow on the base of the lower mandible. Plumage is grayish-brown above and white below, with rufous primary flight feathers. The tail feathers are boldly patterned with black and white below. The legs are short and bluish-gray, and adults have a narrow, yellow eye ring. Juveniles resemble adults, except the tail patterning is less distinct, and the lower bill may have little or no yellow. Males and females differ slightly, as males tend to have a slightly larger bill.

The cuckoo has been associated with cottonwood (*Populus* spp.)-willow (*Salix* spp.) dominated riparian habitats (Hamilton and Hamilton 1965, Gaines 1974, Gaines and Laymon 1984, Laymon and Halterman 1986, 1987, 1989, Halterman 1991, Halterman and Laymon 1994, 1995). Cottonwood-willow remains the predominant and preferred habitat, but tall screwbean-honey mesquite stands are also used. In addition, cuckoos have been found to utilize a mixture of tamarisk (*Tamarix* spp.) and cottonwood/willows (Corman and Magill, 2000). Gaines (1974) found that vegetative density, distance to water, and the length and width of the habitat area were important characteristics when surveying for cuckoos. Western yellow billed cuckoos breed in large blocks of riparian habitats (particularly woodlands with cottonwoods and willows). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (Halterman 1991).

The cuckoo arrives on the breeding grounds beginning in mid- to late May (Franzreb and Laymon 1993). Nesting activities usually take place between late June and late July, but may begin as early as late May, and continue to late August, depending on the season. Nest building takes 2-4 days. Nests are typically built in willow or mesquite thickets 4 to 10 feet (but as high as 35 feet) above the ground, are usually well-hidden by foliage, and are almost always near water. Incubation begins as soon as the first egg is laid and lasts 11 days. Clutch size is usually two or three eggs, and development of the young are very rapid, with a breeding cycle of 17 days from egg-laying to fledging young. The young are fed large food items such as green caterpillars, tree frogs, katydids, and grasshoppers for the 6-7 day nestling period. After fledging the young are dependent on the adults for at least 2 weeks.

Historically, the cuckoo occupied and bred in riparian zones from western Washington (possibly southwestern British Columbia) to northern Mexico, including Oregon, Washington, southwestern Idaho, California, Nevada, Utah, western Colorado, Arizona, New Mexico, and western Texas (American Ornithologists‘ Union 1998). Today, the species is absent from Washington, Oregon, and most of California, is likely extirpated in Nevada, is rare in Idaho and Colorado, and occurs in the balance of its range in riparian habitats that are much reduced from their previous extent and are heavily affected by human use (USFWS 2002a, 2001a).

Principal causes of riparian habitat losses are conversion to agricultural and other uses, dams and river flow management, stream channelization and stabilization, and livestock grazing. Available breeding habitats for cuckoos have also been substantially reduced in area and quality by groundwater pumping and the replacement of native riparian habitats by invasive nonnative plants (particularly tamarisk) (Groschupf 1987; Rosenberg et al. 1991). Estimates of riparian habitat losses in the west as a result of the factors described above range from 90 to 99 percent in California, 90 percent in New Mexico, and 90 to 95 percent in Arizona (USFWS 2001a). In Arizona, the greatest losses of riparian habitat have occurred along the lower Colorado River valley and its major tributaries at elevations below about 3,000 feet (USFWS 2001a). Cuckoo numbers appear to have declined substantially in Arizona. In 1976, an estimated 846 cuckoo pairs occupied the lower Colorado River and five of its major tributaries (USFWS 2001a), while in 1999, just 172 cuckoo pairs and 81 unmated adults were located during surveys of 221 miles of riparian habitat (Corman and Magill 2000). Specific declines in cuckoo numbers in Arizona have been documented along the lower Colorado River and the Bill Williams River delta (Rosenberg et al. 1991).

Nevertheless, Arizona is thought to contain the largest remaining cuckoo population in the western states (USFWS 2002f). Currently in Arizona, cuckoos occur in a scattered fashion throughout the central, east-central, west central, and southeastern parts of the state, with the majority of known populations occurring along the San Pedro, Verde, and Agua Fria rivers, Cienega Creek in Pima, Pinal, Cochise, and Yavapai counties, and Sonoita Creek in Santa Cruz County (Corman and Magill 2000).

Northern Mexican Gartersnake

The northern Mexican gartersnake (*Thamnophis eques megalops*) was placed on the list of candidate species as a Category 2 species in 1985 (50 FR 37958). Category 2 species were those for which existing information indicated that listing was possibly appropriate, but for which substantial supporting biological data to prepare a proposed rule were lacking. In the 1996 Candidate Notice of Review (61 FR 7596), the use of Category 2 candidates was discontinued, and the northern Mexican gartersnake was no longer recognized as a candidate.

On December 19, 2003, we received a petition dated December 15, 2003, requesting that we list the northern Mexican gartersnake as threatened or endangered, and that we designate critical habitat concurrently with the listing. We acknowledged the receipt of the petition in a letter dated March 1, 2004. In that letter, we advised the petitioners that, due to funding constraints in fiscal year 2004, we would not be able to begin processing the petition at that time.

On May 17, 2005, the petitioners filed a complaint for declaratory and injunctive relief, challenging our failure to issue a 90-day finding in response to the petition as required by 16 U.S.C. 1533(b)(3)(A) and (B). In a stipulated settlement agreement, we agreed to submit a 90-day finding to the *Federal Register* by December 16, 2005, and if positive, submit a 12-month finding to the *Federal Register* by September 15, 2006 [*Center for Biological Diversity v. Norton*, CV-05-341-TUC-CKJ (D. Az)]. The settlement agreement was signed and adopted by the District Court of Arizona on August 2, 2005.

On December 13, 2005, we made our 90-day finding that the petition presented substantial scientific information indicating that listing the northern Mexican gartersnake (*Thamnophis eques megalops*) may be warranted publishing in the *Federal Register* on January 4, 2006 (71 FR 315). Subsequently on September 26, 2006, we issued a 12-month Finding (71 FR 56228) that found the northern Mexican gartersnake did not warrant Federal listing due to inadequate information on the species' status in Mexico. This finding resulted in additional litigation and we have agreed to review the finding.

The northern Mexican gartersnake may occur with other native gartersnake species and can be difficult for people without herpetological expertise to identify. With a maximum known length of 44 inches (in) [112 centimeters (cm)], it ranges in background color from olive to olive-brown to olive-gray with three stripes that run the length of the body (AGFD 2001b). The middle dorsal stripe is yellow and darkens toward the tail. The pale yellow to light-tan lateral stripes distinguish the Mexican gartersnake from other sympatric (co-occurring) gartersnake species because a portion of the lateral stripe is found on the fourth scale row, while it is confined to lower scale rows for other species. Paired black spots extend along the olive dorsolateral fields and the olive-gray ventrolateral fields. A conspicuous, light-colored crescent extends behind the corners of the mouth. The two dark brown to black blotches that occur behind the head of several gartersnake species may be diffuse or absent in the Mexican gartersnake. The coloration of the venter is bluish-gray or greenish-grey. The dorsolateral scalation is keeled, the anal plate is single, and there are eight or nine upper labial scales (Rosen and Schwalbe 1988; Rossman et al. 1996).

The northern Mexican gartersnake is a member of the family Colubridae and subfamily Natricinae (harmless live-bearing snakes) (Lawson et al. 2005). The taxonomy of the genus *Thamnophis* has a complex history partly because many of the species are similar in appearance and scutelation (arrangement of scales), but also because many of the early museum specimens were in such poor and faded condition that it was difficult to study them (Conant 2003). There are approximately 30 species that have been described in the gartersnake genus *Thamnophis* (Rossman et al. 1996). De Queiroz et al. (2002) identified two large overlapping clades (related taxonomic groups) of gartersnakes that they called the "Mexican" and "widespread" clades which were supported by allozyme and mitochondrial DNA genetic analyses. *Thamnophis eques* is a member of the "widespread" clade and is most closely related taxonomically to, although genetically and phenotypically distinct from, the checkered gartersnake (*T. marcianus*) (De Queiroz and Lawson 1994).

Rossman et al. (1996) noted that the current specific name *eques* was not applied at the time of the original description of the holotype because the specimen was mistakenly identified as a black-necked gartersnake (*T. cyrtopsis*). In recent history and prior to 2003, *Thamnophis eques* was considered to have three subspecies, *T. e. eques*, *T. e. megalops*, and *T. e. virgatenuis* (Rossman et al. 1996). *T. eques* displays considerable phenotypic variability (variation in its physical appearance) across its distribution, and all subspecific descriptions under *T. eques* have been based on morphometrics or morphological characters. The subspecies *T. e. eques* and *T. e. megalops* are distinguished by average differences in sub-caudal scale counts, while *T. e. virgatenuis* is distinguished from *T. e. megalops* based on having a darker background color and a narrower vertebral stripe (Rossman et al. 1996). Rossman et al. (1996) also noted that the discontinuous distributions of high-elevation and low-elevation *T. e. virgatenuis* and *T. e. megalops*, respectively, are "zoogeographically peculiar and unique among gartersnakes."

Rossman et al. (1996) describe the distribution of *T. e. eques* as occurring from southern Nayarit eastward along the Transverse Volcanic Axis to west-central Veracruz, and identified an additional disjunct population in central Oaxaca. *T. e. virgatenuis* is distributed in three isolated, high-elevation populations in southwestern Durango and in west-central and northwestern Chihuahua (Rossman et al. 1996).

In 2003, an additional seven new subspecies were identified under *T. eques*: (1) *T. e. cuitzeoensis*; (2) *T. e. patzcuaroensis*; (3) *T. e. inspiratus*; (4) *T. e. obscurus*; (5) *T. e. diluvialis*; (6) *T. e. carmenensis*; and (7) *T. e. scotti* (Conant 2003). These seven new subspecies were described based on morphological differences in coloration and pattern; have high endemism (degree of restriction to a particular area) with highly restricted distributions; and occur in isolated wetland habitats within the mountainous Transvolcanic Belt region of southern Mexico, which contains the highest elevations in the country (Conant 2003).

The most widely distributed of the 10 subspecies under *T. eques* is the northern Mexican gartersnake, which is the only subspecies that occurs in the United States. In Mexico, *T. e. megalops* historically occurred throughout the Sierra Madre Occidental south to Guanajuato, and east across the Mexican Plateau to Hidalgo, which comprised approximately 85 percent of the total rangewide distribution of the species (Rossman et al. 1996). Robert Kennicott first described the northern Mexican gartersnake in 1860, as *Eutenia megalops* from the type locality of Tucson, Arizona (Rosen and Schwalbe 1988). In 1951, Dr. Hobart Smith renamed the subspecies with its current scientific name (Rosen and Schwalbe 1988). A summary of this species' lengthy taxonomic history can be found in Rosen and Schwalbe (1988).

Throughout its rangewide distribution, the northern Mexican gartersnake occurs at elevations from 130 to 8,497 feet (ft) (40 to 2,590 meters (m)) (Rossman et al. 1996). The northern Mexican gartersnake is considered a riparian obligate (restricted to riparian areas when not engaged in dispersal behavior) and occurs chiefly in the following general habitat types: (1) Source-area wetlands [e.g., cienegas (mid-elevation wetlands with highly organic, reducing (basic, or alkaline) soils), stock tanks (small earthen impoundment), etc.]; (2) large river riparian woodlands and forests; and (3) streamside gallery forests (as defined by well-developed broadleaf deciduous riparian forests with limited, if any, herbaceous ground cover or dense grass) (Hendrickson and Minckley 1984; Rosen and Schwalbe 1988; AGFD 2001c). Vegetation characteristics vary based on the type of habitat. For example, in source-area wetlands, dense vegetation consists of knot grass (*Paspalum distichum*), spikerush (*Eleocharis*), bulrush

(*Scirpus*), cattail (*Typha*), deergrass (*Muhlenbergia*), sacaton (*Sporobolus)*, Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii)*, and velvet mesquite (*Prosopis velutina*) (Rosen and Schwalbe 1988).

In riparian woodlands consisting of cottonwood and willow or gallery forests of broadleaf and deciduous species along larger rivers, the northern Mexican gartersnake may be observed in mixed grasses along the bank or in the shallows (Rossman et al. 1996; Rosen and Schwalbe 1988). Within and adjacent to the Sierra Madre Occidental in Mexico, it occurs in montane woodland, Chihuahuan desertscrub, mesquite-grassland, and Cordillera Volcánica montane woodland (McCranie and Wilson 1987).

In small streamside riparian habitat, this snake is often associated with Arizona sycamore (*Platanus wrightii*), sugar leaf maple (*Acer grandidentatum*), velvet ash (*Fraxinus velutina*), Arizona cypress (*Cupressus arizonica*), Arizona walnut (*Juglans major*), Arizona alder (*Alnus oblongifolia*), alligator juniper (*Juniperus deppeana*), Rocky Mountain juniper (*J. scopulorum*), and a number of oak species (*Quercus* spp.) (McCranie and Wilson 1987; Cirett-Galan 1996).

The northern Mexican gartersnake is surface active at ambient temperatures ranging from 71 degrees Fahrenheit (˚F) to 91˚F [22 degrees Celsius (˚C) to 33 ˚C] and forages along the banks of waterbodies. The northern Mexican gartersnake is an active predator and is believed to heavily depend upon a native prey base (Rosen and Schwalbe 1988). Generally, its diet consists predominantly of amphibians and fishes, such as adult and larval native leopard frogs [e.g., lowland leopard frog (*Rana yavapaiensis*) and Chiricahua leopard frog (*R. chiricahuensis*)], as well as juvenile and adult native fish species [e.g., Gila topminnow (*Poeciliopsis occidentalis occidentalis*), desert pupfish (*Cyprinodon macularius*), Gila chub (*Gila intermedia*), and roundtail chub (*G. robusta*)] (Rosen and Schwalbe 1988). Auxiliary prey items may also include young Woodhouse's toads (*Bufo woodhousei*), treefrogs (Family Hylidae), earthworms, deermice (*Peromyscus maniculatus*), lizards of the genera *Aspidoscelis* and *Sceloporus*, larval tiger salamanders (*Ambystoma tigrinum*), and leeches (Rosen and Schwalbe 1988; Holm and Lowe 1995; Degenhardt et al. 1996; Rossman et al. 1996; Manjarrez 1998). To a much lesser extent, this snake's diet may include nonnative species, including juvenile fish, larval and juvenile bullfrogs, and mosquitofish (*Gambusia affinis*) (Holycross et al. 2006).

Sexual maturity in northern Mexican gartersnakes occurs at 2 years of age in males and at 2 to 3 years of age in females (Rosen and Schwalbe 1988). Northern Mexican gartersnakes are ovoviviparous (eggs develop and hatch within the oviduct of the female). Mating occurs in April and May in their northern distribution followed by the live birth of between 7 and 26 neonates (newly born individuals) (average is 13.6) in July and August (Rosen and Schwalbe 1988). Approximately half of the sexually mature females within a population reproduce in any one season (Rosen and Schwalbe 1988).

The United States comprises the northern portion of the northern Mexican gartersnake's distribution. Within the United States, the northern Mexican gartersnake historically occurred predominantly in Arizona with a limited distribution in New Mexico that consisted of scattered locations throughout the Gila and San Francisco headwater drainages in western Hidalgo and Grant counties (Price 1980; Fitzgerald 1986; Degenhardt et al. 1996; Holycross et al. 2006). Fitzgerald (1986) provided museum records for the following historical localities for northern Mexican gartersnakes in New Mexico: (1) Mule Creek; (2) the Gila River, 5 miles (mi) [8 kilometers (km)] east of Virden; (3) Spring Canyon; (4) the West Fork Gila River at Cliff Dwellings National Monument; (5) the Tularosa River at its confluence with the San Francisco River; (6) the San Francisco River at Tub Spring Canyon; (7) Little Creek at Highway 15; (8) the Middle Box of Gila River at Ira Ridge; (9) Turkey Creek; (10) Negrito Creek; and (11) the Rio Mimbres.

Within Arizona, the historical distribution of the northern Mexican gartersnake ranged from 130 to 6,150 ft (40 to 1,875 m) in elevation and occurred variably based on the relative permanency of water and the presence of suitable habitat. In Arizona, the northern Mexican gartersnake historically occurred within several perennial or intermittent drainages and disassociated wetlands that included: (1) the Gila River; (2) the Lower Colorado River from Davis Dam to the International Border; (3) the San Pedro River; (4) the Santa Cruz River downstream from the International Border; (5) the Santa Cruz River headwaters/San Rafael Valley and adjacent montane canyons; (6) the Salt River; (7) the Rio San Bernardino from International Border to headwaters at Astin Spring (San Bernardino National Wildlife Refuge); (8) Agua Fria River; (9) the Verde River; (10) Tanque Verde Creek in Tucson; (11) Rillito Creek in Tucson; (12) Agua Caliente Spring in Tucson; (13) the downstream portion of the Black River from the Paddy Creek confluence; (14) the downstream portion of the White River from the confluence of the East and North forks; (15) Tonto Creek from the mouth of Houston Creek downstream to Roosevelt Lake; (16) Cienega Creek from the headwaters to the "Narrows" just downstream of Apache Canyon; (17) Pantano Wash (Cienega Creek) from Pantano downstream to Vail; (18) Potrero Canyon/Springs; (19) Audubon Research Ranch and vicinity near Elgin; (20) Upper Scotia Canyon in the Huachuca Mountains; (21) Arivaca Creek; (22) Arivaca Cienega; (23) Sonoita Creek; (24) Babocomari River; (25) Babocamari Cienega; (26) Barchas Ranch, Huachuca Mountain bajada; (27) Parker Canyon Lake and tributaries in the Canelo Hills; (28) Big Bonito Creek; (29) Lake O'Woods, Lakeside area; (30) Oak Creek from Midgley Bridge downstream to the confluence with the Verde River; and (31) Spring Creek above the confluence with Oak Creek (Woodin 1950; Nickerson and Mays 1970; Bradley 1986; Rosen and Schwalbe 1988; 1995; 1997; Holm and Lowe 1995; Sredl et al. 1995b; 2000; Rosen et al. 2001; Holycross et al. 2006; Brennan and Holycross 2006; Radke 2006; Rosen 2006; Holycross 2006).

One record for the northern Mexican gartersnake exists for the State of Nevada, opposite Fort Mohave, in Clark County along the shore of the Colorado River (De Queiroz and Smith 1996); however, any populations of northern Mexican gartersnakes that may have historically occurred in Nevada were associated with the Colorado River and are likely extirpated.

Within Mexico, northern Mexican gartersnakes historically occurred within the Sierra Madre Occidental and the Mexican Plateau in the Mexican states of Sonora, Chihuahua, Durango, Coahila, Zacatecas, Guanajuato, Nayarit, Hidalgo, Jalisco, San Luis Potosí, Aguascalientes, Tlaxacala, Puebla, México, Veracruz, and Querétaro, which comprises approximately 70 to 80 percent of its historical rangewide distribution (Conant 1963; 1974; Van Devender and Lowe 1977; McCranie and Wilson 1987; Rossman et al. 1996; Lemos-Espinal et al. 2004).

Holycross et al. (2006) included the northern Mexican gartersnake as a target species at 33 sites surveyed within drainages along the Mogollon Rim. A total of 874 person-search hours and 63,495 trap-hours were devoted to that effort, which resulted in the capture of 23 snakes total in 3 (9 percent) of the sites visited. This equates to approximately 0.03 snakes observed per person-search hour and 0.0004 snakes captured per trap-hour over the entire effort. For comparison, a population of northern Mexican gartersnakes at Page Springs, Arizona, that we consider stable yielded 0.22 snakes observed per person-search hour and 0.004 snakes captured per trap-hour (an order of magnitude higher) (Holycross et al. 2006). Survey sites were selected based on the existence of historical records for the species or sites where the species may occur based on habitat suitability within the historical distribution of the species. Holycross et al. (2006) calculated the capture rates for the northern Mexican gartersnake as 12,761 trap-hours per snake and 49 person-search hours per snake. Northern Mexican gartersnakes were found at 2 of 11 (18 percent) historical sites and 1 of 22 (4 percent) sites where the species was previously unrecorded (Holycross et al. 2006). When compared with extensive survey data in Rosen and Schwalbe (1988), these data demonstrate dramatic declines in both capture rates and the total number of populations of the species in areas where multiple surveys have been completed over time. However, these data may be affected by differences in survey efforts and drought.

In 2000, Rosen et al. (2001) resurveyed many sites in southeastern Arizona that were historically known to support northern Mexican gartersnake populations during the early to mid-1980s, and also provided additional survey data collected from 1993-2001. Rosen et al. (2001) reported their results in terms of increasing, stabilized, or decreasing populations of northern Mexican gartersnakes.

Our analysis of the best available data on the status of the northern Mexican gartersnake distribution in the United States indicates that its distribution has been significantly reduced in the United States, and it is now considered extirpated from New Mexico (Nickerson and Mays 1970; Rosen and Schwalbe 1988; Holm and Lowe 1995; Sredl et al. 1995b; 2000; Rosen et al. 2001; Painter 2005, 2006; Holycross et al. 2006; Brennan and Holycross 2006; Radke 2006; Rosen 2006; Holycross 2006). Fitzgerald (1986) visited 33 localities of potential habitat for northern Mexican gartersnakes in New Mexico in the Gila River drainage and was unable to confirm its existence at any of these sites. The New Mexico Department of Game and Fish (NMGFD) State Herpetologist, Charles Painter, provided several causes that have synergistically contributed to the decline of northern Mexican gartersnakes in New Mexico, including bullfrog and nonnative fish introductions, modification and destruction of habitat, commercial exploitation, direct human-inflicted harm, and fragmentation of populations. The last known observation of the northern Mexican gartersnake in New Mexico occurred in 1994 on private land (Painter 2000; Painter 2005).

Our analysis of the best available information indicates that the northern Mexican gartersnake has likely been extirpated from a large portion of its historical distribution in the United States. We define a population as "likely extirpated" when there have been no northern Mexican gartersnakes reported for a decade or longer at a site within the historical distribution of the species, despite at least minimal survey efforts, and natural recovery at the site is not expected due to the presence of known threats. The perennial or intermittent stream reaches and disassociated wetlands where the northern Mexican gartersnake has likely been extirpated include: (1) the Gila River; (2) the Lower Colorado River from Davis Dam to the International Border; (3) the San Pedro River; (4) the Santa Cruz River downstream from the International Border at Nogales; (5) the Salt River; (6) the Rio San Bernardino from International Border to headwaters at Astin Spring (San Bernardino National Wildlife Refuge); (7) the Agua Fria River; (8) the Verde River upstream of Clarkdale; (9) the Verde River from the confluence with Fossil Creek downstream to its confluence with the Salt River; (10) Tanque Verde Creek in Tucson; (11) Rillito Creek in Tucson; (12) Agua Caliente Spring in Tucson; (13) Potrero

Canyon/Springs; (14) Babocamari Cienega; (15) Barchas Ranch, Huachuca Mountain bajada; (16) Parker Canyon Lake and tributaries in the Canelo Hills; and (17) Oak Creek at Midgley Bridge (Rosen and Schwalbe 1988; 1997; Rosen et al. 2001; Brennan and Holycross 2006; Holycross 2006; Holycross et al. 2006; Radke 2006; Rosen 2006).

Conversely, our review of the best available information indicates the northern Mexican gartersnake is likely extant in a fraction of its historical range in Arizona. We define populations as "likely extant" when the species is expected to reliably occur in appropriate habitat as supported by recent museum records and/or recent (i.e., less than 10 years) reliable observations. The perennial or intermittent stream reaches and disassociated wetlands where we conclude northern Mexican gartersnakes remain extant include: (1) the Santa Cruz River/Lower San Rafael Valley (headwaters downstream to the International Border); (2) the Verde River from the confluence with Fossil Creek upstream to Clarkdale; (3) Oak Creek at Page Springs; (4) Tonto Creek from the mouth of Houston Creek downstream to Roosevelt Lake; (5) Cienega Creek from the headwaters downstream to the "Narrows" just downstream of Apache Canyon; (6) Pantano Wash (Cienega Creek) from Pantano downstream to Vail; (7) Upper Scotia Canyon in the Huachuca Mountains; and (8) the Audubon Research Ranch and vicinity near Elgin (Rosen et al. 2001; Caldwell 2005; Brennan and Holycross 2006; Holycross 2006; Holycross et al. 2006; Rosen 2006).

The current status of the northern Mexican gartersnake is unknown in several areas in Arizona where the species is known to have historically occurred. We base this determination on mostly historical museum records for locations where survey access is restricted, survey data are unavailable or insufficient, and/or current threats could preclude occupancy. The perennial or intermittent stream reaches and disassociated wetlands where the status of the northern Mexican gartersnake remains uncertain include: (1) the downstream portion of the Black River drainage from the Paddy Creek confluence; (2) the downstream portion of the White River drainage from the confluence of the East and North forks; (3) Big Bonito Creek; (4) Lake O'Woods near Lakeside; (5) Spring Creek above the confluence with Oak Creek; (6) Bog Hole Wildlife Area; (7) Upper 13 Tank, Patagonia Mountain bajada; (8) Babocamari River; and (9) Arivaca Cienega (Rosen and Schwalbe 1988; Rosen et al. 2001; Brennan and Holycross 2006; Holycross 2006; Holycross et al. 2006; Rosen 2006).

In summary, after consultation with species' experts and land managers, and based upon our analysis of the best available scientific and commercial data, we conclude that the northern Mexican gartersnake has been extirpated from 85 to 90 percent of its historical distribution in the United States.

Several physical threats to northern Mexican gartersnake habitat (i.e., riparian and aquatic communities) have occurred and continue to occur within the distribution of the species in the United States and Mexico. Competition with and predation from nonnative predators such as sportfish, crayfish, and bullfrogs is the primary and most serious threat to the continued existence of this species. Other threats have synergistically affected and continue to affect riparian and aquatic communities such as dams, diversions, groundwater pumping, nonnative plant species, woodcutting, mining, contaminants, urban and agricultural development, road construction, livestock grazing, wildfires, and undocumented immigration (Hendrickson and Minckley 1984; Ohmart et al. 1988; Bahre 1995; Medina 1990; Sullivan and Richardson 1993; Fleischner 1994; Hale et al. 1995; DeBano and Neary 1996; Rinne and Neary 1996; Stromberg et al. 1991;

Girmendock and Young 1997; Rinne et al. 1998; Belsky et al. 1999; Esque and Schwalbe 2002; Hancock 2002; Voeltz 2002; Webb and Leake 2005; Holycross et al. 2006; McKinnon 2006a, 2006b, 2006c, 2006d, 2006e; Fish and Watershed Committee 2006; Segee and Neeley 1996).

Narrow-headed Gartersnake

The narrow-headed gartersnake (*Thamnophis rufipunctatus rufipunctatus*) was placed on the list of candidate species as a Category 2 species in 1985 (50 FR 37958). In the 1996 Candidate Notice of Review (61 FR 7596), the use of Category 2 candidates was discontinued, and the northern Mexican gartersnake was no longer recognized as a candidate. Currently, the narrow-headed gartersnake has no Federal status but is considered a species of special concern for the AGFD and is listed as threatened by the NMDGF (NMDGF 2007).

The narrow-headed gartersnake (Cope *in* Yarrow 1875) is a small to medium-sized gartersnake which, unlike striped gartersnakes, is easily distinguished from sympatric gartersnake species. Narrow-headed gartersnakes attain a total length approaching 30 inches, have a background color that is olive-brown to olive with dull brick-red to dark brown to blackish spots on the dorsum, and eyes positioned high on the head (Rosen and Schwalbe 1988; NMDGF 2007). The venter is brownish-gray. A distinguishing feature and namesake of this species is the shape of the head which narrows conspicuously towards the snout, yielding an elongated appearance.

Narrow-headed gartersnakes have been documented from northern Durango, Mexico in the Sierra Madre Occidental north to the Gila Wilderness in New Mexico and Mogollon Rim in Arizona (Holycross et al. 2006). Within the United States, the species is found in the states of Arizona and New Mexico, where it is found in Gila, Salt and Verde watersheds (Holycross et al. 2006). Detailed distribution information can be found in Holycross et al. (2006) and NMDGF (2007). Holycross et al. (2006) found this species in only five of 42 targeted sites (11 percent) in central and east-central Arizona. Within the Verde watershed, narrow-headed gartersnakes were historically present within Oak Creek, East Verde River, and along the mainstem, upper Verde River (Holycross et al. 2006). Currently, the species is known from isolated populations in Oak Creek and a low-density persistence along the Verde River mainstem according to two verified sightings; one at approximately one mile downstream of the Fossil Creek confluence and the other in the upper Verde basin at Mormon Pocket between Perkinsville and the confluence with Sycamore Creek (Holycross et al. 2006).

Narrow-headed gartersnakes inhabit perennial streams at elevations between 2,300 and 8,000 feet (Rosen and Schwalbe 1988; Holycross et al. 2006). Stream reaches that possess boulder substrate and adjacent rock outcrops and boulder structure along the floodplain provide for thermoregulatory needs during the active and dormant seasons (Rosen and Schwalbe 1988). The species may be found in riffles, runs, or pools. Vegetation associated with narrow-headed gartersnake habitat includes conifer and broadleaf tree species and velvet ash, Arizona alder, willows and canyon grape in montane and Great Basin conifer woodlands, chaparral, and upland desertscrub (AGFD 2002; Holycross and Brennan 2006).

Narrow-headed gartersnakes bear live young averaging approximately 11 neonates per birthing and each female is believed to reproduce each year (Rosen and Schwalbe 1988). This species is highly piscivorous preying almost exclusively on fish caught in the water column while the snake is anchored posteriorly in the stream substrata (Hibbitts and Fitzgerald 2005). Native fish species are preferred prey items but nonnative species such as red shiner, rainbow trout and brown trout are also taken (Degenhardt et al. 1996; Rossman et al. 1996).

The primary threats to narrow-headed gartersnakes include the loss or degradation of habitat from development, modification, and siltation of streamside microhabitats, competition with and predation form nonnative species, and human predation (Nowak and Santana-Bendix 2002; Rosen and Schwalbe 1988, 2002; Rossman et al. 1996; Nowak 2006).

Lowland Leopard Frog

Lowland leopard frog (*Rana yavapaiensis*) is one of seven native leopard frog species in Arizona which is described as medium sized frog (3.4 in snout vent length) that is olive-brown with dark spots and dorsolateral folds that are broken posteriorly (AGFD 2001a; Brennan and Holycross 2006). Additional physical descriptors include and absence of spots on the snout, a faint stripe on the upper lip which fades toward the eye, and dense, dark reticulations on the rear thighs (Brennan and Holycross 2006).

Lowland leopard frogs historically ranged from northern Sonora, Mexico northward through southwestern New Mexico, central and western Arizona, and southeastern California at elevations from sea level to approximately 5,600 ft (Stebbins 2003; Sredl *in* Lanoo 2005). The species is currently found in central and southeastern Arizona (parallel to, but below the Mogollon Rim) with the majority of localities occurring in Gila, Maricopa, and Yavapai counties (central Arizona below the Mogollon Rim) (Brennan and Holycross 2006). They are now absent from the lower Colorado River, the lower Gila River, the San Pedro River, and the Santa Cruz River and have significantly declined in southeastern Arizona (Rorabaugh 2006, Brennan and Holycross 2006).

The lowland leopard frog breeds from January through late April and October and deposit egg masses underwater; attaching them to structural anchors such as wooden debris, vegetation, rocks, or gravel (AGFD 2006b; Sredl *in* Lanoo 2005). Lowland leopard frogs are considered habitat generalists and occur in a variety of natural and manmade habitats including perennial and intermittent streams, beaver ponds, cienegas, springs, cattle tanks, livestock drinkers, canals, irrigation ditches, wells, mine, adits abandoned swimming pools, and back yard ornamental ponds (Sredl *in* Lanoo 2005). Brennan and Holycross (2006) list Sonoran desertscrub to Great Basin Conifer Woodland and Madrean Evergreen Woodland as vegetation communities associated with lowland leopard frogs.

The frog has been described as a habitat generalist and breed in a variety of natural (e.g., rivers, streams, cienegas) and man-made (e.g., cattle tanks, backyard ponds) aquatic systems (AGFD 2006b). In Arizona, the species ranges from 480 to 8,200 ft in elevation but generally occurs at elevations less than 6,400 ft. The species reproduces primarily from January to May, with additional reproduction occurring in some populations in summer and early fall after the onset of summer monsoon rains. Reproduction occurs in the water with females depositing egg masses in shallow water which attach to submerged vegetation, bedrock, or gravel. Egg masses have been observed between January to late April and in October. Adult lowland leopard frogs feed on arthropods and other invertebrates, and larvae are herbivorous and likely eat algae, organic debris, and plant tissue.

Threats to this species include habitat alteration and fragmentation (such as damming, draining, and diversion of water), and predation from nonnative species such as sportfish, crayfish, and bullfrogs (AGFD 2006b). Introduced Rio Grande leopard frogs (*Rana berlandieri*) are also believed to be a significant cause for extirpations of lowland leopard frog populations in the lower Colorado, Gila, and Salt rivers through competition and displacement (Brennan and Holycross 2006). The chytrid fungus has also infected this species in central and southeastern Arizona (Sredl *in* Lanoo 2005). AGFD (2006b) also note water pollution and heavy grazing and threats to this species.

Razorback Sucker

We listed the razorback sucker as endangered on November 22, 1991 (56 FR 54967). The Razorback Sucker Recovery Plan (USFWS 1998a) and recovery goals were approved in 2002 (USFWS 2002b). Critical habitat was designated in 1994, which included the Verde River from the Prescott National Forest boundary to Horseshoe Dam (46 river miles) (59 FR 13374).

Primary constituent elements for the species' critical habitat described in the Federal Register upon designation were addressed within three general categories: water, physical habitat, and biological environment (USFWS 1994a).

Under the general category of "water", the Federal Register describes "…. A quantity of water of sufficient quality (i.e. temperature, dissolved oxygen, lack of nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage (for razorback sucker)" (USFWS 1994a). The discussion under "physical habitat" describes "areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing, or corridors between these areas. In addition to river channels, these areas also include bottom lands, side channels, oxbows, backwaters, and other areas in the 100-year flood plain, which when inundated provide spawning, nursery, feeding and rearing habitats, or access to these habitats" (USFWS 1994a). Lastly, the critical habitat designation describes criteria under the "biological environment" as "Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas" (USFWS 1994a).

The razorback sucker is the only representative of the genus *Xyrauchen* and is distinguished from all others by the sharp edged, bony keel that rises abruptly behind the head. The body is robust with a short and deep caudal peduncle (Bestgen 1990). The razorback sucker may reach lengths of 3.3 feet and weigh between 11 and 13 pounds (Minckley 1973). Razorback suckers are long-lived, reach the age of at least the mid-40's, and historically occurred at elevations ranging from 181 – 5,000 feet (McCarthy and Minckley 1987; AGFD 2003b).

Adult razorback suckers use most of the available riverine habitats, although there may be an avoidance of whitewater type habitats. Main channel habitats used tend to be low velocity ones such as pools, eddies, nearshore runs, and channels associated with sand or gravel bars (Bestgen 1990). Adjacent to the main channel, backwaters, oxbows, sloughs, and flooded bottomlands are also used by this species.

Data from radio-telemetered razorback suckers in the Verde River showed they used shallower depths and slower velocities than in the upper Colorado River basin. They avoided depths of less than 1.3 feet, but selected depths between 2.0 and 3.9 feet, which likely reflected a reduced availability of deeper waters compared to the larger upper Colorado River basin rivers. However, use of slower velocities (mean = 0.1ft/sec) may have been an influence of rearing in hatchery ponds. Similar to the upper Colorado River basin, razorback suckers were found most often in pools or runs over silt substrates, and avoided substrates of larger material (Clarkson et al. 1993).

Razorback suckers also use reservoir habitat, where the adults may survive for many years. In reservoirs, they use all habitat types, but prefer backwaters and the main impoundment (USFWS 1998). Much of the information on spawning behavior and habitat comes from fishes in reservoirs where observations can readily be made.

Habitat needs of larval and juvenile razorback sucker are reasonably well known. In reservoirs, larvae are found in shallow backwater coves or inlets (USFWS 1998a). In riverine habitats, captures have involved backwaters, creek mouths, and wetlands. These environments provide quiet, warm water where there is a potential for increased food availability. During higher flows, flooded bottomland and tributary mouths may provide these types of habitats.

Spawning takes place in the late winter to early summer along gravelly shorelines or bays, depending upon local water temperatures (AGFD 2003b). One female is joined by 2 to 12 males that nudge the female with their heads to entice gamete release marked by vibrating movements and a subsequent cloud of silt and sand (Minckley 1973).

Razorback sucker diet varies depending on life stage, habitat, and food availability. Larvae feed mostly on phytoplankton and small zooplankton, and in riverine environments, on midge larvae. Diet of adults taken from riverine habitats consisted chiefly of immature mayflies, caddisflies, and midges, along with algae, detritus, and inorganic material (USFWS 1998a).

Razorback suckers are somewhat sedentary; however, considerable movement over a year has been noted in several studies (USFWS 1998a). Spawning migrations have been observed or inferred in several locales (Minckley 1973; Osmundson and Kaeding 1989; Bestgen 1990; Tyus and Karp 1990). During the spring spawning season, razorbacks may travel long distances in both lacustrine and riverine environments, and exhibit some fidelity to specific spawning areas (USFWS 1998a). In the Verde River, radio-tagged and stocked razorback suckers tend to move downstream after release. Larger fish did not move as much from the stocking site as did smaller fish (Clarkson et al. 1993).

The razorback sucker is adapted to widely fluctuating physical environments characteristic of rivers in the pre-settlement Colorado River Basin. Adults can live 45-50 years and, once reaching maturity between two and seven years of age (Minckley 1983), apparently produce viable gametes even when quite old. The ability of razorback suckers to spawn in a variety of habitats, flows and over a long season are also survival adaptations. In the event of several consecutive years with little or no recruitment, the demographics of the population might shift, but future reproduction would not be compromised. Average fecundity recorded in studies ranges from 46,740-100,800 eggs per female (Bestgen 1990). With a varying age of maturity, and the fecundity of the species, it would be possible to quickly repopulate after a catastrophic loss of adults.

Many species of nonnative fishes occur in occupied habitat of the razorback sucker. These nonnative fishes are predators, competitors, and vectors of parasites and diseases (Tyus et al. 1982; Pacey and Marsh 1999). Many researchers believe that nonnative species are a major cause for the lack of recruitment (e.g., Minckley 1983). There are reports of predation of razorback sucker eggs and larvae by common carp (*Cyprinus carpio*), channel catfish, smallmouth bass (*Micropterus dolomeiui*), largemouth bass, bluegill (*Lepomis macrochirus*), green sunfish, and redear sunfish (*Lepomis microlophus*) (Langhorst 1989). Marsh and Brooks (1989) reported that channel catfish and flathead catfish were major predators of stocked razorback sucker in the Gila River. Juvenile razorback sucker (average total length 6.7 inches) stocked in isolated coves along the Colorado River in California, suffered extensive predation by channel catfish and largemouth bass (Langhorst 1989).

Reintroduction efforts were initiated in the Verde River in 1980s and have continued periodically since that time. Razorback suckers are generally stocked at Beasley Flats and Childs (Reach 4). Early on, millions of razorback larvae were stocked and it is assumed that none of these fish survived due to predation or other factors. In 1993, managers began stocking larger individuals at lengths of at least 12" (Hyatt 2004). Initially, very few stocked fish were recaptured in subsequent years, despite considerable monitoring effort. Loss of these fish was due primarily to predation from nonnative fishes within hours after stocking (Marsh and Brooks 1989; Hyatt 2004). Laboratory tests indicated that larger sub-adult or adult suckers (>12 in.) may have a better chance of avoiding predators and surviving (Johnson et al. 1993). Between 1994 and 2003, 19,745 adult razorback suckers were released into the Verde River near the Childs power plant (Weedman 2003). During the 1990s, the increase in the number of razorback suckers captured during monitoring efforts has been steady (Jahrke and Clark 1999).

Clarkson et al. (1993) noted high infestation levels of the nonnative parasite *Lernaea cyprinacea* (anchorworm) on reintroduced razorbacks in the Verde River near Perkinsville. They suspected that high levels of parasitism increased mortality of the reintroduced fish and considered that this could represent another obstacle to reestablishment of the species. Robinson et al. (1998) found that levels of parasitism on both native and nonnative fishes were higher at Perkinsville than at Childs, but rated all fishes examined as "healthy," and concluded that parasitism was not seriously impacting Verde River fishes.

Gila Topminnow

The Gila topminnow was listed as endangered in 1967 without critical habitat (USFWS 1967). The species was later revised to include two subspecies, *P. o. occidentalis* (Gila topminnow) and *P. o. sonoriensis* (Yaqui topminnow) (Minckley 1969, 1973). *Poeciliopsis occidentalis*, including both subspecies, is collectively known as the Sonoran topminnow. Both subspecies are protected under the Act. Gila topminnow populations are not protected in Mexico under the

Act. The reasons for decline of Gila topminnow include past dewatering of rivers, springs, and marshlands, impoundment, channelization, diversion, regulation of flow, land management practices that promote erosion and arroyo formation, and the introduction of predacious and competing nonnative fishes (Miller 1961, Minckley 1985).

Gila topminnow belong to a group of live-bearing fishes within the family Poeciliidae that includes the familiar guppy (*Poecilia reticulata*), which is not native to the Gila basin. Males are smaller than females, rarely greater than 1 inch, while females are larger, reaching 2 inches. Body coloration is tan to olivaceous, darker above, lighter below, often white on the belly (AGFD 2003i). Breeding males are usually blackened, with some golden coloration of the midline, and with orange or yellow at the base of the dorsal fin.

Gila topminnow mature a few weeks to many months after birth, depending on when they are born. They breed primarily from March to August, but some pregnant females occur throughout the year (Schoenherr 1974). Some young are produced in the winter months. Minckley (1973) and Constantz (1980) reported that Gila topminnow are opportunistic feeders which eat bottom debris, vegetation, amphipods, and insect larvae when available.

Gila topminnow can tolerate a variety of physical and chemical conditions. They are good colonizers in part because of this tolerance and in part because a single gravid female can start a population (Meffe and Snelson 1989). Minckley (1969, 1973) described their habitat as edges of shallow aquatic habitats, especially where abundant aquatic vegetation exists. Simms and Simms (1992) found the densities of Gila topminnow in Cienega Creek, Pima County, Arizona, to be greater in pool, glide, and backwater habitats and less dense in marsh, riffle, chute, cascade, and fall habitats. They occurred more frequently over sand substrates than over other categories of substrates. Although Gila topminnow may occupy pools and ponds that are up to 6 feet deep, they are normally found in the upper one-third of the water column (Forrest 1992).

Gila topminnow is known to occur in streams fluctuating from 51-99 °F, pH from 6.6 to 8.9, dissolved oxygen levels of (2.2-11 ppm), and can tolerate salinities approaching those of sea-water. Topminnow can burrow under mud or aquatic vegetation when water levels decline, and regularly inhabit springheads with high loads of dissolved carbonates and low pH (Meffe 1983, Meffe and Snelson 1989). This factor has helped protect small populations of topminnow from mosquitofish (*Gambusia affinis*) that are usually rare or absent under these conditions (Meffe 1983).

Gila topminnow are highly vulnerable to adverse effects from nonnative aquatic species (Johnson and Hubbs 1989). Predation and competition from nonnative fishes have been major factors in their decline and continue to be a major threat to the remaining populations (Meffe 1985, Brooks 1986, Marsh and Minckley 1990, Stefferud and Stefferud 1994, Weedman and Young 1997). Both large (Bestgen and Propst 1989) and small nonnative fish cause problems for Gila topminnow as can nonnative crayfish (Fernandez and Rosen 1996) and bullfrogs.

Historically, the Gila topminnow was abundant in the Gila River drainage and was one of the most common fishes of the Colorado River basin, particularly in the Santa Cruz system (Hubbs and Miller 1941). This was reduced to only 15 recent naturally occurring populations. Only 12 of the 15 recent natural Gila topminnow populations are considered extant (Weedman and Young 1997). Only three (Cienega Creek, Monkey Spring, Cottonwood Spring) have no nonnative fish present and therefore can be considered secure from nonnative fish threats. There have been at least 175 wild sites stocked with Gila topminnow; however, topminnow persist at only 18 of those localities. Of the 18, one site is outside topminnow historical range and four contain nonnative fish now (Weedman and Young 1997).

The status of the species is poor and declining. Gila topminnow has gone from being one of the most common fishes of the Gila basin to one that exists at not more than 30 localities (12 natural and 18 stocked). Many of these localities are small and highly threatened. The theory of island biogeography can be applied to these isolated habitat remnants, as they function similarly (Meffe 1983). Meffe (1983) considered extinction of Gila topminnow populations almost as critical as recognized species extinctions, and Moyle and Williams (1990) noted that fish in California that are in trouble tend to be endemic, restricted to a small area, part of fish communities with fewer than five species, and found in isolated springs or streams. Gila topminnow has most of these characteristics.

We approved the Gila Topminnow Recovery Plan on March 15, 1984, and currently we are working on a revision to the Recovery Plan and a draft dated December 1998 is available on our website. The highest priority actions in the draft revised Gila topminnow recovery plan are ones that are absolutely essential to prevent extinction in the foreseeable future. These include the protection and maintenance of all known natural populations, as well as newly discovered natural populations (Weedman 1999). The available draft revised Recovery Plan (Weedman 1998) for the topminnow includes similar conservation recommendations and objectives as the 1984 Recovery Plan (e.g., protection of natural and reestablished sites, prevention of nonnative fish invasion, periodic population monitoring, and information and education strategies.

Federal actions have contributed to the degraded environmental baseline of the Gila topminnow. Federal actions requiring section 7 consultations affecting Redrock Canyon, Cienega Creek, and Sonoita Creek in the Santa Cruz River sub-basin and others in the Gila River basin have contributed to the lowered baseline for the Gila topminnow, including two formal consultations resulting in jeopardy biological opinions. Although the reasonable and prudent alternatives removed jeopardy, other adverse effects are not totally removed by the reasonable and prudent alternatives. Other Federal actions, as well as non-Federal actions that have not undergone section 7 consultation, also have some unmitigated adverse effects that contribute to the degraded baseline. Fortunately, recovery actions continue for this species, such as efforts to pursue a Statewide Safe Harbors Agreement for private landowners who wish to contribute to recovery of this species on their land. Some recovery projects have been more successful than others.

Colorado Pikeminnow

The Colorado pikeminnow (pikeminnow) was included on the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001) and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). The final rule for designation of critical habitat for the pikeminnow was published on March 21, 1994 (59 FR 13374) with an effective date of April 20, 1994 (USFWS 1994a). There is no designated critical habitat in the lower Colorado River basin, including none in the Verde River. The Colorado Pikeminnow Recovery Goals, a supplement to the recovery plan, was published in 2002 (USFWS 2002c). A final rule for a section 10(j) experimental non-essential population of pikeminnow in the Salt and Verde Rivers in Arizona was published July 24, 1985 (50 FR 30188) (USFWS 1985).

Critical habitat for the pikeminnow in the San Juan River extends from near the confluence of the Animas River with the San Juan River (NM State Route 371 bridge), downstream to the full pool elevation of Lake Powell, downstream of the proposed crossing but still within the action area. The FWS identified water, physical habitat, and the biological environment as PCEs of critical habitat. This includes a quantity of water of sufficient quality that is delivered to specific habitats in accordance with a hydrologic regime that is required for the particular life stage for the species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide access to spawning, nursery, feeding, and rearing habitats, are included. Food supply, predation, and competition are important elements of the biological environment.

The pikeminnow is the largest cyprinid (member of the minnow family, Cyprinidae) native to North America and it evolved as the top predator in the Colorado River system. It is an elongated pike-like fish that once grew as large as 6 feet in length and weighed nearly 100 pounds (Behnke and Benson 1983); such fish were estimated to be 45 to 55 years old. Today, fish rarely exceed 3 feet in length or weigh more than 18 pounds. The diet of pikeminnow longer than 3 or 4 inches consists almost entirely of other fishes (Vanicek and Kramer 1969).

Spawning behavior in the Colorado pikeminnow is initiated by increasing water temperatures and decreasing flow. The period when these conditions are present, and pikeminnow spawn, is considered early July through mid August (Sublette et al. 1990, ADFG 2003a). Riffles and/or rapids with cobble or gravel substrates are preferred as spawning habitat (Sublette et al. 1990). Detailed life history information on the pikeminnow is available in the biological support documents for the designation of critical habitat (USFWS 1993) and in the Colorado Pikeminnow Recovery Goals (USFWS 2002c).

Characterized as a “big river” generalist species, adult pikeminnow occur in turbid, deep, and strong current habitats whereas juvenile and subadult pikeminnow are known to prefer backwater habitat with no current and often a silt/sand substrate (Sublette et al. 1990).

Pikeminnow often migrate considerable distances (up to 124 miles) to spawn in the Green and Yampa Rivers (Miller et al. 1982; Archer et al. 1986; Tyus and McAda 1984; Tyus 1985; Tyus 1990; Lucas and Baras 2001), and similar movement has been noted in the main stem San Juan River. Spawning, both in the hatchery and under natural riverine conditions, generally occurs in a 2-month period between late June and late August. Pools, runs, and other deep water areas, especially in upstream reaches, are important winter habitats for pikeminnow (Osmundson et al. 1995).

Due to the low numbers of pikeminnow collected in the San Juan River, it is not possible to quantify population size or trends. Estimates during the 7-year research period between 1991 and 1997 suggested that there were fewer than 50 adults in a given year (Ryden 2000). Between 100,000 to 500,000 age 0 pikeminnow have been stocked annually since 1996, with the exceptions of 1998 and 2001 (Ryden 2007a). Catch of pikeminnow per unit effort has increased since 2003 (Ryden 2007b), most likely because of the large number of fish that have been stocked. A new population estimate has not been calculated.

Successful reproduction was documented in the San Juan River in 1987, 1988, 1992 to 1996, 2001, and 2004 by the collection of larval and/or YOY pikeminnow (Platania et al. 2000; Brandenburg and Farrington 2007). The majority of the YOY pikeminnow were collected in the San Juan River inflow to Lake Powell (Buntjer et al. 1994; Lashmett 1994; Platania 1990). Some YOY pikeminnow have been collected near the Mancos River confluence, New Mexico and in the vicinity of the Montezuma Creek confluence near Bluff, Utah, and at a drift station near Mexican Hat, Utah (Buntjer et al. 1994; Snyder and Platania 1995).

Pikeminnow in the upper Colorado River Basin live with about 20 species of warm water nonnative fishes (Tyus et al. 1982) that are potential predators, competitors, and vectors for parasites and disease. Channel catfish (*Ictalurus punctatus*) has been identified as a threat to juvenile, subadult, and adult pikeminnow in the San Juan River. Stocked juvenile and adult pikeminnow that have preyed on channel catfish have died from choking on the pectoral spines (McAda 1983; Pimental et al. 1985). Mechanical removal (electrofishing, seining) of channel catfish began in 1995 in the San Juan River and intensified in 2001.

The pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin down to the Gulf of California, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, the San Juan River and some of its tributaries, and the Gila River system in Arizona (Seethaler 1978; Platania 1990). Extant natural populations of pikeminnow are currently found in the San Juan River in New Mexico and Utah; the Colorado and Yampa Rivers in Colorado; and the Colorado and Green Rivers in Utah.

The AGFD raises Colorado pikeminnow in their Bubbling Springs Hatchery until they reach a length of approximately 16 inches, when approximately 2000 fish are released annually into the Verde River at Beasley Flats Recreation Area under the section 10(j) designation. It is presumed that the survivorship of stocked pikeminnow is low. Hyatt (2004) declared the presence of nonnative fish to be the primary reason for the lack of success of this 25 year Colorado pikeminnow stocking program. Bonar et al. (2004) counted only 2 individuals during their sampling effort from March 2002 through January 2003 in the Verde River. Both individuals were observed within the reach between Clarkdale and Beasley Flat.

Threats to the species include stream regulation, habitat modification, competition with and predation by nonnative fish, and pesticides and pollutants.

Because pikeminnow occurs intermittently across a large landscape, it is vulnerable to numerous Federal actions. Actions that may have affected pikeminnow and their habitat include timber sales, post-fire timber salvage, fire suppression, livestock grazing, road improvements, National Pollutant Discharge Elimination System permits, flood control structures, Clean Water Act section 404 permits, and water diversions.

Loach Minnow

Loach minnow was listed as a threatened species on October 28, 1986 (USFWS 1986a). Critical habitat was designated, remanded, and re-designated on March 21, 2007 (72 FR 13356). In

Arizona, the current designation includes portions of the Black River, East Fork Black River, North Fork East Fork Black River, and Boneyard Creek; Aravaipa Creek and its tributaries Deer and Turkey creeks; the San Francisco River, Eagle Creek, and the Blue River and its tributaries, Campbell Blue Creek and Little Blue Creek. In New Mexico, the current designation includes portions of the Blue River; the San Francisco River and its tributary Whitewater Creek; the Tularosa River and its tributary, Negrito Creek; Campbell Blue Creek; Dry Blue Creek and its tributaries Frieborn and Pace creeks; the Gila River, including portions of its West, Middle, and East forks.

Loach minnow is a small fish from the minnow family Cyprinidae. Loach minnow are olivaceous in color, and highly blotched with darker spots (AGFD 2003h). 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, USFWS 1991c).

Loach minnow is endemic to the Gila River basin of Arizona and New Mexico within the United States, and Sonora, Mexico, where it was recorded only in the Rio San Pedro. Historically, loach minnow in Arizona were found in the Salt River mainstem near and above the Phoenix area, the White River, East Fork White River, Verde River, Gila River, San Pedro River, Aravaipa Creek, San Francisco River, Blue River, and Eagle Creek, as well as some tributaries of these streams. In New Mexico, loach minnow historically occupied the Gila River including its West, Middle, and east Forks, the San Francisco River, the Tularosa River, and Dry Blue Creek (Minckley 1973, Minckley 1985).

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; 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).

The limited taxonomic and genetic data available for loach minnow indicate there are substantial differences in morphology and genetic makeup between remanant loach minnow populations. Tibbets (1993) concluded that results from mitochondrial DNA 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 indicated 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.

When critical habitat was designated, the FWS determined the primary constituent elements (PCEs) for loach minnow. Constituent elements include those habitat features required for the physiological, behavioral, and ecological needs of the species. For loach minnow, these include:

1) Permanent, flowing water with no or minimal levels of pollutants (Baker 2005);

2) Living areas with appropriate flow velocities and depths for the various life stages of the fish, as follows:

PCE	Life stage of loach minnow	Parameters
Flow velocities	Adult	9 to 32 in/sec. (24 – 80 cm/sec.)
	Juvenile	1 to 34 in./sec (3 – 85 cm/sec.)
	Larval	3 to 20 in./sec (9 – 50cm/sec.)
Depth	Adult	1 – 30 in. (3 cm – 75 cm)
	Juvenile	1 – 30 inches (3 cm - 75 cm)
	Larval	Shallow areas

Spawning areas are also required, and should have slow to swift flow velocities in shallow water where cobble and rubble and the spaces between them are not filled in by fine dirt or sand (Barber and Minckley 1966, Propst et al. 1988, Propst and Bestgen 1991, Rinne 1989).

3) Water with dissolved oxygen levels (approximately 3.5 cubic centimeters per liter or greater) and no or minimal pollutant levels for pollutants such as copper, arsenic, mercury, and cadmium; human and animal waste products; pesticides; suspended sediments; and gasoline or diesel fuels (Baker 2005);

4) Sand, gravel, and cobble substrates with low or moderate amounts of fine sediment and substrate embeddedness, which are generally maintained by a natural, unregulated hydrograph that allows for periodic flooding, or, if flows are modified or regulated, a hydrograph that allows for adequate river functions, such as flows capable of transporting sediments (Propst et al. 1984, Propst et al. 1988, Propst and Bestgen 1991, Rinne 1989, Rinne 2001).

5) Streams that have low gradients of less than approximately 2.5 percent (Rinne 1989, Rinne 2001).

6) Water temperatures in the approximate range of 35 to 82 degrees Fahrenheit (^{o}F) (1.7 to 27.8 degrees Celsius (^{o}C)] with additional natural daily and seasonal variation (Bonar et al. 2005, Britt 1982, Leon 1989, Propst et al. 1988, Propst and Bestgen 1991, Vives and Minckley 1990).

7) Pool, riffle, and run habitat components (AGFD 1994, Bagley et al. 1995, Barber and Minckley 1966, Britt 1982, J.M. Montgomery 1985, Marsh et al. 2003, Propst et al. 1984, Propst et al. 1988, Propst and Bestgen 1991, Rinne 1989, Vives and Minckley 1990).

8) An abundant aquatic insect food base consisting of mayflies, true flies, black flies, caddisflies, stoneflies, and dragonflies (Propst et al. 1988, Propst and Bestgen 1991, Schreiber 1978).

9) Habitat devoid of nonnative aquatic species or habitat in which nonnative aquatic species are at levels that allow persistence of spikedace (Anderson 1978; Bonar et al. 2004; Carlson and Muth 1989; Courtenay and Meffe 1989; Douglas et al. 1994; Fuller et al. 1999; Lachner et al. 1970; Lassuy 1995, Miller 1961; Minckley 1985; Minckley and Deacon 1991; Moyle 1986; Moyle et al. 1986; Ono et al. 1983, Propst et al. 1986, Williams et al. 1985), and;

10) Areas within perennial, interrupted stream courses that are periodically dewatered but that serve as connective corridors between occupied or seasonally occupied habitat and through which the species may move when the habitat is wetted.

The PCEs are generalized descriptions and ranges of selected habitat factors that are critical for the survival and recovery of loach minnow. The appropriate and desirable level of these factors may vary seasonally and is highly influenced by site-specific circumstances. Therefore, assessment of the presence/absence, level or value of the constituent elements must include consideration of the season of concern and the characteristics of the specific location. The constituent elements are not independent of each other and must be assessed holistically, as a functioning system, rather than individually. In addition, the constituent elements need to be assessed in relation to larger habitat factors, such as watershed, floodplain, and streambank conditions, stream channel geomorphology, riparian vegetation, hydrologic patterns, and overall aquatic faunal community structure.

Critical habitat was designated in four separate complexes for loach minnow, including the Black River Complex, the Middle Gila/Lower San Pedro/Aravaipa Creek Complex, the San Francisco/Blue River Complex, and the Upper Gila River Complex. The Black River Complex includes 12.2 miles of the East Fork Black River, 4.4 miles of the North Fork East Fork Black River, and 1.4 miles of Boneyard Creek. Within this complex, the last record of loach minnow on the East Fork and North Fork East Fork Black rivers was in 2004 (AGFD 2004a, ASU 2002). The last record of loach minnow within Boneyard Creek was in 1996 (AGFD 2004a, ASU 2002). Surveys in 2004 located only a few individuals in the forks of the Black River.

Within the Middle Gila/Lower San Pedro/Aravaipa Creek Complex, no portions of the Middle Gila or Lower San Pedro rivers are included for loach minnow. Twenty-eight miles of Aravaipa Creek, 2.3 miles of Deer Creek and 2.7 miles of Turkey Creek are included as critical habitat for loach minnow. Aravaipa Creek supports one of the largest and most protected loach minnow populations due to special use designations on Bureau of Land Management (BLM) land, substantial ownership by The Nature Conservancy, and a completed fish barrier at its lower end designed to prevent invasion of nonnative fish species.

The San Francisco and Blue rivers Complex includes approximately 235 miles of critical habitat for loach minnow. This mileage includes 17.7 miles on Eagle Creek, 126.5 miles on the San Francisco River in both Arizona and New Mexico, 18.6 miles on the Tularosa River, and 51.1

miles on the Blue River. Mileage is also included along Negrito, Whitewater, Campbell Blue, Dry Blue, Pace, Frieborn, and Little Blue creeks. The Blue River contains one of the more stable populations of loach minnow, which are distributed throughout the system. Loach minnow were last detected as follows within this complex:

Stream	Last Detection	Source
Eagle Creek	1997	Bagley and Marsh 1997
San Francisco River	2005	Paroz et al. 2002, Propst 2005, . 2006
Tularosa River	2002	Propst 2002, Propst 2005
Frieborn Creek	1998	ASU 2002
Pace Creek	1998	ASU 2002
Negrito Creek	1998	Miller 1998
Whitewater Creek	1984	Propst et al. 1988
Blue River	2004	Carter 2005, Propst 2005
Campbell Blue Creek	2004	Carter 2005
Little Blue Creek	1981	AGFD 2004a, ASU 2002
Dry Blue Creek	2001	Propst 2006

Critical habitat within the Upper Gila River Complex includes approximately 94.9 miles of the Gila River, 26.1 miles of the East Fork Gila River, 11.9 miles of the Middle Fork Gila River, and 7.7 miles of the West Fork Gila River. Loach minnow were detected in the Gila River in annual surveys last conducted in 2006. They were last detected in the East Fork Gila River in 1998 (Propst 2002, Propst 2006, in the Middle Fork Gila River in 1998 (Paroz et al. 2006, Propst 2002, Propst 2006), and in the West Fork Gila River in 2002 (Paroz et al. 2006, Propst 2002, Propst 2006). This complex contains the largest remaining population of loach minnow. In 2007, recovery efforts reintroduced the species into Fossil Creek, Redfield and Hotsprings Canyons (Mary Richardson, FWS, pers. comm.).

Actions that may adversely affect the species can include road crossing construction and maintenance, livestock grazing, water withdrawals, contaminants, recreational activities, and nonnative aquatic species. Our information indicates that, approximately 275 consultations have been completed or are underway for actions affecting spikedace and loach minnow. The majority of these opinions concerned the effects of grazing, roads and bridges, or agency planning. Additional consultations dealt with timber harvest, fire, flooding, recreation, realty, animal stocking, water development, recovery (including loach minnow reintroduction efforts), and water quality issues.

The status of loach minnow is declining rangewide. Although it is currently listed as threatened, the FWS determined in 1994 that a petition to uplist the species to endangered status is warranted (USFWS 1994b). The FWS confirmed this decision in 2000 (USFWS 2000). A reclassification proposal is pending; however, work on it is precluded due to work on other higher priority listing actions (USFWS 1994b).

Spikedace

Spikedace was listed as a threatened species on July 1, 1986 (USFWS 1986b). Critical habitat was designated and remanded twice, and designated again on March 21, 2007 (72 FR 13356) (USFWS 1994c). Critical habitat includes portions of the Verde River, the middle Gila River, the upper San Pedro River, and Aravaipa Creek in Arizona, and portions of the upper Gila River and its West, Middle and East Forks in New Mexico.

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 in Arizona and New Mexico, but is currently only known from the middle and upper portions of the Gila River, and Aravaipa and Eagle Creeks (Barber and Minckley 1966, Minckley 1973, Anderson 1978, Marsh et al. 1990, Sublette et al. 1990, Jakle 1992, Knowles 1994, Rinne 1999, Paroz et al. 2006, Propst 2005).

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 spawn 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 live about two years in the wild 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 (AGFD 2003g; Schreiber 1978, Barber and Minckley 1983, Marsh et al. 1989).

Recent taxonomic and genetic data on spikedace indicate 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 by unsuitable habitat and long distances. Anderson and Hendrickson (1994) found that spikedace from Aravaipa Creek is 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).

When critical habitat was designated, the FWS determined the PCEs for spikedace. Constituent elements include those habitat features required for the physiological, behavioral, and ecological needs of the species. For spikedace, these include:

1) Permanent, flowing water with no or minimal levels of pollutants (Baker 2005);

2) Living areas with appropriate flow velocities and depths for the various life stages of the fish, as follows:

PCE	Life stage of spikedace	Parameters
Flow velocities	Adult	8 to 24 in/sec. (20 – 60 cm/sec.
	Juvenile	8+ in./sec (18+ cm/sec.)
	Larval	4+ in./sec (10+ cm/sec.)
Depth	Adult	4 – 40 inches (3 cm – 1 m)
	Juvenile	1.2 – 40 inches (3 cm - 1 m)
	Larval	1.2 – 40 inches (3 cm – 1 m)

(Anderson 1978; Barber and Minckley 1966; Hardy 1990; Propst et al. 1986; Rinne 1991; Rinne and Kroeger 1988; Schreiber 1978; Sublette et al. 1990).

3) Water with appropriate dissolved oxygen levels (approximately 3.5 cubic centimeters per liter) and no or minimal pollutant levels for pollutants such as copper, arsenic, mercury, and cadmium; human and animal waste products; pesticides; suspended sediments; and gasoline or diesel fuels (Baker 2005);

4) Sand, gravel, and cobble substrates with low or moderate amounts of fine sediment and substrate embeddedness. Appropriate substrate embeddedness is generally maintained by a natural, unregulated hydrograph that allows for periodic flooding, or, if flows are modified or regulated, a hydrograph that allows for adequate river functions, such as flows capable of transporting sediments (Mueller 1984; Propst et al. 1986; Stefferud and Rinne 1996; Velasco 1997);

5) Streams that have low gradients of less than approximately 1.0 percent (Barber et al. 1970; Neary et al.1996; Propst et al. 1986; Rinne 2001; Rinne and Kroeger 1988; Rinne and Deason 2000; Rinne and Stefferud 1996; Stefferud and Rinne 1996; Sublette et al. 1990);

6) Water temperatures in the approximate range of 35 to 82 degrees Fahrenheit (^{o}F) [1.7 to 27.8 degrees Celsius (^{o}C)] with additional natural daily and seasonal variation (Barber et al. 1970, Propst et al. 1986, Bonar et al. 2005);

7) Riffle, run, and backwater components (Anderson 1978; Barber et al. 1970; Barber and Minckley 1966; J.M. Montgomery 1985; Propst et al. 1986; Rinne and Stefferud 1996);

8) An abundant aquatic insect food base consisting of mayflies, true flies, caddisflies, stoneflies, and dragonflies (Anderson 1978, Barber and Minckley 1983, Propst et al. 1986, Schreiber 1978);

9) Habitat devoid of nonnative aquatic species or habitat in which nonnative aquatic species are at levels that allow persistence of spikedace (Anderson 1978; Bonar et al. 2004; Carlson and Muth 1989; Courtenay and Meffe 1989; Douglas et al. 1994; Fuller et al. 1990; Lachner et al. 1970; Lassuy 1995, Miller 1961; Minckley 1985; Minckley and Deacon 1991; Moyle 1986; Moyle et al. 1986; Ono et al. 1983, Propst et al. 1986, Williams et al. 1985), and;

10) Areas within perennial, interrupted stream courses that are periodically dewatered but that serve as connective corridors between occupied or seasonally occupied habitat and through which the species may move when the habitat is wetted.

The constituent elements are generalized descriptions and ranges of selected habitat factors that are critical for the survival and recovery of spikedace. The appropriate and desirable level of these factors may vary seasonally and is highly influenced by site-specific circumstances. Therefore, assessment of the presence/absence, level or value of the constituent elements must include consideration of the season of concern and the characteristics of the specific location. The constituent elements are not independent of each other and must be assessed holistically, as a functioning system, rather than individually. In addition, the constituent elements need to be assessed in relation to larger habitat factors, such as watershed, floodplain, and streambank conditions, stream channel geomorphology, riparian vegetation, hydrologic patterns, and overall aquatic faunal community structure.

Critical habitat was designated in three separate complexes for spikedace, including the Verde River Complex; the Middle Gila River (Arizona), San Pedro River, and Aravaipa Creek Complex; and the Upper Gila River Complex (New Mexico), including the West, Middle, and East Forks of the Gila River. The Verde River Complex includes 43.0 miles of the Verde River in Yavapai County, Arizona, from the Prescott and Coconino National Forest boundary with private lands at Township 17 North, Range 3 East, section 7 upstream to Sullivan Dam. Spikedace likely occupy the complex, with the last known record from 1999. Recent surveys have failed to locate spikedace, but these surveys are not considered thorough enough to conclude absence of spikedace within the complex.

The Middle Gila River, San Pedro River, and Aravaipa Creek Complex includes 39.0 miles of the Gila River from the Ashurst-Hayden Dam upstream to its confluence with the San Pedro River; 13.4 miles of the San Pedro River from its confluence with the Gila River upstream to its confluence with Aravaipa Creek; and 28.1 miles of Aravaipa Creek extending from its confluence with the San Pedro River upstream to its confluence with Stowe Gulch. Within this complex, the last record of spikedace on the Gila River is from 1991, however, surveys have not been consistent or thorough in this area (AGFD 2004a, ASU 2002, Jakle 1992). Spikedace are consistently found in semi-annual surveys of Aravaipa Creek, and were most recently in April of 2007. Aravaipa Creek supports one of the largest and most protected spikedace populations due to special use designations on BLM land, substantial ownership by The Nature Conservancy, and a completed fish barrier at its lower end designed to prevent invasion of nonnative fish species. In 2007, recovery efforts reintroduced the species into Fossil Creek, Redfield and Hotsprings Canyons (Mary Richardson, FWS, pers. comm.).

The Upper Gila River Complex in New Mexico includes 94.9 miles of the upper Gila River extending from its confluence with Moore Canyon near the Arizona/New Mexico border upstream to the confluence of the East and West Forks of the Gila River, excluding lands owned by the Phelps Dodge Corporation. This complex contains the largest remaining population of spikedace. Spikedace are consistently found in this complex in annual surveys, and were most recently found in 2006 (2007 survey data not yet compiled). The most recent detections for spikedace in tributaries to the Gila River in New Mexico are 2000 for the East Fork Gila River, 1995 for the Middle Fork Gila River, and 2005 for the West Fork Gila River (Paroz et al. 2006, Propst 2002, Propst 2006).

Historically occurring throughout the mid-elevations of the Gila River drainage, the spikedace is currently extant in the middle Gila, and upper Gila and Verde rivers, and Aravaipa and Eagle creeks (Barber and Minckley 1966, Minckley 1973, Anderson 1978, Marsh et al. 1990, Sublette et al. 1990, Jakle 1992, Knowles 1994, Rinne 1999).

Actions that may adversely affect the species can include road crossing construction and maintenance, livestock grazing, water withdrawals, contaminants, recreational activities, and nonnative aquatic species. Our information indicates that, approximately 275 consultations have been completed or are underway for actions affecting spikedace and loach minnow. The majority of these opinions concerned the effects of grazing, roads and bridges, or agency planning. Additional consultations dealt with timber harvest, fire, flooding, recreation, realty, animal stocking, water development, recovery (including spikedace reintroduction efforts), and water quality issues (USFWS 2001b).

The status of spikedace is declining rangewide. Although it is currently listed as threatened, the FWS determined in 1994 that a petition to uplist the species to endangered status is warranted (USFWS 1994d). The FWS confirmed this decision in 2000 (USFWS 2000). A reclassification proposal is pending, however, work on this decision is precluded due to work on other higher priority listing actions (USFWS 1994d).

Roundtail Chub

In 1989, the roundtail chub was placed into category 2 (54 FR 554). Due to lack of funding to gather existing information, it remained in category 2 through the 1991 (56 FR 58804) and 1994 (59 FR 58982) candidate notices of review. In the 1996 candidate notice of review, category 2 was eliminated, and roundtail chub no longer had status under the candidate identification system. Following receipt of a 2002 petition to list the roundtail chub in a Distinct Population Segment (DPS) of the lower Colorado River basin as threatened or endangered with critical habitat [the headwater chub (*Gila nigra*) was also included] from the Center for Biological Diversity, and pursuant to a stipulated settlement agreement, a 90-day finding was published on July 12, 2005 (70 FR 39981), finding that the petitioners had provided sufficient information to indicate that listing of the roundtail chub may be warranted. On May 3, 2006, a 12-month finding was issued (71 FR 26007) that stated listing the roundtail chub as a DPS was not warranted. This decision is currently being re-evaluated.

The roundtail chub is a cyprinid fish (member of Cyprinidae, the minnow family) with a streamlined body shape. Color in roundtail chub is usually olive-gray to silvery, with the belly lighter, and sometimes with dark blotches on the sides; headwater chub color is usually dark gray to brown overall, with silvery sides that often have faded lateral stripes. Roundtail chub are generally 25 to 35 centimeters (cm) [9 to 14 inches (in)] in length, but can reach 50 cm (20 in) (AGFD 2003e).

Baird and Girard first described roundtail chub from specimens collected from the Zuni River in northeastern Arizona and northwestern New Mexico (Baird and Girard 1853). Headwater chub was first described from Ash Creek and the San Carlos River in east-central Arizona in 1874 (Cope and Yarrow 1875). The taxonomy of the roundtail chub and its relatives has often been confusing, and has undergone numerous revisions (see Miller 1945; Holden 1968; Rinne 1969, 1976; Holden and Stalnaker 1970; Smith et al. 1977; DeMarais 1986, 1992; Rosenfeld and Wilkinson 1989; Dowling and DeMarais 1993; Douglas et al. 1998; Minckley and DeMarais 2000); both are now recognized as distinct species (Minckley and DeMarais 2000; Nelson et al. 2004). A summary of the taxonomic history can be found in Voeltz (2002).

Roundtail chub historically occurred in the Colorado River and its tributaries from Wyoming's Green and Snake river drainages, south to the Little Colorado River confluence in Arizona, including several drainages in the lower Colorado River basin (Baxter and Stone 1995; Weitzel 2002). In Mexico, it occurs in Río Yaqui basin and perhaps more southern rivers (Hendrickson et al. 1981). Voeltz (2002), estimating historical distribution based on museum collection records, agency database searches, literature searches, and discussion with biologists, found that roundtail chub in the lower Colorado River basin was historically found in the Gila and Zuni rivers in New Mexico; and in the Black, Colorado, Little Colorado, Bill Williams, Gila, San Francisco, San Carlos, San Pedro, Salt, Verde, White, and Zuni rivers in Arizona, and in numerous tributaries within those basins. Voeltz (2002) estimated the lower Colorado River basin roundtail chub historically occupied approximately 4,500 km (2,796 miles) of rivers and streams in Arizona and New Mexico.

Roundtail chub in the lower Colorado River basin in Arizona currently occurs in two tributaries of the Little Colorado River (Chevelon and East Clear creeks); several tributaries of the Bill Williams River basin (Boulder, Burro, Conger, Francis, Kirkland, Sycamore, and Trout creeks); the Salt River and three of its tributaries (Black River, Cherry Creek and Salome Creek); the Verde River and four of its tributaries (Fossil, Oak, West Clear, and Wet Beaver creeks); Aravaipa Creek; and in New Mexico, in the upper Gila River (Bonar et al. 2004; Voeltz 2002; AGFD 2005a, 2005b). Roundtail chub are presumed to inhabit several streams in the Salt River drainage, although their status is not currently known; these streams include Wilder, Canyon, Carrizo, Cedar, Cibecue, and Corduroy creeks, and White River (Voeltz 2002).

Roundtail chub in the Lower Colorado River basin are found in cool to warm waters of mid elevation rivers and streams, and often occupy the deepest pools and eddies of large streams (Minckley 1973; Brouder et al. 2000; Minckley and DeMarais 2000; Bezzerides and Bestgen 2002). Although roundtail chub are often associated with various cover features, such as boulders, vegetation, and undercut banks, they are less apt to use cover than congeneric species such as the headwater chub and Gila chub (*Gila intermedia*) (Minckley and Demarais 2000). Water temperatures for occupied by Gila chub vary between 14° and 24° C (57˚ and 75˚F); spawning has been documented at 18° and 22° C (64˚ and 72˚F) (Bestgen 1985; Kaeding et al. 1990; Brouder et al. 2000). Spawning occurs from February through June in pool, run, and riffle habitats, with slow to moderate water velocities (Neve 1976; Bestgen 1985; Propst 1999; Brouder et al. 2000). Roundtail chub are omnivores, consuming aquatic and terrestrial invertebrates, aquatic vegetation, detritus, and occasionally vertebrates (Propst 1999; Schreiber and Minckley 1981).

Estimating status of the roundtail chub is difficult because little is known of its former distribution due to a lack of surveys prior to widespread habitat degradation and introductions and invasions of nonnative fishes. Additionally, their status in several streams on tribal lands is largely unknown. Nevertheless, the decline of this species was noted as early as 1961, and consistently since that time (Miller 1961, 1972; Deacon et al. 1979; Bestgen 1985; Girmendonk and Young 1997; Bezzerides and Bestgen 2002; Voeltz 2002).

A review of the status of these species by Voeltz (2002) found declines from historical levels. Of 40 populations of roundtail chub in the lower Colorado River basin thought occupied in recent times, Voeltz (2002) found that 6 were stable-threatened, 13 were unstable-threatened, 10 were extirpated, and 11 populations were unknown. Voeltz (2002) considered a population stable if the species was abundant or common and data over 5-10 years indicated a recruiting population, secure if no obvious threats were apparent, and threatened if nonnative aquatic species were present or serious current or future habitat-altering land or water uses were identified. Roundtail chub are known to occupy only 18 percent of their former range, and have an unknown status in 14 percent of their range. Thus, based on the best available scientific information, roundtail chub in the lower Colorado River basin appears to occupy about between 18 and 32 percent of its former range [approximately 800 km (497 miles) out of the 4,500 km (2,796 miles) considered to be formerly occupied] in Arizona and New Mexico, and every known population of the entire currently occupied range is considered threatened by both the presence of nonnative species and habitat alteration Voeltz (2002). Survey results from the 2002 status review were confirmed in 2004 and 2005 (AGFD 2005a, 2005b; Clarkson and Marsh 2004).

In summary, the roundtail chub has been extirpated from approximately 82 percent of its historical range and is likely to disappear from at least another 12 percent in the immediate future unless efforts are undertaken to ameliorate threats and protect these populations. No portion of its range is secure. The roundtail chub is currently considered a sportfish by the AGFD as a management tool, however limited harvest of roundtail chub is not considered to impede conservation of the species or limit persistence (Brouder et al. 2000; Voeltz 2002). In 2004, AGFD and the other basin states within the species range signed a range-wide conservation agreement to protect the roundtail chub. AGFD has developed and is implementing a Statewide Conservation Agreement and strategy for roundtail chub and five other native fish species (AGFD 2007). A number of state, federal, tribal, and non-governmental parties, including SRP, have agreed to assist in the implementation of the statewide program.

Desert Sucker

Desert suckers are found in suitable habitat at elevations ranging from 480 to 8,840 ft in the lower Colorado River downstream of the Grand Canyon, the Gila and San Francisco basins of New Mexico, tributary streams of the Gila River upstream of Gila, Arizona, along the Virgin River basin of Utah, and White River and Meadow Valley Wash in Nevada (Sublette et al. 1990; AGFD 2003c). Its physical appearance is marked by dark green to tan on the lateral and dorsal regions which fades to silvery yellow on the lower lateral region; a broadly rounded snout oriented downward for bottom feeding; and an average, overall maximum size that can attain almost 13 inches in total length and less than two pounds in weight (Sublette et al. 1990).

These suckers feed primarily on chironomid larvae (as juveniles) and plant detritus using specially adapted jaws for scraping. Desert suckers are not known to move great distances, depending upon the distribution of preferred habitat, within the average system and resist downstream displacement during flood events (Sublette et al. 1990; AGFD 2003c; Lucas and Baras 2001). The species prefers flowing pools and rapids with a substrate comprised of gravel-rubble with interstitial silt within a wide elevational range (AGFD 2003c).

Spawning occurs in late winter and early spring when adults gather in large numbers over riffle substrates where eggs are laid, adhering to the gravel within shallow depressions (Sublette et al. 1990; AGFD 2003c). Juvenile desert suckers remain in quiet, low or no flow shallow water until they mature and assimilate into faster flowing stream habitats (Sublette et al. 1990; AGFD 2003c).

Threats include reduced available habitat due to alteration of historical flow regimes, construction of reservoirs, and competition with and predation by nonnative fish. Nonnative fish have also increased competition and introduced hybridization (AGFD 2003c).

Longfin Dace

The longfin dace is a small-scaled species, rarely exceeding 2.6 inches in length, found at elevations spanning 1,360 to 6,740 feet (Sublette et al. 1990; AGFD 2003f). The physical appearance of the longfin dace was described by Minckley (1973) as "….. dark gray above, white below; sides sometimes silvery or with a dark lateral band lying just below the lateral line." Considered by Minckley (1973) to be the "….. most successful, highly adaptable, cyprinid fish native to the deserts of the American Southwest," the longfin dace occurs in a range of habitat from hot, low desert streams to cool clear brooks at higher elevations with a preference for gravely or sandy substrates (AGFD 2003f).

Longfin dace occur in the Gila and San Francisco river basins of New Mexico, the Bill Williams and Gila River systems of Arizona, as well as the Rio Yaqui and coastal systems draining western Sonora, Mexico (Sublette et al. 1990).

Longfin dace are opportunistic in their diet taking aquatic invertebrates as well as feeding upon detritus, zooplankton, and algae (Minckley 1973; AGFD 2003f). Adults generally become sexually mature within one year of age and spawning occurs over a long, six month period beginning in December and continuing through July (and possibly September in low elevations) with a surge in spawning activity occurring in April (Minckley 1973; AGFD 2003f; Sublette et al. 1990).

Threats include human activities that alter the quality or flow of water, particularly flood control and irrigation, as well as predation from and competition with nonnative fishes (AGFD 2003f).

Sonora Sucker

The Sonora sucker is a noticeably bi-colored species that can attain lengths of 31.5 inches and is described as having a fusiform, chubby body, a large head with brownish coloration dorsally and yellow beneath (Minckley 1973).

Habitat preferred by the Sonora sucker seems to vary widely, from low elevation warm water streams (369 feet) to clear and cold higher elevation streams (2,663 feet) (AGFD 2003d). Minckley (1973) did suggest the species has a tendency to gravitate to gravelly or rocky pools or deep, quiet water. Similar to other members of its genus, the Sonora sucker is very sedentary and greatly resists downstream displacement; with very little seasonal movement observed (Sublette et al. 1990). The Sonora sucker occurs in the Gila and San Francisco drainages in New Mexico as well as the Bill Williams and Gila River systems in Arizona (Sublette et al. 1990).

Sonora suckers are omnivorous, feeding in early morning and late evening, and their diet appears to vary with availability of prey (Sublette et al. 1990; Minckley 1973). Food items taken by the species may include crustaceans, diatoms, algae, protozoans, and miscellaneous invertebrates and young of the species are known to feed "by the millions" along the margins of streams (Sublette et al. 1990; AGFD 2003d; Minckley 1973). Incidentally, Sonora suckers will take baited hooks and do provide the angler with a "slow and determined struggle"; they are also taken by bow and arrow and by snagging (Minckley 1973).

Spawning behavior is observed from late winter through mid-summer (AGFD 2003d). The act of spawning is similar to that of other members of its genus characterized by the tendency larger groups to move into shallower tributaries or onto riffles of larger streams with gravelly substrates where fertilized eggs are deposited, incubate, and develop (AGFD 2003d; Sublette et al. 1990; Minckley 1973).

Threats include reduced available habitat due to alteration of historical flow regimes, construction of reservoirs, and predation and competition by nonnative fish.

Speckled Dace

The speckled dace is a relatively small minnow that rarely exceeds 3 inches in length and has a highly variable ranging in background colors and patterns, even patternless individuals are observed (Minckley 1973; AGFD 2003j; Sublette et al. 1990). The body of this species is described as " … chunky, rounded, somewhat flattened ventrally …." by Minckley (1973).

Occurring in major drainages west of the Continental Divide south of the Columbia River to northern Sonora, Mexico, the speckled dace is generally rare below elevations of 4,900 feet but is considered in peak abundance at elevations between 6,500 and 9,800 feet, below riffles and eddies, in shallow water (<20 inches deep) (Minckley 1973; Sublette et al. 1990). There appears to be a preference of the species for headwaters, creeks, and small to medium rivers but rarely can be found in lakes (AGFD 2003j). The species has relative intolerance for elevated temperatures and reduced oxygen, which explains the species affinity for higher elevation systems throughout its distribution (Sublette et al. 1990). This species is reported by AGFD HDMS (2003) as occurring below Bartlett Dam on the Verde River. They are recognized to have been widespread in both the Verde mainstem and its tributaries and have one of the most extensive distributions of all western cyprinids occurring in virtually every western state and a multitude of habitats (Minckley 1973; Bettaso and Paradzick, AGFD, pers. comm. 2005).

The speckled dace is an omnivorous species that feeds upon algae, detrital material, insect larvae, small crustaceans, small snails along the bottom, but "… sometimes rises to mid-water to inspect, and sometimes devour, floating materials" (Minckley 1973; AGFD 2003j). All feeding activity occurs during the evening hours of 9:00 pm and 1:00 am (Sublette et al. 1990).

Spawning activity in speckled dace has two defined spawning periods; spring and late fall where the prior is dictated by photoperiod and water temperature and the latter influenced by flow regimes (Sublette et al. 1990; Minckley 1973; AGFD 2003j). Swift water is sought by breeding adults where the female enters an area with gravelly substrate that has been cleared by courting males and releases her eggs into the substrate that is showered by sperm from several males (Sublette et al. 1990).

Threats include nonnative predatory fish and land uses that damage aquatic habitat (AGFD 2003j).

The conclusions of this biological opinion are based on the project as described in the "Description of the Proposed Action" section of this document, and the information contained in the final HCP, final EIS, and the Fish and Watershed Committee Report.

We note that this biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service (No. 03-35279) to complete the following analysis with respect to critical habitat.

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 which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species under consultation and their habitat to provide a platform from which to assess the effects of the action now under consultation.

Action Area

The "action area" means all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action. Indirect effects are those that are caused by the action and are later in time, but are still reasonably certain to occur (50 CFR 402.02). The effects of the action arise from: 1) implementation of the optimum operation of Horseshoe and Bartlett, and 2) effects of proposed mitigation and monitoring activities that are part of the HCP. In regard to the first item, the action area includes the conservation space of each reservoir as well as streams and riparian areas upstream and downstream of each dam. Also part of the action area are the mitigation sites that are proposed to be obtained outside of the Verde watershed, which are expected to include at least 150 acres in the Safford Valley along the Gila River, and potentially along the San Pedro River. Any future mitigation actions will be in compliance with either section 7 or 10 of the Act, as appropriate.

The components of the action area considered in this analysis are the 100-year floodplain of the Verde River from Granite Reef Dam (confluence with the Salt River) upstream to the Allen Diversion/Tunnel at Peck's Lake near Clarkdale (Figure 1), and the Safford Valley mitigation lands. Also included in the action area are portions of six tributaries to the Verde River: Lime Creek, East Verde River, Fossil Creek, West Clear Creek, Wet Beaver Creek and Oak Creek, as well as the proposed mitigation sites described above. Specifically, the action area can be described as:

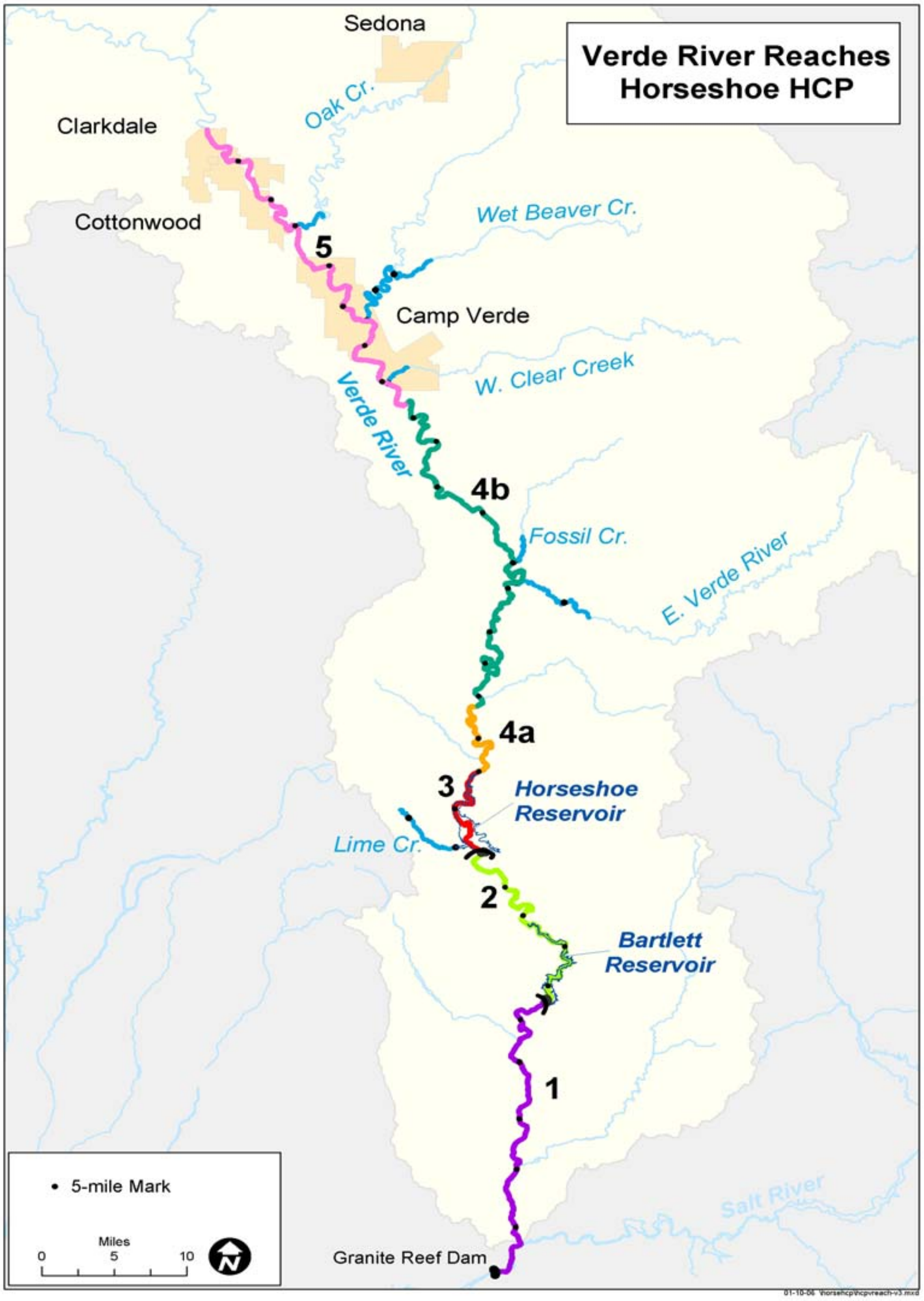


Figure 1. Action area along the Verde River; also depicting designated reaches.

- The Salt River and 100-year floodplain between Granite Reef Dam and the confluence with the Verde River;

- The Verde River and the 100-year floodplain between the confluence with the Salt River and the upper end of Horseshoe at full pool;

- The Verde River between the upper end of Horseshoe at full pool and the Allen Ditch Diversion near Peck's Lake;

- The lower 0.125 stream miles of all intermittent and ephemeral streams and washes tributary to the reaches listed above;

- The lower 6 stream miles of Lime Creek, the lower eight stream miles of the East Verde River, the lower three stream miles of Fossil Creek, the lower two stream miles of West Clear Creek, the lower 12 stream miles of Wet Beaver Creek, the lower three stream miles of Oak Creek, (each from the confluence with the Verde River – upstream); and

- Lands acquired and protected for flycatcher and cuckoo mitigation.

Consistent with the analysis provided in ERO (2008) and in acknowledgement that the activities and their impacts included in the environmental baseline vary within the geographically-broad action area, we partitioned the action area into five reaches for a more accurate analysis (Figure 1):

- Reach 1. Granite Reef to Bartlett Dam (28 stream miles)

- Reach 2. Bartlett Dam to Horseshoe Dam (21 stream miles)

- Reach 3. Horseshoe Dam to the top elevation of Horseshoe Reservoir – ten stream miles of reservoir (at full pool) plus all six stream miles of Lime Creek

- Reach 4a. Top elevation of Horseshoe Reservoir to eight stream miles upstream (eight stream miles)

- Reach 4b. Eight miles upstream of Horseshoe Reservoir to the upstream end of Wild and Scenic River section (near Beasley Flats) [44 stream miles of mainstem plus 11 stream miles of tributaries (specifically, eight stream miles of the East Verde River and three stream miles of Fossil Creek.)]

- Reach 5. Upstream end of Wild and Scenic River section to the Allen diversion at Clarkdale [38 stream miles of mainstem plus 17 stream miles of tributaries (specifically two stream miles of West Clear Creek, 12 stream miles of Wet Beaver Creek, and three stream miles of Oak Creek.)]

Reach 4 is further divided into two sub-reaches, 4a and 4b. This is done to account for influence of out-migration of largemouth bass on the fish community upstream of Horseshoe Reservoir at full pool. In total, 183 stream miles within the Verde watershed are considered herein.

Vegetation

Vegetation along the Verde River and its floodplain in the action area is classified as Deciduous Riparian Woodland and Emergent Marshland, according to Brown (1973, 1982). Dominant species in the riparian woodland community type include Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), velvet ash (*Fraxinus velutina*), velvet mesquite (*Prosopis velutina*), salt cedar (*Tamarix ramosissima*), and seepwillow (*Baccharis salicifolia*). Dominant wetland plant species include cattails (*Typha* spp.), horsetail (*Equisetum* spp.), bulrushes (*Scirpus* spp.), rushes (*Juncus* spp.), spike rushes (*Eleocharis* spp.), and sedges (*Carex* spp.).

Geomorphology

The geomorphology of the Verde River generally reflects the corresponding geologic setting, forming broad basins through less resistant formations and narrow valleys as it flows through harder materials (Pearthree 1996). Canyon reaches, found intermittently in Reaches 1 and 4, constrain the river to a narrow valley bottom, with discontinuous pockets of floodplain material. Alluvial terraces are less common, often merging with colluvial deposits, tributary debris flow deposits, and alluvial fans to form uneven higher areas along the valley sidewalls (Beyer 1997). Structural basins, such as the Verde Valley in Reach 5, generally provide a wider valley bottom and more continuous floodplain and terrace development (Beyer 1997). Despite these variations, the river exhibits a distinct low-flow channel within a wider flood channel (Beyer 1997; MEI 2004).

Flow

Perennial flow in the Verde River and its major tributaries is maintained by groundwater discharge from several large rock units, and surface flow which is hydraulically connected to groundwater within the alluvium throughout the action area (Owen-Joyce and Bell 1983). A variety of factors influence the hydrologic system of the Verde River in the action area including precipitation, streamflow, sub-surface flow, groundwater interactions, and water loss from evaporation and transpiration (Owen-Joyce and Bell 1983). Anthropogenic influences on these factors include surface water diversions, groundwater pumping from the alluvial aquifer and source aquifers, and changes in watershed condition that affect run-off amount and patterns.

Introduction to Watershed Impacts

The aquatic and riparian communities of the Verde River and its major tributaries have been and continue to be altered by impacts from land uses, water use, alteration in water quality, livestock grazing, sand and gravel extraction operations, recreation and a number of other activities described later in this document. However, a portion of the river in the action area (Reach 4) still retains qualities that deserved the designation of a Wild and Scenic River.

Land ownership varies throughout the action area. The U.S. Forest Service manages almost 69 percent of the river (100.5 miles), Indian tribes own 10 percent (15.2 miles), private entities own 21 percent (30.4 miles), and the State of Arizona owns less than 1 percent (0.35 mile). Private lands are concentrated between Clarkdale and Camp Verde in Reach 5, along Oak Creek, and along the lower reaches of Wet Beaver Creek and West Clear Creek. The action area crosses three National Forests: the Prescott National Forest (PNF) generally borders the west side of Reach 5; the Coconino National Forest (CNF) borders the east side of Reach 4 and 5 to Fossil Creek; and the Tonto National Forest (TNF) extends on both sides of the river from Fossil Creek to the Fort McDowell Yavapai Nation (Reaches 1, 2, 3 and 4).

The Arizona Department of Environmental Quality (ADEQ) identified a number of non-point source activities that contribute to water pollution, alterations in river flow characteristics, and changes in vegetation and wildlife populations within the Verde River portion of the action area (ADEQ 1988). These activities include agricultural diversions and water impoundments, grazing, urbanization/development, roads, bridge construction, in-stream recreational activities (e.g., ATVs), resource extraction, agricultural return flows, leaking septic tanks, riparian alteration, streambank modification/destabilization, and dam construction (ADEQ 1988; Cook et al. 1991).

Water quality parameters in this portion of the action area also were evaluated using the ADEQ's biennial report, termed the 305(b) report, which provides the results of two years of compiling and assessing large amounts of data consisting of analytical results from water quality samples collected by multiple agencies, academic institutions, and private entities (from 1998-2003) to determine, within a designated waterbody or reach, if any or all designated uses of those waterbodies are attaining their representative water quality standards. Bioassessments by ADEQ provide an indication of water quality and also provide an index to the availability of prey resources for native and nonnative fish species. Several designated uses were identified by ADEQ, but the Aquatic & Wildlife (cold water) (A&Wc) or Aquatic and Wildlife (warm water) (A&Ww) designated uses are the sole uses that determine whether the quality of the water is supporting aquatic biota as an element of habitat (e.g. warmwater versus coldwater fishes).

In many instances, a given reach was assessed by ADEQ as "Inconclusive." This term indicates that a potential water quality issue was observed, but the data set was deemed insufficient according to ADEQ policy, which prevented ADEQ from determining whether the designated use was being attained. With respect to exceedances in turbidity levels, the turbidity standard was repealed in rule by ADEQ in 2002, with the understanding that samples would still be analyzed for turbidity but waterbodies would not be designated as "Impaired" due to this parameter alone, until such time that an adequate standard is adopted in rule to address suspended sediment (unless the U.S. Environmental Protection Agency does so by citing a violation of the narrative water quality standard). A reach that has any designated use assessed as "Inconclusive" is automatically added the ADEQ's "Planning List" where it will receive additional sampling effort until the designated uses for the reach can be confirmed as "Attaining." Because of the timeliness of the data, the following discussion on water quality is based on ADEQ's (2004) "The Status of Water Quality in Arizona – 2004 Arizona's Integrated 305(b) Assessment and 303(d) Listing Report," unless otherwise referenced.

The extent to which human activities impact habitat can be attributed to population growth in the area. Arizona increased its population by 394 percent from 1960 to 2000, and is second in population growth only to Nevada (SSDAR 2000). Over the same time period, population growth rates in Arizona counties have varied by county; Maricopa County grew by 463 percent and Yavapai County by 579 percent in this 40 year span (SSDAR 2000). In the past 50 years, the human population within the Verde River watershed has grown substantially, with ranches and farms being converted into residential and commercial areas [Yavapai County Water Advisory Committee (YCWAC) and U.S. Bureau of Reclamation (USBR) 2003]. The population in the Verde Valley (Reach 5) has doubled in each of the past two decades (YCWAC and USBR 2003). These changes have had, and will continue to have, a significant effect on the river system, including increased demand for water, increased run-off, shortened return intervals for flood events, water quality impacts, and increased recreation impacts (YCWAC and USBR 2003; Barnett and Hawkins 2002; ADEQ 2004; PNF 2001; USDA 2004).

Growth in the Verde River basin, both within the action area and beyond the boundaries of the action area, has placed added pressure on limited water resources. Increased groundwater pumping along the river and at source locations (springs, aquifers) affect the amount of base flow available in the river (Owen-Joyce and Bell 1983). In addition to dewatering, diversions for irrigation ditches have a number of impacts on the stream channel including: a reduction in the quantity and quality of aquatic resources for native fish; changes in stream channel morphology; changes in water temperature, chemistry and flow pattern; and, reduction in riparian area width and vegetation type (USFWS 1989). Return flows from agricultural fields have the potential to introduce pesticides and fertilizers back into the river (USFWS 1989). Unused water eventually returns to the river; however, the majority of the ditches are unlined so that large amounts are lost to seepage, resulting in redistribution of surface water to generally shallow groundwater.

During flood events, diversions can create major erosion and sediment problems in the river or stream channel (Alam 1997). Washout of rock and earth diversion dams is reported to occur with some regularity during periods of high runoff. Often when the diversions are washed out, front-end loaders and dozers are used in the stream channel to re-build the structures. Rapidly rising floodwaters in ditches may quickly exceed ditch capacity and overtop the ditch causing extensive erosion of stream banks between the ditch and the stream channel (Alam 1997).

Sullivan and Richardson (1993) observed that, in general, areas immediately downstream from diversion structures have a decreased potential to support a diverse and abundant aquatic community due to reduced water levels. They reported that water flows became negligible at these points and that anaerobic conditions prevailed and aquatic productivity was reduced in the little water that remained in the channel below these points.

Historical grazing of livestock along the river and current grazing within the watershed have also played indirect roles in the degradation of the aquatic and riparian habitat along the river. Although impacts have lessened in recent years, grazing has historically had significant adverse impacts to stream bank vegetation along the Verde River. Some sections of the river are severely grazed and livestock use in some areas has been a long-term chronic problem (USDA 2004). Analysis of the impacts of livestock grazing on fish and fish habitat requires examination of long-term, incremental changes in watershed functions, riparian and aquatic communities, and stream channel morphology; however, extrapolations of general hydrologic and biologic principles provide a large body of evidence linking degradation of watersheds, stream channels, aquatic and riparian communities, and fish habitat and populations in western North America to grazing and grazing management (Leopold 1924, 1946; York and Dick-Peddie 1969; Hastings and Turner 1980; Dobyns 1981; Kauffman and Krueger 1984; Skovlin 1986; Kinch 1989; Chaney et al. 1990; Platts 1990; Armour et al. 1991; Bahre 1991; Meehan 1991; Fleischner 1994).

The impacts of livestock grazing on native fish survival and recovery, as well as on their critical habitat, occur through seven components: 1) water quality (e.g., nutrient concentrations, water temperature); 2) stream channel morphology (e.g., channel depth and width, substrates); 3) hydrology (e.g., overland runoff, peak flow, flood velocity); 4) riparian zone soils (e.g., compaction, infiltration); 5) instream vegetation (e.g., algae and emergent vegetation abundance); 6) stream bank vegetation (e.g., herbaceous cover, overhanging vegetation, species composition); and 7) trophic level or food web changes (e.g., aquatic insect or amphibian composition/abundance) (Armour et al.1991; Belsky et al. 1999). Alteration to these components can have varying impacts on native fish communities and their habitat. Changes in the uplands or watershed can include removal of vegetation, alteration of species composition of vegetation communities, decreased soil stability and porosity, decreased water infiltration, and increased soil erosion and compaction which can reduce the roughness coefficient of watersheds and result in more surface runoff, soil erosion, and flooding, which have impacts on the river. Resulting changes to watercourses can include changes in the hydrograph such as decreased base flows, increased flood flows, and increased sediment (Gifford and Hawkins 1978; Kauffman and Krueger 1984; Chaney et al. 1990; Platts 1990; Fleischner 1994).

Livestock grazing is the most pervasive discretionary activity on National Forest land and has had the greatest effect on soil conditions and watershed function according to allotment files, historical documents, and research. Reduced livestock numbers, changes in timing and duration of grazing, and other management improvements are slowly improving ecological conditions on the river, but trespass and uncontrolled livestock grazing still present a problem in a number of locations along the river (PNF 2001; Ross Unpublished).

Olden and Poff (2005) included proliferation of nonnative fish species as a primary threat to the endemic and unique fish faunas of the American Southwest. The fastest expanding nonnative species are red shiner, fathead minnow, green sunfish, largemouth bass, western mosquitofish, and channel catfish. These species are considered to be the most invasive in terms of their negative impacts on native fish communities (Olden and Poff 2005). Many nonnative fishes such as yellow and black bullheads, flathead catfish, and smallmouth bass, in addition to those listed immediately above, have been introduced into Arizona's perennial rivers, including the Verde River (Bestgen and Propst 1989; Marsh and Minckley 1990; Sublette et al. 1990; Abarca and Weedman 1993; Stefferud and Stefferud 1994; Weedman and Young 1997; Voeltz 2002; Bonar et al. 2004).

Bonar et al. (2004) found that nonnative fishes were approximately 2.6 times more dense per unit volume of river than native fishes, and their standing crop was approximately 2.8 times that of native fishes per unit volume of river. Bonar et al. (2004) verified the findings of Voeltz (2002), in stating that red shiner were the most commonly encountered nonnative fish species in the Verde River by almost four-fold; they found the species to be present throughout the Verde River year-around, but noted the highest numbers in the reach between Beasley Flat to Sheep Bridge above Horseshoe Reservoir in riffle habitats. River reaches above Horseshoe Reservoir have resident self-sustaining populations of bass, green sunfish, catfish, and carp, with a low, unstable native fish community, which results in fewer native fish predation observations in sampling results for this reach (Bonar et al. 2004). Reaches below Bartlett Reservoir had both high native and nonnative fish abundance, which resulted in more frequent observations of nonnative predation on native fish according to Bonar et al. (2004). Lastly, Bonar et al. (2004) found that channel and flathead catfish, green sunfish, largemouth and smallmouth bass, and yellow bullhead had the highest rates of piscivory (fish predation) on native and nonnative fish species in all river reaches; of these species, largemouth bass were documented as the most significant predator on native fish. Largemouth bass are particularly concerning because it is a species well-suited to exploit reservoir habitat for reproduction and recruitment.

Past Reservoir Operations

Operation of Horseshoe and Bartlett reservoirs has resulted in fluctuating lake levels and stream flows since the inception of operations in the 1930s and 1940s. Lake levels respond to stored winter runoff being gradually used in spring and summer, and from year-to-year depending on the amount of runoff entering the system from precipitation on the watershed and reservoir releases to meet water demands. Stream flows below the reservoirs are primarily driven by dam operations. However, flood flows have periodically spilled downstream due to the limited capacity of these reservoirs.

Over time, the fluctuating lake level at Horseshoe and occasional scouring floods have resulted in varying amounts of riparian vegetation at Horseshoe and along the Verde River. Minimal amounts of riparian vegetation have occurred historically at Bartlett because of its relatively steep, rocky shoreline. Between the late 1970s and early 1990s, a relatively wet period, areas of riparian vegetation expanded at the inlet to Horseshoe and along the Verde River below Bartlett as the result of large scouring floods and high lake levels. Since the mid-1990s, low water levels caused by drought have allowed additional riparian vegetation to become established along the Verde River on the exposed lakebed of Horseshoe. The fluctuations in lake levels and stream flows affected the amount of riparian and aquatic habitat available at Horseshoe, Bartlett, and along the Verde River.

In average and above-average runoff years, Horseshoe Reservoir has stored water for 3 to 6 months at some point during December through June. Horseshoe Reservoir was generally emptied each year unless lack of storage space in Bartlett meant that water released from Horseshoe would be spilled.

Riparian Vegetation

The recent drought reduced stream flows and resulted in low reservoir levels throughout the West. Typically, this resulted in the growth of vegetation at lower elevations of affected reservoirs. In the Verde River system, the most dramatic vegetation changes of this type have occurred at the Horseshoe inflow. New vegetation now occurs on the Horseshoe bed. Some of this new vegetation has developed into patches of tall dense willow nesting habitat that flycatchers occupy, but most of the new vegetation remains relatively short or sparse.

SRP contracted with researchers at Arizona State University to evaluate the effects of up to six months inundation of tall dense vegetation in Horseshoe that occurred during the winter and spring of 2005 (Paradzick 2007). Researchers also evaluated if management of reservoir drawdown timing and rate at Horseshoe could facilitate desirable woody vegetation seedling establishment above elevation 2,010, primarily to promote the creation of habitat for southwestern willow flycatcher.

The inundation study found that patches of vegetation at the lowest elevations in the reservoir, which were inundated for the longest period of time, had the highest mortality, especially among tamarisk trees and shrubs. Willow trees had relatively low mortality (less than 5 percent) regardless of the duration of inundation.

Several studies and publications pertaining to tall woody vegetation along the lower Verde River are available.

In 2004, Mussetter Engineering, Inc. (MEI), a sub-contractor for ERO Resources Corporation (ERO), completed a study of reservoir operations on fluvial geomorphology at three study sites in support of a companion study (ERO 2004) of riparian vegetation in relation to operation of Horseshoe and Bartlett. MEI (2004) focused on inundation and substrate stability at each study site. In summary, MEI (2004) reported three primary conclusions:

- Operation of Bartlett and Horseshoe has caused little, if any, morphological or sedimentological adjustment of the Verde River.

- The changes in hydrology caused by the dam operations reduced the frequency of inundation and mobilization of sediments. The effect downstream of Horseshoe was less than the effect downstream of Bartlett because of the smaller capacity of Horseshoe.

- The reduction in frequency of flood events below Bartlett enabled vegetation to become better established and withstand higher magnitude floods.

The ERO report examined the effects of reservoir operations on the downstream riparian vegetation on the Verde River, as compared to riparian vegetation conditions upstream of Horseshoe Reservoir (ERO 2004). ERO (2004) concluded that the floodplain occupied by tall woody riparian vegetation along the lower Verde River is dynamic in both the regulated and unregulated reaches. In general, the acreage of tall woody vegetation acreage increased at the three study sites since aerial photos first became available in 1934, prior to the construction of Bartlett and Horseshoe dams in the late 1930s and early 1940s. Comparison of vegetation types and long-term trends for the study sites indicates that low regulation has not had a significant adverse effect overall on establishment and maintenance of tall woody vegetation stands through 2003. A slightly greater increase in tall woody vegetation at the two regulated sites over the past 60 years suggests that the dams may have provided a slight long-term benefit to persistence of woody stands by reducing the frequency and magnitude of scouring.

Stromberg et al. (2007a) summarizes how Horseshoe and Bartlett dams and their operations have influenced the woody riparian vegetation on the lower Verde River:

> "The degree of change in *Populus* [cottonwood] and *Salix* [willow] abundance and age structure parallels the degree of change in the flood hydrograph, as exemplified by a case study of the Verde River in central Arizona. The two major dams and reservoirs on the Verde River are managed to supply water to downstream Phoenix metropolitan area. The total flow volume is not altered, but typical of many rivers (Richter et al. 1996) dam operation has decreased average peak flow rate, flood frequency, and variability of some flow components, and shifted the timing of flow maxima and minima. Compared to some western rivers, the Verde reservoirs have a low storage to runoff ratio. Although small floods are captured in the reservoirs, large floods still occur in very wet years in which the reservoir capacity is exceeded, allowing for periodic channel movement, sediment redistribution, and *Populus* and *Salix* regeneration. During the wet winter of 1995, for example, reservoir spills during March and April were largely unmodified (i.e., larger run-of-the-river), and *Populus* and *Salix* established at about equal densities above and below the dam (Beauchamp and Stromberg, [*in review*] 2007). Tree recruitment during wet years also has been observed on other regulated rivers in the regions (Zamaro-Arroyo et al. 2001). Smaller-scale recruitment events, associated with smaller floods, are likely to be pre-empted [*or occur less frequently, see Appendix 4 of HCP*] along such rivers."

The findings of Stromberg et al. (2007a) relative to the similar abundance of cottonwood-willow forest above and below dams are not unique to the Verde River. Lytle and Merritt (2004) found that cottonwood forest was most abundant when floods were slightly less frequent than the natural flood regime due to dams because flood scour of seedlings is reduced and mortality caused by drought may be minimized though elevated base flows.

McNatt et al. (1980) studied riparian habitat and instream flows on the FMYN near the mouth of the Verde River and found high cottonwood mortality in the late 1970s, possibly from the combined effect of severe drought and groundwater pumping.

In 1986, as a part of water right negotiations, ERO Resources evaluated the riparian vegetation communities on the Fort McDowell Reservation using ground and aerial vegetation surveys, analysis of historical aerial photos dating from 1934, coring of cottonwoods to determine age, soil studies, and analysis of surface and groundwater hydrology (SRP 2002). In 2001, SRP did extensive hydrological analysis on the effect of the Horseshoe and Bartlett on river flow (SRP 2002). Findings from these studies included:

- The status of cottonwood and willow along the lower Verde River resulted from a combination of natural fluctuations and man-induced changes, including channel migration, land use, pumping, drought, and dam operations.
- Broad, extensive areas of riparian woodland were not present prior to dam construction.
- River morphology has not changed significantly since the construction of Bartlett Dam.

- Given the small size of the SRP reservoirs on the Verde in relation to annual runoff, the natural hydrograph has not been substantially modified by reservoir operations.

- Vegetation density on the active floodplain of the lower Verde River increased since the late 1930s when river flows became regulated as the result of the construction of Bartlett Reservoir.

- Some cottonwood regeneration occurred on the FYMN; a number of saplings near the Highway 87 bridge resulted from high flow events in 1978 and 1980.

- Recreational use of riparian areas and grazing by cattle and horses heavily impacted cottonwood/willow communities along the lower Verde.

- Recruitment of new trees and shrubs from high flow events has been limited.

- Upstream from the FMYN and above Needle Rock, a relatively high-gradient channel and riparian land uses (e.g., grazing) appeared to be the biggest factors limiting riparian vegetation.

- High bank cottonwood trees that are overly mature but important to bald eagles as nesting and roosting habitat appear to be decadent primarily as a result of age, disease, and a declining water table resulting from the natural migration of the active channel to the opposite side of the floodplain.

A minimum flow of 100 cfs released from Bartlett Dam was incorporated into the water rights settlement with the FMYN and has been in effect since 1994 (SRP 2002). ERO (2004) concluded the minimum flow of 100 cfs below Bartlett since 1994 may have benefited downstream tall woody vegetation.

In 1999, Dr. William Graf prepared a paper on the fluvial hydrology of regulated rivers for incorporation into the Southwestern Willow Flycatcher Recovery Plan (FWS 2002a, Appendix J). Dr. Graf used 1945-1991 gage data above and below the dams and 1904-1944 gage data at the lowest gage location to evaluate the effects of storage and releases of water on Verde River flows. Major findings in the paper are:

- The dams created conditions of numerous periods of very low flow and no flow, which result in a loss of the surface water stream and less recharge to the alluvial aquifer.

- Larger “ordinary low flows” for most of the year provide ecological benefits by increasing groundwater recharge and a larger surface water stream.

- Reduced mean annual peak flow and increased variability of annual peak flows have resulted in a smaller active channel.

- Fine sediment has been stored behind the dams and was not deposited along the channel downstream which resulted in poor substrate for cottonwood, willow, and tamarisk.

To summarize the environmental baseline with respect to dam operations on downstream riparian vegetation, a combination of factors including groundwater pumping and periods of no water releases from Bartlett appear to have caused the loss of some cottonwood trees in the late 1970s, which resulted in the establishment of a 100 cfs minimum flow in 1994. Cottonwood and willow recruitment below the dams appears to have been affected by several factors in addition to the operation of Horseshoe and Bartlett reservoirs. The most recent research by Stromberg et al. 2007a, quoted above, suggests that riparian woody vegetation (i.e., cottonwood, willow, and tamarisk) is persisting and regenerating below Bartlett dam.

Analysis of Environmental Baseline by Reach

The mainstem reaches and their associated tributaries within the action area are considered in this section. In addition, some upstream impacts influence not only the ecological integrity of the lower-most reaches of these tributaries but also that of the Verde River mainstem itself. Thus, we include a brief discussion of the environmental baseline of these six tributaries to the Verde River.

Reach 1: Granite Reef Dam to Bartlett Dam

Discharge of the Verde River in this reach is controlled by discharge at Bartlett Dam, except for very large flood pulses that exceed storage capacity of Horseshoe and Bartlett reservoirs. Below Bartlett Dam, the river channel tends to be constrained by bedrock outcrops. As the Verde River flows from upstream reaches to downstream reaches, the valley broadens. Vegetation along this reach is dominated by a Fremont cottonwood-Goodding's willow riparian community.

<u>Land Use:</u> The lower 19 miles of this reach (63 percent) are within the boundaries of the FMYN and the Salt River Pima Maricopa Indian Community lands. The remaining 11 miles from FMYN to Bartlett Dam are managed by the TNF, except for two small parcels of private land.

<u>Water Use:</u> For over 50 years, the City of Phoenix extracted groundwater from the alluvial aquifer in the lower reaches of the Verde River below Bartlett Dam. The City maintained a maximum of 14 wells in this reach. A 1945 USGS study indicated that the principal source of water for this well field was recharge from the surface flow and subsurface flow of the Verde River (McDonald and Padgett 1945). This USGS study also indicated that the groundwater table was being lowered as a result of pumping at these wells, based on water yield from the well field and estimated recharge rates from river flows. Groundwater depletion along this reach is likely to have affected instream flows, riparian vegetation and aquatic habitat during that period (McDonald and Padgett 1945; USFWS 1980). The City of Phoenix has since abandoned this well field, but some of the wells are being operated by FMYN for water supply purposes.

<u>Diversion Structures:</u> An earthen diversion dam has been constructed within the river channel on the northern end of the FMYN. This structure diverts water into 17 miles of irrigation ditches that supply water to orchards and croplands on 1,463 acres on the FMYN. In more recent years, the FMYN has increased its water use from this diversion in the river and from the underlying alluvial aquifer. This water use is expected to continue to grow as the human population, commercial enterprise and agricultural operations expand on the FMYN (Hoffman and O'Day 2001).

The Fort McDowell Water Settlement entitles the FMYN to divert up to 36,350 acre-feet (AF) per year from the Verde. In the future, the FMYN expects to divert all but 4,526 AF of that amount (31,824 AF diverted). That water has been leased to the City of Phoenix for 99 years.

Recreation: Due to its proximity to the Phoenix metropolitan area, this reach of the Verde River experiences intense recreation pressure year-round, with the most popular Forest Service areas suffering from excessive litter, soil compaction, off-road vehicle use, and contamination with feces (USDA 2004). Areas to the west of the river in Scottsdale, Rio Verde, and unincorporated areas of the County have experienced extensive residential and commercial development in the last 5 years. Because of the close proximity of the Phoenix urban area, recreation pressures along this reach of the river are expected to continue to increase. The portion of the reach located on National Forest land is managed by AGFD to enhance sportfish – standard state fish harvest regulations apply, and the use of live bait fish is permitted. The fisheries in the reach downstream of the National Forest are managed by the Fort McDowell Yavapai Nation.

Urbanization, Development, Roads: There is little new development occurring along the Verde River in both the northern and southern portions of this reach. Lands adjacent to the southern portion of this reach are under the control of the FMYN. The northern portion is under the control of the TNF. Areas between the FMYN and TNF are experiencing rapid residential development. Unpaved roads and unauthorized off-road vehicle use on both the TNF and FMYN are heavily used for recreation.

Water Quality: Within Reach 1, approximately 93 water quality samples were collected between 1998 and 2002 by AGFD, U.S. Geological Survey (USGS), SRP, University of Arizona (UofA), or ADEQ. Samples were collected in Camp Creek, Colony Wash, Grande Wash, and the Verde River. Grande Wash is "Not Attaining" the full-body contact designated use due to exceedances in two of two samples for *Escherichia coli*. However, *E. coli* is not a parameter that directly affects the suitability of the aquatic habitat for fish and therefore is not of particular concern for this analysis. The Verde River from Bartlett Dam downstream to the confluence with Camp Creek was assessed as "Impaired" for the A&Ww designated use due to exceedances of the chronic copper standards in four of 80 samples as well as exceedances of the total and chronic selenium standards.

The remaining downstream portion is largely within the FMYN and therefore, not in the jurisdiction of ADEQ. Hoffman and O'Day (2001) collected six samples within the area of the northern boundary of the Fort McDowell Indian Community between 1998 and 1999. Sample results indicated that parameters (major ions and nutrients, organic compounds, metals and suspended sediment), were all generally within acceptable limits, according to state and federal water quality standards (Hoffman and O'Day 2001).

Groundwater Pumping: There are 662 groundwater production wells in the vicinity of Reach 1, according to the ADWR Wells 55 Database. This number includes wells along Sycamore Creek, which drains into this reach.

Livestock Grazing: Unrestricted livestock grazing occurs on FMYN lands. Both cattle and wild horses graze along the river year-round. The TNF Bartlett Allotment lies adjacent to the Verde River but grazing is not currently permitted.

Water Management: Under the Fort McDowell Water Settlement, SRP is required to release a minimum flow of 100 cfs year-round from Bartlett Dam plus water orders on the Verde River except in situations of emergency, drought, or water quality problems, as specified in the Settlement Agreement. Drought is defined as any time that 1) total SRP storage is less than 50 percent of normal for the month; and 2) SRP Verde storage is less than 80,000 AF from March through November, or 60,000 AF from December through February. Although the drought criteria have been triggered in recent years, SRP has not released less than 100 cfs minimum flow.

Sand and Gravel Mining: FMYN operates a large sand and gravel mine in the floodplain adjacent to the active river channel. These mining facilities remove unconsolidated stream deposits to produce materials for construction and require water for washing aggregates and equipment, for dust control, and other activities.

Fire: Recently, catastrophic fires have occurred in Sonoran Desert vegetation within the watershed adjacent to the action area. Changes in plant species composition and soil condition as a result of those fires will have long-term consequences on the watershed in the form of reduced infiltration, rapid runoff and sedimentation and increased presence of fire-resistant exotic vegetation, such as red brome and buffel grass. However, data are lacking to quantify the extent of impact on this reach due to these wildfires. Impacts of recent fires that occurred further upstream would be partially mitigated by the dams that would capture any toxic ash flows from higher in the watershed.

Reach 2: Bartlett Dam to Horseshoe Dam

This reach of the Verde River is bounded by Horseshoe Dam at the upstream end and Bartlett Dam on the downstream end. It encompasses all of Bartlett Lake and 20 miles of river.

Water Use: Except for water use for one private landowner, the remainder of the flow remains in the Verde River. This diversion structure is used to shunt water to irrigated pasturelands and fields on the east side of the river. The diversion is an earthen structure that typically gets washed out during high flow events and is reconstructed using earth-moving equipment.

Land Use: The TNF manages this reach of the river, except for a privately owned parcel (less than 1 mile of river frontage) just downstream from Horseshoe Dam.

Urbanization, Development, Roads: Because most of the lands adjacent to this reach of the river are under the control and management of the TNF, the area is largely undeveloped. Unpaved Forest Service roads lead to recreational sites along the river and a paved road leads to recreational amenities at Bartlett.

Recreation: This reach receives heavy recreational pressures at Bartlett Lake and along the western side of the river corridor. The primary activities at Bartlett Lake are related to the use of watercraft, such as boating, fishing, water-skiing, jet-skiing, and access to camping and picnicking sites. AGFD manages the fishery to enhance sportfish – standard state fish harvest regulations apply, and the use of live bait fish is permitted.

A number of developed Forest Service campsites are located along the western bank of the river upstream from Bartlett Lake. These campsites receive heavy use from both foot and vehicular traffic. Campsite areas tend to be heavily impacted, and noxious weeds, such as yellow star thistle, are present.

Water Quality: Bank erosion is a problem in the riverine portion of this reach. It is unclear whether the erosion is caused by dam releases or recreation (or a combination of both), but the resulting instability may be contributing to sediment influxes into the stream channel.

The ADEQ 305(b) report states that, within Reach 2, approximately 66 samples were collected by AGFD, U of A, or ADEQ in predominantly the Verde River and Bartlett. The results for samples collected in the Verde River between Horseshoe Dam and the confluence with Alder Creek were assessed as "Inconclusive" by ADEQ because the minimum number of samples required for conclusive assessment was not collected and several core parameters were missing from the analysis (i.e., *E. coli*, total metals [boron and mercury], and dissolved metals [copper, cadmium, and zinc]) according to the ADEQ 305(b) report.

With respect to the A&Ww designated use, one sample result out of sixty exceeded the standard for pH and one (out of seven samples analyzed for turbidity) exceeded the former standard for turbidity. Additionally, analytical parameters such as dissolved copper, cadmium and zinc were missing from the analysis. For these reasons, ADEQ assessed Bartlett as "Inconclusive" for the A&Ww designated use.

Groundwater Pumping: There are eight domestic wells pumping groundwater adjacent to the river in this reach. These wells are associated with activities at Bartlett Lake and at the private ranch that is located just downstream from Horseshoe Dam.

Livestock Grazing: The Bartlett, Sears Club-Chalk Mountain and St. Clair allotments lie adjacent to or near the river in this reach.

Fire: This reach is sensitive to impacts of catastrophic fire due to recent wildfires in adjacent uplands. However, data are lacking to quantify the extent of impact on this reach due to recent burns. Impacts of fires further upstream would are partially mitigated by Horseshoe dam that would capture any toxic ash flows from higher in the watershed.

Reach 3: Horseshoe Dam to the top elevation of Horseshoe

This reach encompasses the entire length of Horseshoe to its full capacity including Lime Creek.

Lime Creek

Lime Creek drains directly into Horseshoe Reservoir from the west. Perennial flow begins about one-half mile downstream from Lime Cabin Spring, approximately 6 stream miles upstream from the reservoir's shores at full pool. However, the length of the perennial reach varies with changes in spring discharge and runoff. The remaining distance to the reservoir is considered to be ephemeral. This ephemeral reach creates a physical barrier to fish movement between the reservoir and the creek, except when the lake is full and the ephemeral reach is flowing in response to a runoff event. Although this creek does not have a hydrologic connection to the river because of this ephemeral reach, the entire length of this creek is included in the action area because its channel enters directly into the reservoir. Flood pulses in Lime Creek coupled with high reservoir levels create temporary connectivity.

Land Use: The entire reach is managed by the TNF.

Urbanization, Development, Roads: The adjacent uplands are undeveloped grasslands and desert scrub. Except for roads that lead to the dam and lake, the area is largely inaccessible with few Forest Service roads leading directly to the upper end of the lake.

Recreation: Recreational activities are primarily associated with Horseshoe, and include boating, fishing, camping, and picnicking. Recreational impacts appear to be low to moderate. The AGFD changed its fishing regulations in 1998 permitting unlimited harvest of channel catfish, flathead catfish, smallmouth bass, and largemouth bass, and restricted the use and importation of live bait fish into the reach.

Water Quality: The ADEQ 319(b) report states that the AGFD and the U of A collected a total of 19 water quality samples at four sites within Horseshoe between 1999 and 2000. In one sample, the pH standard for the A&Ww designated use was exceeded at a pH of 9.3. Additionally, the former A&Ww turbidity standard, 25 Nepholometric Turbidity Units (NTU), was exceeded in four of eight samples with results ranging from 0.8 to 90 NTU. Core parameters such as total boron, mercury, manganese, copper and lead, and dissolved copper, cadmium and zinc were missing from the analyses for Horseshoe. For these reasons, ADEQ assessed the A&Ww designated use for this reach as "Inconclusive."

Groundwater Pumping: A single domestic well near Horseshoe Dam occurs within this reach.

Livestock Grazing: The Sears Club-Chalk Mountain Forest Service Grazing Allotment lies adjacent to Horseshoe Reservoir.

Fire: Fires during the summer of 2005 forced temporary closure of public access by the Tonto National Forest to Horseshoe and the Verde River, which eliminated removal of nonnative sportfish by anglers in a year when reservoir levels were maintained high for a longer than normal period. However, an increase in the size and number of predatory fish species in Horseshoe following this closure was not observed during the fall 2005 sampling (Robinson 2007).

Wildfires in June to July 2004, and July 2005, in the watershed above Horseshoe Dam resulted in flushes of ash and sediment into the area upstream from the lake, and caused a fish kill in tributaries and Verde River. Although they did not cause fish kills in the lake, the potential for this type of impact exists in the future. Flushes of ash and sediment may cause adverse impacts on aquatic biota. For example, AGFD, USFS, and USFWS personnel salvaged Gila topminnow from Lime Creek in July 2005 during the Cave Creek Complex fire due to the concern that late summer monsoon storms would wash resulting ash into the creek and cause a catastrophic fish kill.

Reach 4: Top elevation of Horseshoe to Beasley Flats.

The gradient of the river increases at the upstream end of this reach as the river flows out of the Verde Valley and crosses a landscape dominated by basalt cliffs. Floodplain width narrows, water velocity increases, riffles become larger and more frequent, and low velocity pools are present between riffles. Several large rapids are present in this reach, including the Class 4 rapids at Verde Falls, approximately two miles downstream from Beasley Flat. The extent of riparian and emergent vegetation is influenced by the geomorphology of the reach, narrowing where the river flows through steep-walled canyons. Annual base flow at the upper end of this reach (Camp Verde gage) averages 159 cfs (4.5 cms) (USGS website). Major perennial tributaries along this reach are Fossil Creek and East Verde River.

This reach of the Verde River is characterized as having long pools separated by short riffles. Habitat mapping of the Wild and Scenic reach identified 29 percent pools, 13 percent riffles and less than one percent side channels in the Scenic Section and 37 percent pools, 14 percent riffles and six percent side channels in the Wild section (A. Sillas, PNF, pers. comm.).

<u>Fossil Creek</u>

Fossil Creek is a perennial stream with its confluence at 31.5 stream miles upstream of Horseshoe, originating at Fossil Springs on the Mogollon Plateau north of Strawberry. Several other small springs discharge into the creek channel but contribute very little to the base flow (Sullivan and Richardson 1993). Until 2005, the creek was diverted 14 miles upstream of the confluence for the Childs-Irving hydroelectric plant. In November 2004, a fish barrier was constructed on the creek, 3 miles upstream of the confluence, prior to the full return of diverted flows to the stream channel in June 2005 (USGS 2005). The lower three stream miles of Fossil Creek are considered in the action area.

<u>East Verde River</u>

The confluence of the East Verde River is located 25 stream miles upstream of the upper end of Horseshoe, originating along the Mogollon Rim and flowing from the east for 53 stream miles to its confluence with the Verde River (Sullivan and Richardson 1993). Intermittent stream flows in the upper reaches have been supplemented by water piped over from the Blue Ridge (now C.C. Cragin) Reservoir on the north side of the Mogollon Rim. This supplemental water was discontinued in the mid-1990s but is expected to resume in the near future.

On recent stream survey trips, TNF personnel found dry stretches of streambed occurring intermittently from upstream of Pine Creek (15 stream miles from confluence) to a mile or so from the headwaters (C. Nelson, USFS, pers. comm.). Flows in this 38-mile stretch could be defined as interrupted perennial. Additionally, a series of small waterfalls creates a physical barrier approximately eight miles upstream from the confluence where the action area ends. Above the waterfalls, the stream is diverted at Doll Baby Ranch for irrigation, and just upstream of the ranch another small waterfall exists.

<u>Land Use:</u> This reach is under National Forest management and is split among the Prescott, Coconino, and the Tonto National Forests. The northern boundary of the TNF is approximately three miles upstream of the confluence with Fossil Creek.

Special Management/Regulation: In 1984, 39.5 miles of the Verde River were designated as Wild and Scenic under the authority of the 1968 Wild and Scenic Rivers Act, as amended. The boundaries of this designation extend from Beasley Flat to Red Creek. The Scenic River area extends 14.5 miles through this reach from Beasley Flat to below Childs. This portion of the river is managed to preserve naturally occurring flora and fauna, river-oriented recreational activities, scenic qualities, and archaeological and historic resources (USDA 2004).

Urbanization, Development, Roads: Lands adjacent to the mainstem are largely undeveloped. However, significant residential development associated with the community of Payson has occurred on private lands along the East Verde River in unincorporated areas.

Recreation: Road access is limited and dispersed camping and impacts associated with road and trail access are not extensive (USFS 2002a). Vehicular access to the river within this reach includes the Beasley Flat Road (FS 334), the Falls-Sycamore Canyon Road (FS 500), Brown Springs Road (FS 574), Childs Access Road (FS 502), Powerline Road (FS 16), and FS 7. Trails can be accessed from FS 500, 574 and 57. In areas where road access is provided, primarily at Beasley Flats and Childs, impacts are moderate to severe.

Recreational activities include camping, hiking, fishing, swimming and boating. It is a popular reach for kayaks and canoes because of the white water conditions in some areas. The most popular times for floating the river are March and April. River use is very light on the Wild section and light to moderate on the Scenic section with both day and overnight usage. Boating use fluctuates with water level.

The Beasley Flat site is the beginning of the Verde Wild and Scenic River and the demarcation point for whitewater boating. This site is popular with users, being the only access point between Camp Verde and Brown Springs, and receives consistent heavy day use and fishing use. The Beasley Flat site provides parking, restrooms, and paths to the river (PNF 2001).

The popular recreational site located at the Verde Hot Springs, located just upstream from Childs, receives heavy recreation pressure, especially during summer months. A dispersed camping area at Childs also receives heavy recreational use.

Most recreational fishing takes place at easily accessible sites, such as Beasley Flat, Verde Falls, Gap Creek, and Childs. The AGFD changed its fishing regulations in 1998 permitting unlimited harvest of channel catfish, flathead catfish, smallmouth bass, and largemouth bass, and restricted the use and importation of live bait fish into the reach.

Numerous river campsites occur within the Wild and Scenic section of the Verde River and a total of 97 campsites were evaluated by the Forest Service (USFS 2002b) with more than half the campsites having moderate to widespread litter, feces, excessive fire rings, and other damage.

Water Quality: Bioassessments conducted in the Verde River from West Clear Creek to Fossil Creek and from Tangle Creek to Ister Flat found good and exceptional macroinvertebrate communities (ADEQ 2000). The A&Ww designated use was assessed as “Not Attaining” due to exceedances of the former turbidity standard (six of 17 samples) and the chronic selenium standard (one of one sample). Fish macroinvertebrate communities and habitat were found to be poor at Childs due to organic sediment enrichment, recreational use and vehicle disturbance (USDA 2004). The A&Ww designated use in the lower reach (confluence of Tangle Creek to Ister Flat) was assessed as "Inconclusive" due to exceedances of the former turbidity standard (five of 24 samples).

The ADEQ 305(b) report stated that within Reach 4, approximately 155 water quality samples were collected by USGS, ADEQ, U of A, and SRP in the East Verde River, Fossil Creek, Round Tree Canyon Creek, Sycamore Creek, and the Verde River.

The East Verde River was determined to exceed A&Ww standards for former turbidity (two of two samples), chronic selenium (two of two samples), boron (four of 20 samples), and arsenic (seven of 23 samples); the latter is thought to be due to naturally high levels in native soils. The East Verde River was divided by ADEQ into three reaches for assessment purposes: 1) the upper reach from the headwaters to the Ellison Creek confluence (A&Wc designated use) (outside the action area); 2) the middle reach from the Ellison Creek confluence to the American Gulch confluence (outside the action area); and 3) the lower reach from American Gulch to the confluence with the Verde River. With respect to the A&Wc and A&Ww designated uses, the upper reach assessed as "Inconclusive" (only two sampling events) and the lower reach assessed as "Attaining." The middle reach assessed as "Impaired" due to the aforementioned exceedances in chronic selenium.

The A&Ww designated use was assessed as "Inconclusive" for Fossil Creek (only two samples collected).

Groundwater Pumping: The ADWR Wells 55 database has 1,411 groundwater wells listed in the vicinity of this reach. The majority of groundwater pumping is associated with the communities of Payson, Pine and Strawberry, and surrounding developments. These communities are associated with the East Verde River and Fossil Creek watersheds. Impacts from pumping mainly impact the East Verde River.

Livestock Grazing: Six Forest Service grazing allotments are associated with this reach. They include the Brown Springs Allotment on the PNF and Skeleton Ridge, Red Creek, Cedar Bench, Payson/Cross V, and Deadman Mesa Allotments on the Tonto National Forest. Cattle access the river portion of the Brown Springs Allotment for part of the year, but the Forest Service is proposing to fence the river in that area to exclude grazing. Most livestock have been excluded from Forest Service lands along the river. However, grazing impacts on the TNF portion of the reach are variable. Reports prepared by Forest biologists (Ross unpublished) indicated that trespass livestock grazing occurs frequently in many locations and that grazing is still having a negative impact in a number of locations along this reach.

Other Factors: Recent large, very hot wildfires outside of the action area in the upper watershed (i.e. Willow Fire) resulted in negative impacts to water quality in the East Verde River and in the mainstem Verde below the confluence with the East Verde and above Horseshoe Lake. During large precipitation events in the summer of 2004 and 2005, flushes of ash and sediment were washed into the stream channel causing adverse impacts to aquatic biota. Fish kills were reported in the East Verde and the mainstem Verde down to Sheep's Bridge in 2004 and above Horseshoe Lake in 2005 (T. Robinson, AGFD, pers. comm.). The extent of impacts to the fish community are unknown at this time. Another long-term consequence from these wildfires is reduced infiltration, rapid runoff and sedimentation that results from soil damage through removal of organic matter, loss of surface layer and changes to surface soil structure (Barnett and Hawkins 2002).

Reach 5: Upper End of Wild and Scenic Reach to Allen Diversion

Reach 5 generally encompasses the area from Clarkdale to below Camp Verde, an area that is referred to as the Verde Valley. Historically, this area has been more densely populated than other areas on the Verde River. The major tributaries that contribute to the river in this reach are Oak Creek, Wet Beaver Creek, and West Clear Creek. These tributaries originate on the Coconino Plateau or Mogollon Rim.

This reach tends to have low flow velocities and low channel gradient, which would likely contribute to greater fish species diversity by allowing the accumulation of detritus and nutrients important to aquatic life (Adamus et al. 1991). However, Sullivan and Richardson (1993) report that disturbances within the reach have reduced the quality of habitat for native species relative to upper reaches of the Verde River. Sullivan and Richardson (1993) cited a number of factors that contributed to degradation of aquatic habitat in this reach, including agricultural operations, urban development, bridge construction, road-building, agricultural diversions, extensive recreational use, sand and gravel operations, and historical and current removal of riparian vegetation. The increase in impervious surfaces that results from urban development and road building results in increased surface runoff, which may contain fertilizers, pesticides and other contaminants. Increased surface runoff also affects the timing and magnitude of peak flood flows (Barnett and Hawkins 2002).

A number of highly erosive areas occur in this reach because of vegetation removal, sand and gravel operations, and extensive recreational activities. Sullivan and Richardson (1993) attributed a decline in aquatic diversity in the vicinity of these erosive areas to an increase in suspended solids.

<u>Oak Creek</u>

Oak Creek feeds into the Verde River approximately 75 stream miles from the upper end of Horseshoe in the upper portion of Reach 5. The creek is a high-elevation boulder dominated system, with higher gradients than the Verde River. Oak Creek is perennial from its source at the confluence of Sterling Canyon and Pumphouse Wash to its confluence with the Verde River. Base flow in Oak Creek is maintained by springs at Indian Gardens, Page Springs and along Spring Creek, all located above the town of Cornville. Winter base flow from springs and numerous small springs along the creek and West Fork of Oak Creek increases from 13 cfs near the headwaters to approximately 62 cfs at the Verde River (Owen-Joyce and Bell 1983). Large seasonal differences in evapotranspiration rates and numerous irrigation diversions and returns in the vicinity of Cornville have resulted in considerable variations in baseflow (Owen-Joyce and Bell 1983). Only the lower three stream miles of Oak Creek are affected by the proposed action.

<u>Wet Beaver Creek</u>

Wet Beaver Creek is a 33-mile long tributary that flows southwest into the Verde River. The confluence is located near the town of Camp Verde; 64 stream miles upstream of the upper end of Horseshoe. The creek historically was considered to be perennial from its source at springs on the Mogollon Rim (Section 14, T15N, R7E) to the Montezuma Castle National Monument, which is 5 miles upstream from the confluence with the Verde River (Owen-Joyce and Bell 1983). Due to drought conditions in recent years, the upper reaches dried up, thus reducing the distance of perennial flow (S. Reger, AGFD, pers. comm.; C. Benedict, AGFD, pers. comm.; M. Rinker, AGFD, pers. comm.). The stream flows intermittently below the Monument (Owen-Joyce and Bell 1983). During the summer growing seasons, however, all or part of the flow approximately 9 miles above the confluence is diverted for irrigation purposes (Sullivan and Richardson 1993). The combination of diversions and interrupted (non-perennial) flow at the mouth of this creek limits the connectivity to the Verde River. Although Wet Beaver Creek water rights have not been adjudicated, use of surface water in the reach included in this action area is extensive. The primary surface water diversion from Beaver Creek is used to irrigate a golf course. Recently, the golf course was sold to a development company. This follows a general trend in the vicinity towards increased conversion of land to residential development. Typically, development is occurring in the form of lot splits with individual wells that extract water from the stream alluvium. (pers. comm. Greg Kornrumph, water rights specialist, SRP, 2-10-05; Janet Kelly, realtor, Coldwell Banker Real Estate, 2-10-05). The lower 12 stream miles of Wet Beaver Creek are affected by the proposed action.

<u>West Clear Creek</u>

West Clear Creek flows almost due west into the Verde River near the southern end of the Town of Camp Verde. The creek's confluence with the Verde River is located approximately 55 stream miles upstream of Horseshoe. It begins as a perennial stream at the confluence of Clover Creek and Willow Creek (GSRBM: Section 33, T14N, R9E) and flows in a westerly direction for approximately 37 miles before its confluence with the Verde River (Owen-Joyce and Bell 1983). Owen-Joyce and Bell (1983) measured a flow of 1.88 cfs at the headwaters and 19 cfs at the USGS gaging station located 11 miles upstream from the confluence, but base flow at this gage averages 16 cfs. As with Beaver Creek, diversions for irrigation occur downstream from Highway 260 (less than 4 miles from the confluence) and often fully deplete the flow of the creek, particularly during the peak irrigation period (Owen-Joyce and Bell 1983). All surface water rights in West Clear Creek are fully appropriated. Approximately 15 miles upstream from the confluence, a 50-foot waterfall provides a natural barrier to upstream movement of fish (Reger, pers. comm. 2004). The lower two stream miles of West Clear Creek are expected to be influenced by the indirect effects of the proposed action.

<u>Land Use:</u> More than 30 stream miles of this reach are privately owned, 1.4 miles are tribal lands, and 0.35 mile is owned by the State of Arizona, Arizona State Parks Board.

<u>Water Use:</u> Rapid population growth in this reach and in the upper Verde watershed is a significant concern for to instream flows in this reach of the river. Groundwater pumping from both domestic and commercial wells contributes to dewatering within this reach (ADWR 2000).

<u>Diversion Structures:</u> Stream flows in this reach are highly modified due to the presence of 47 diversions (Alam 1997). Twelve active diversions are located on the mainstem of the Verde in this reach, 23 diversions are on Oak Creek, nine diversions are on Wet/Beaver Creek, and three diversions are on West Clear Creek (Alam 1997). The Arizona Department of Water Resources Verde River Watershed Study (2000) and Alam (1997) include a detailed inventory of these ditch systems.

Irrigation ditches range in size from over 50 cfs and 17 miles long to less than 1 cfs and less than 1 mile long (Alam 1997). An estimated 15,000 acre-feet are diverted for irrigation of 4,770 acres. Although farming is mainly reliant on surface water, approximately 1,200 irrigation wells provide water during shortfalls in surface water availability (ADWR 2000).

Use of surface water for agricultural and landscape irrigation and other domestic uses impacts the integrity of the river by diverting significant amounts of water from the stream channel into ditch systems. Some of these diversions can remove the entire surface flow of the river or tributary during portions of the year (Alam 1997; Owen-Joyce and Bell 1983). The magnitude of diversions is such that the flow in the Verde River is reduced by two-thirds or more downstream from the Cottonwood Ditch (and is nearly dry in years of extreme drought).

<u>Urbanization, Development, Roads:</u> Increased urbanization within this reach continues to place a greater demand on water resources for municipal, agricultural, industrial and recreational uses. This river segment, including perennial tributaries, runs through the communities of Clarkdale, Cottonwood, Verde Village, Rimrock, Lake Montezuma, McGuireville, Cornville, Page Springs, Sedona, West Sedona, Village of Oak Creek, and surrounding unincorporated areas of private and state trust lands.

Barnett and Hawkins (2002) identified urbanization as being a contributor to changes in the hydrology of the river and its major tributaries, especially Oak Creek, Beaver Creek and West Clear Creek. Depending on the type and character of development and the amount and configuration of impervious surfaces, urbanization can increase the timing and amount of storm water runoff from the watershed. Impervious areas reduce infiltration of precipitation and produce runoff from rainstorms in larger amounts and more rapidly, resulting in higher peak flood flows and more frequent flows of a given magnitude (e.g., a flood magnitude that would occur on a five-year frequency interval may be occurring on a two-year interval) (Barnett and Hawkins 2002). Storm runoff from urbanized areas has the potential to increase sediment and turbidity in the river channel. In addition, there are impacts of storm runoff flushing contaminants from streets, parking lots, and commercial and industrial areas (Barnett and Hawkins 2002).

<u>Population:</u> The population in this reach has been doubling each decade for the past two decades (Yavapai County Water Advisory Committee and U.S. Bureau of Reclamation 2003). In recent years, all towns within the Verde Valley have experienced rapid increases in their populations. The population of the Verde Valley doubled between 1980 and 1994. During that same time period, the Towns of Camp Verde, Clarkdale, and the City of Cottonwood experienced population increases of 89 percent, 63 percent and 38 percent respectively (ADWR 2000). These population increases have contributed to the land use, and water quantity and quality impacts in Reach 4.

Recreation: Mixed land ownership makes access to the river and most of its tributaries difficult to regulate. Existing public and private access points exist along the entire corridor. The Verde Village Homeowner's Association owns a 2-mile stretch of the river, which provides recreational access for local homeowners. The PNF has installed seven developed access points in the Verde Valley and many undeveloped access points exist by way of ephemeral washes that drain into the river from the west side of the valley.

Recreational use of the river and its banks tends to be high. Activities include fishing, camping, picnicking, horseback riding, swimming, rock throwing and skipping, boating, hiking, and all terrain vehicle use. Motorized off-road vehicle use, illegal unregulated camping, dumping of trash, and removal and trampling of vegetation have all been noted as problems in the area. Although driving into and in the river is unauthorized on both the PNF and CNF, and a number of roads to the river have been closed, vehicles driving in the river and floodplain remain a problem. Impacts and violations are greatest between Cottonwood and Camp Verde where there are often several roads within a segment of floodplain (PNF 2001). A heavily traveled road that crosses the river exists upstream from the I-17 bridge on the Camp Verde Yavapai Apache tribal land. Trucks traveling from a sand and gravel operation regularly drive across the river at this location. Vehicle use within the active channel and floodplain results in reduced vegetative cover, compacted soils, increased turbidity and increased surface runoff. The AGFD changed its fishing regulations in 1998 to permit unlimited harvest of channel catfish, flathead catfish, smallmouth bass, and largemouth bass, and restricted the use and importation of live bait fish into the reach. Locations within the reach are stocked with rainbow trout in winter months by AGFD.

Water Quality: The USGS, ADEQ, and SRP previously evaluated the bacteriological quality of surface flows under the single sample category. Samples taken in Oak Creek and the Verde River periodically exceed the maximum allowable limits. Fecal pollution at some sites may be a potential hazard to swimmers during the summer months when streamside recreation and tourism is at its peak. High fecal coliform counts also may be attributed to livestock and other wild animals defecating in or close to streams (Owen-Joyce et al. 1983).

Much of the Verde River was listed as water quality limited in past 305(b) reports due to turbidity (ADEQ 1998). The most recent 305(b) Report listed the portion of the Verde River in this assessment meets surface water quality criteria except one station near Camp Verde, which is in partial support of full body contact due to *E. coli* (ADEQ 2000). Much of the river corridor in the Verde Valley is in private ownership and not managed by the Forest Service. Many residents of Camp Verde use septic systems and poor water quality may be due to septic leakage or from livestock on private land. Because no livestock are permitted on the river within National Forest lands in the Verde Valley, this impairment is not attributed to livestock grazing on public lands (PNF 2001). In its 1998 report, ADEQ listed the Verde River as impaired due to turbidity.

ADEQ collected 29 water quality samples in Beaver Creek; the A&Ww designated use was assessed as "Inconclusive" because several core parameters were missing from the analysis [i.e. *E. coli*, total metals (lead, copper, and mercury), and dissolved metals (copper, cadmium, and zinc)] and due to exceedances of the former turbidity standard in five of 26 samples collected. Between Slide Rock State Park to the confluence of Dry Creek on Oak Creek, the A&Ww designated use was assessed as "Attaining."

Within Reach 5 on the mainstem Verde River, the segment between the confluence of Oak Creek to the confluence of Beaver Creek with A&Ww designated use was assessed as "Not Attaining" due to a history of exceedances of the former turbidity standard. Ongoing data collection and a total maximum daily load analysis to address the potential sources of turbidity substantiates this designation. Between the confluence of Beaver Creek to the confluence of West Clear Creek, the A&Ww designated use was assessed as "Inconclusive" due to missing analysis of dissolved metals (copper, cadmium, and zinc).

Livestock Grazing: The PNF administers the Squaw Peak, Verde and Brown Springs grazing allotments along this reach. River frontage on the Squaw Peak allotment was fenced to exclude livestock grazing in the early 1980s and the Verde allotment frontage was fenced in 1995 (PNF 2001). Cattle access the river at several watering points on the Brown Springs allotment (PNF 2001). However, the PNF recently received a grant from the Arizona Water Protection Fund to fence river frontage on the Brown Springs allotment, except for an area of about 50 to 100 yards where livestock access is controlled (PNF 2001; Doug Macphee pers. comm. 2006).

Mining: Copper mining played a significant role in the early years in Yavapai County and the Verde Valley and was once one of the largest employers. The copper mines in the Verde Valley were phased out of operation by the end of the 1960s. There are still a few tailings piles in the vicinity of Clarkdale adjacent to the river, which may contribute minerals and metals to the Verde River (AWDR 2000).

Historically, sand and gravel operations were found throughout Reach 5 within the active channel of the Verde River. However, only three major locations remain. One is along the mainstem upstream from the I-17 bridge on lands owned by the Yavapai Apache Nation. The other two operations occur near the mouth of tributaries along West Clear Creek and Beaver Creek.

Washing aggregate accounts for the bulk of water use by sand and gravel facilities. The estimated total demand for water in 1997 was 1,540 AF. Approximately 1,400 AF of this number was groundwater and 140 AF was effluent (Sullivan and Richardson 1993).

Fire: In recent years, wildfires burned large acreages within the watershed associated with this reach. However, there have been no recent reports of fish kills in this reach due to flushing of ash and sediment off the burned areas into the river.

Fish Community Composition in the Verde Mainstem

The widespread decline of native fish species from the arid southwestern United States and Mexico has resulted largely from interactions with nonnative species and has been captured in the listing rules or 12-month Findings of several native species listed under the Act whose historical and/or current ranges included the Verde watershed, including: Colorado pikeminnow (32 FR 4001, March 11, 1967), spikedace (51 FR 23769, July 1, 1986), loach minnow (51 FR 39468, October 28, 1986), razorback sucker (56 FR 54957, October 23, 1991), roundtail chub (71 FR 26007, May 3, 2006), and Gila topminnow (32 FR 4001, March 11, 1967).

Bonar et al. (2004) conducted a comprehensive study of the composition, density and standing crop of fishes in the Verde River mainstem. As documented in Table 1 below, six species of native fish and 12 species of nonnative fish are regularly found and have reproducing or extant adult (stocked) populations in the mainstem Verde River within the action area (Bonar et al. 2004; Valdez 2004; AGFD 2004a). Nonnative species included bluegill (*Lepomis macrochirus*), brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*), flathead catfish (*Pylodictis olivaris*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), mosquitofish (*Gambusia affinis*), rainbow trout (*Onchorhynchus mykiss*), red shiner (*Cyprinella lutrensis*), rockbass (*Ambloplites rupestris*), smallmouth bass (*Micropterus dolomieu*), threadfin shad (*Dorosoma petenense*), *Tilapia* ssp., and goldfish (*Carassius auratus*). Native fishes that occur in the tributary streams within the action area include speckled dace and Gila topminnow. Spikedace and loach minnow are extirpated from the action area but have been reintroduced into Fossil Creek, above the action area, through recovery activities.

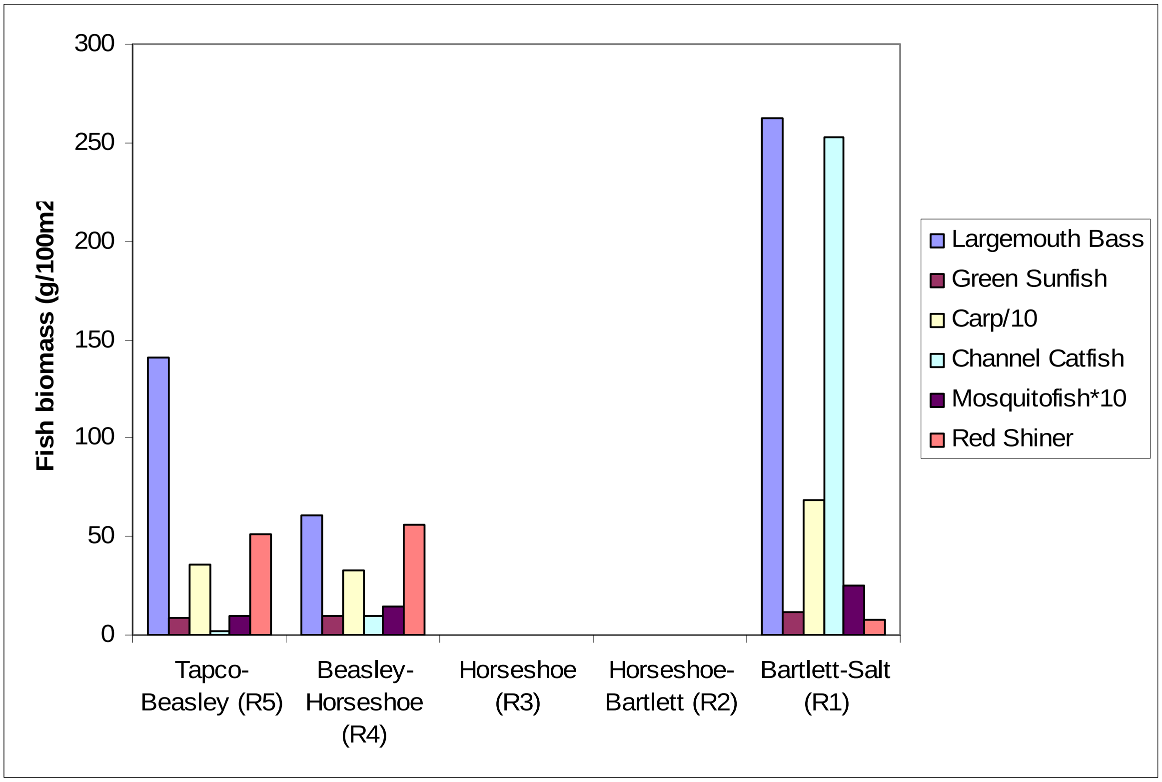
Overall, Bonar et al. (2004) found that nonnative fishes were approximately 2.6 times denser per 100 m^2 of river than native fishes, and their standing crop was approximately 2.8 times that of native fishes per 100 m^2 of river. Bonar et al. (2004) discovered that red shiner were the most commonly encountered nonnative fish species in the Verde River by almost four-fold and found the species to be present throughout the Verde River year-around, but noted the highest numbers in the reach between Beasley Flat to Sheep Bridge above Horseshoe Reservoir in riffle habitats. Reaches above Horseshoe (Reaches 4 and 5) have resident self-sustaining populations of bass, green sunfish, catfish, and carp with a low, unstable native fish community. Researchers observed little native fish predation in this reach. Reaches below Bartlett Lake (Reach 1) had both high native and nonnative fish abundance, which resulted in more frequent observations of nonnative predation on native fish (Bonar et al. 2004).

Table 1. Native and nonnative fish relative abundance in the action area (Verde River and selected tributaries).

Origin	Species	Reach 1	2	3	4	5
Native	Colorado pikeminnow		S, R[1]	S, R[2]	S, U	S, R
	Desert sucker	C			C	C
	Gila topminnow			T, C		
	Longfin dace	C		T, U	T, U	T, U
	Razorback sucker			S, R	S, U	
	Roundtail chub	U			U	U
	Sonora sucker	C			C	C
	Speckled dace				T, U	T, U
Nonnative	Bluegill	U	C	U	C	C
	Brown trout					T, U
	Channel catfish	C	C	U	C	U
	Common carp	C	C	C	C	C
	Flathead catfish	U	C	U	U	U
	Green sunfish	C	C	U	C	C
	Largemouth bass	C	C	U	C	C
	Mosquitofish	C	C	C	C	C
	Rainbow trout	S				S
	Red shiner	C	C	C	C	C
	Rockbass					T, R
	Smallmouth bass		U		C	C
	Threadfin shad	R	C		R	
	Tilapia	C	U			
	Goldfish			C		
	Yellow bullhead	U	R		T, C	U

C = Common; U= Uncommon; R = Rare; S = Stocked; T = Found only in tributary.
[1] Few records of Colorado pikeminnow caught by anglers below Horseshoe.
[2] Colorado pikeminnow were found in reservoir in 1996; the species was not found during the most recent sampling.
Sources: Bonar et al. 2004, Robinson 2005, Weedman pers. comm. 2004, Bryan, et al. 2000.

Figure 2. Abundance (biomass) of selected nonnative fish in the mainstem Verde River in the action area.



Note: R1-R5 denotes reaches of action area; reaches 2 and 3 were not sampled; carp biomass was divided by 10 and mosquitofish biomass was multiplied by 10 to scale abundance with other species.
Source: Bonar et al. 2004.

Reach 1: (Granite Reef – Bartlett Dam). Bonar et al. (2004) found the highest densities of desert sucker and Sonora sucker in this reach compared to other reaches of the Verde River. Similarly, Bryan et al. (2000) documented large populations of both species and longfin dace. Bonar et al. (2004) reported relatively low densities of roundtail chub. The native fish are somewhat more abundant in a short reach of the Verde River just below Bartlett Dam. Bryan et al. (2000) also found roundtail chub and observed spawning activity. Based on size/age class structure of the chub population, most recruitment probably coincides with large flood events. Both researchers found abundant and self-sustaining populations of largemouth bass, mosquitofish, red shiner, channel catfish, flathead catfish, and common carp. Bonar et al. (2004) reported the highest densities in Reach 1 compared to other reaches for common carp, mosquitofish, and *Tilapia*. Other nonnative species documented included green sunfish, bluegill, rainbow trout (found close to stocking site), and one threadfin shad.

Reach 2: AGFD completed surveys of Bartlett Lake in 1991-1994, 1996-1997, and 2003 (D. Weedman, AGFD, pers. comm.). Overall, the Bartlett Reservoir has healthy and abundant self-sustaining populations of nonnative fish, primarily largemouth bass, black crappie, green and redear sunfish, bluegill, threadfin shad, channel and flathead catfish, and common carp and is actively managed as a sport fishery by AGFD; artificial habitat structures were added in the 1990s to enhance the recreational fishery. No native fish have been documented in the reservoir in recent surveys. No data exist concerning the fish population between Bartlett and Horseshoe.

However, with Horseshoe Dam acting as a barrier to upstream movement and an obstacle to downstream movement, a stable and actively managed sport fishery in Bartlett Reservoir, and based on angler use and its location between the reservoirs, the fish community is thought to be dominated by nonnative species including largemouth bass, channel and flathead catfish, and green sunfish.

Reach 3: Robinson (2007) conducted fish sampling in Horseshoe during 2005 and 2006 to determine community composition and population structure. In 2006, he found that common carp and goldfish comprised 97.1 percent of the fish community (AGFD 2007). Other species that were captured in 2005 and 2006 but had low abundance were Colorado pikeminnow, razorback sucker, channel catfish, largemouth bass, yellow bullhead, red shiner, and mosquitofish (AGFD 2007). Based on size structure of the population, a healthy, reproducing population of common carp persist in the reservoir. While sampling Horseshoe Reservoir in 2005 and 2006, ten razorback suckers and three Colorado pikeminnow were captured (AGFD 2007). Robinson (2007) determined that the razorback suckers captured had likely been in the river for three to eight years, based on the location of coded wire tags on the specimens. Colorado pikeminnow captured were only in the system for approximately three to nine months prior to their capture (AGFD 2007). A single Sonora sucker was also captured in this effort.

Reach 4: Bonar et al. (2004) reported 15 fish species in this reach. Four native fish were captured (razorback, desert, and Sonora suckers, and roundtail chub). They reported that razorback sucker density was the highest in this reach compared to other reaches due to stocking. Eleven nonnative species were documented which did not include *Tilapia*, threadfin shad, or yellow bullhead. Largemouth bass was present within the reach but its overall biomass was less than Reaches 1 and 5. Green sunfish had similar biomass among the reaches sampled, and carp biomass was similar to Reach 5, but less than Reach 1. Both Rinne et al (1998) and Bonar et al (2004) reported that native species generally comprise less than 20 percent of the fish community in this segment of the river.

Reach 5: Fish community composition was similar to reach 4, but the biomass of largemouth bass and smallmouth bass biomass was higher. Yellow bullhead were also found in this reach. Razorback sucker was not found, but Colorado pikeminnow (stocked), desert and Sonora sucker, and roundtail chub were detected. Rainbow trout are stocked during winter months for recreational angling between Tuzigoot National Monument and Bridgeport Bridge (Sullivan and Richardson 1993; AGFD files) and near Camp Verde. Of the reaches analyzed by Bonar et al. (2004), nonnative fish had the highest standing crop in this reach.

Fish Community Composition in Tributaries

The AGFD Nongame Fish database (AGFD 2004a) provides sampling records of various tributaries within the action area starting in 1985. Other sources of information include published reports, AGFD Sportfish stocking program records, and communication with fisheries experts.

Lime Creek

As previously discussed, Lime Creek is spring-fed and runs perennially for a variable distance. The lower reaches are ephemeral. Because of its location and the occasional connection that may occur during a high flow event and because of the presence of native fish in the perennial portion, this tributary is affected by nonnative fishes produced in Horseshoe Reservoir. Surveys by AGFD (Voeltz. 2005) documented Gila topminnow and longfin dace in the upper reaches of Lime Creek. Nonnative fish (i.e., green sunfish, goldfish) have been periodically detected in the lower reaches of the creek downstream of occupied topminnow habitat, but are subsequently removed probably due to large floods or drying of the stream during droughts (Voeltz 2005).

East Verde River

Current information on fish species composition in the East Verde River is not well documented. Ash flows from recent catastrophic wildfires that occurred in the watershed resulted in fish kills in the East Verde and downstream portions of the mainstem Verde River although the actual impact to the fish community is not well known (Warnecke, pers. comm. 2004).

Nonnative fish were reported to be dominant in the confluence area (AGFD 2004a). Fish species composition included red shiner, smallmouth bass, largemouth bass, green sunfish, redear sunfish, bluegill, and fathead minnow. Native species included roundtail chub, desert sucker, Sonoran sucker and razorback sucker. Additional native species found below the ponderosa pine community included longfin dace, speckled dace, desert sucker and Sonora sucker (USFWS 1989).

Voeltz (2002) reports headwater chub in the East Verde River above Weber Creek, which is upstream of the action area. Girmendonk and Young (1997) cite collection records of roundtail chub throughout in the East Verde. Based on proximity to the Verde River, the lower portions of the East Verde River, which are included in the action area, were considered potential roundtail chub habitat. Sullivan and Richardson (1993) reported that aquatic habitat diversity within one stream mile of the confluence with the Verde was relatively low and that refugia and foraging areas for aquatic species were minimal due to a lack of emergent vegetation, thus large chub populations are not expected to persist. Girmendonk and Young (1997) reported samples in the middle portions of the East Verde River (upstream of Doll Baby Ranch, and outside the action area) found no chubs and the habitats were dominated by nonnative fish (largemouth bass, green sunfish). The headwaters of the East Verde (upstream of the action area) are maintained as a put-and-take trout fishery for primarily rainbow trout; although brook trout are also present (AGFD 2004a; Sullivan and Richardson 1993).

Table 2 . Native and nonnative fish species documented in the East Verde River.

Species	Year Detected[1]	Notes
Native species		
Desert sucker	2000	
Roundtail chub	1995	Girmendonk and Young (1997)
Headwater chub	2000	Upstream (out of) action area; Voeltz (2002)
Longfin dace	2000	
Razorback sucker	1988	
Sonora sucker	1997	
Speckled dace	2000	
Nonnative species		
Bluegill	1991	
Fathead minnow	1997	
Green sunfish	2000	
Red shiner	2000	
Rainbow trout	2004	Stocked as sportfish upstream of action area.
Smallmouth bass	2000	
Yellow bullhead	2000	

[1] Unless noted, sampling record from AGFD Nongame Branch Fish Database (AGFD 2004a) since 1980.

Fossil Creek

Fisheries data indicate that Fossil Creek supports a wide variety of aquatic species. Data from reaches in the Verde River upstream and downstream of Fossil Creek indicate that nonnative fish such as carp, red shiner, flathead catfish, channel catfish, yellow bullhead, mosquitofish, smallmouth bass, largemouth bass, green sunfish, and bluegill occur in the vicinity of the confluence of Fossil Creek (AGFD 2004a) and could establish or occupy the lower reaches of Fossil Creek below the existing fish barrier. Native species occurring near the confluence include roundtail chub, desert sucker and Sonora sucker (AGFD 2004a; Heritage Data Management System).

In November 2004, a fish barrier was constructed by the U.S. Bureau of Reclamation approximately 3 miles upstream from the confluence. The barrier is part of the Fossil Creek native fish restoration project and will prevent fish from moving upstream into Fossil Creek from the Verde River mainstem. Nonnative fish were removed from the stream reaches above the barrier. Roundtail chub, speckled dace, headwater chub, and desert and Sonora suckers were salvaged and restocked into Fossil Creek following renovation. In October 2007, spikedace and loach minnow were stocked above the barrier (M. Richardson, FWS, pers. comm.).

West Clear Creek

According to Sullivan and Richardson (1993), the lower portion of West Clear Creek has a moderate potential to support a diversity of aquatic species, based on substrate, hydrology, and vegetative characteristics. They report that the suitability of this area to support aquatic species is limited by the degree of disturbance caused by anthropogenic stressors such as residential development, grazing, and sand and gravel mining activities on private lands within one mile of the confluence. Irrigation diversion ditches near the mouth of West Clear Creek also decrease the habitat potential because they cause the creek to run dry near the confluence during summer months (Sullivan and Richardson 1993).

AGFD has been stocking this creek with rainbow trout at a location just above the diversions. Trout are stocked in the winter months. The number of trout stocked depends on the amount of water in the stream during any given year, with more trout stocked during years when flows are higher, and fewer stocked during dry years. Over the past 5 years, more than 17,000 rainbow trout have been stocked in this creek.

Five native and seven nonnative fish species are found in West Clear Creek (Table 3). No largemouth bass or carp have been detected (C. Benedict, AGFD, pers. comm.).

Table 3. Native and nonnative fish species with extant populations in West Clear and Wet Beaver Creeks.

Species	**Year Detected**[1]	**Notes**
Native species		
Roundtail chub	1998	Voeltz (2002); abundant population found in 1998 above natural barrier, few found below barrier; C. Benedict, D. Weedman (AGFD, pers. comm.)
Longfin dace		C. Benedict, D. Weedman (AGFD, pers. comm.)
Speckled dace		C. Benedict, D. Weedman (AGFD, pers. comm.)
Desert sucker		C. Benedict (pers. comm.)
Sonora sucker	1987	AGFD 2004a, C. Benedict, D. Weedman (AGFD, pers. comm.)
Non-native species		
Rainbow trout	2004	Stocked as sportfish and self-sustaining population; C. Benedict, D. Weedman (AGFD, pers. comm.)
Smallmouth bass	1988	AGFD 2004a, C. Benedict, D. Weedman (AGFD, pers. comm.)
Green sunfish		C. Benedict (AGFD, pers. comm.)
Channel catfish		C. Benedict (AGFD, pers. comm.)
Yellow bullhead		C. Benedict (AGFD, pers. comm.)
Red Shiner		Minckley (1993)
Mosquitofish		Minckley (1993)

[1] Unless noted, sampling record from AGFD Nongame Fish Database (AGFD 2004a) since 1980, blanks indicate pers. comm. with AGFD fish experts from recent surveys.

<u>Wet Beaver Creek</u>

Although Wet Beaver Creek is a perennial tributary of the Verde River, most of the water is diverted about 5 miles upstream from the confluence for irrigation purposes. This restricts the movement of fish in the creek and may kill those fish stranded by receding waters (Sullivan and Richardson 1993).

Five native fish species are found in Wet Beaver Creek which include roundtail chub, longfin dace, speckled dace, desert sucker, and Sonora sucker. Non-native species include rainbow and brown trout, smallmouth bass, yellow bullhead, channel catfish, and green sunfish. No largemouth bass or carp have been found in the creek (C. Benedict pers. comm.). Limited suitable habitat for carp and largemouth bass may be precluding their establishment in Wet Beaver Creek (Weedman, pers. comm. 2005). AGFD stocks Wet Beaver Creek with rainbow trout during winter months in a 5-mile section downstream from the USGS stream gage which is approximately 15 stream miles from the confluence. The number of trout stocked depends on the amount of water in the stream during any given year, with more trout stocked during years when flows are higher, and fewer stocked during dry years. Over the past 5 years, nearly 18,000 rainbow trout have been stocked in this creek (AGFD files).

Oak Creek

Oak Creek is a tributary dominated by 13 species of nonnative fish. Largemouth bass have not been documented in Oak Creek in the most recent surveys but records exist for this species in past surveys (C. Benedict, AGFD, pers. comm.; Minckley 1993). Native fish found in Oak Creek include roundtail chub, speckled dace, desert sucker, and Sonora sucker (Table 4).

The upper portion of Oak Creek is currently managed for rainbow trout and brown trout. AGFD stocks rainbow trout in the creek on a monthly basis. In the 5-year period from 1999 through 2003, more than 310,000 trout were stocked in Oak Creek (AGFD files).

Based on an evaluation of physical and biological characteristics of the lower portion of Oak Creek, Sullivan and Richardson (1993) determined that the lower reaches have the potential to support those fish species that are found in the Verde River near the confluence. However, the presence of diversion ditches in these reaches is likely to reduce the potential for this reach to support a diversity of fish species because of diminished flows (Adamus et al. 1991).

Table 4. Native and nonnative fish species documented in Oak Creek.

Species	**Year Detected[1]**	**Notes**
Native species		
Desert sucker	2000	
Longfin dace	1995	
Roundtail chub	2002	Voeltz (2002)
Sonora sucker	2000	
Speckled dace	1996	
Non-native species		
Bluegill	1995	
Brown trout	2000	
Channel catfish	2002	Voeltz (2002)
Flathead catfish	1989	
Green sunfish	1996	
Mosquitofish	1996	
Red shiner	1996	
Smallmouth bass	2000	
Rainbow trout	2004	Stocked as sportfish
Rock Bass	2000	
Warmouth sunfish	1995	
Largemouth bass	1970	Minckley (1993)
Common carp		

[1] Unless noted, sampling record from AGFD Nongame Branch Fish Database (AGFD 2004a).

Historical and Current Stocking of Sportfish

Arizona Game and Fish Department's sportfish stocking program maintains and enhances recreational fishing opportunities at more than 150 locations within 10 watersheds in Arizona, including the Verde watershed. These angling activities are governed by specific state wildlife statutes (ARS Title 17), and the rules that implement those laws and are funded, in part, by Federal funding of sport fishing programs. Specific plans that describe the objectives of recreational angling programs are outlined in Wildlife 2006 (AGFD 2001c). These objectives met a cumulative demand of 5.3 million angler-use days in 2001 (Silberman 2003). Within the action area, AGFD, USFWS, and others have stocked sportfish since 1933. Most stockings were focused on the reaches above Horseshoe and included warmwater, coldwater, and native fish. Currently, AGFD stocks seven locations upstream of Horseshoe with primary goals of providing coldwater (rainbow trout) recreational angling opportunities and enhanced habitat for native fish through unlimited harvest of smallmouth bass, largemouth bass, channel catfish, and flathead catfish. There have been recent tribal and private stocking of the Verde River with rainbow trout during winter months downstream of Bartlett Dam.

Reach 1: Granite Reef – Bartlett Dam. AGFD does not currently stock sportfish in this reach; however, both rainbow trout and channel catfish were stocked in the past by USFWS and AGFD (USFWS 1980). A private fly fishing club stocked 400 to 700 rainbow trout annually near Rio Verde in 2001 to 2003 (Weedman, pers. comm. 2003). Stocking of both these species was on a catchable-size basis (8-inch fish) (Weedman, pers. comm. 2003). From 1976 through 1979, 10,000 8-inch rainbow trout were stocked by USFWS in this reach of the Verde River within the FMYN boundaries each year from November through March (approximately 2,000 per month) (Weedman, pers. comm. 2003). In 2002, approximately 4,500 rainbow trout were stocked in this reach to provide fishing opportunities and to supplement the diet of bald eagles on Native American reservation lands (Bonar et al. 2004).

Table 5. Verde River watershed historical and current sportfish stocking locations.

Site	Historical Stocking (Warmwater[1], Coldwater[2], Native[3])	First Year Stocked	Last Year Stocked	Currently Stocking (Warm or Coldwater)
Reach 1: Granite Reef – Bartlett Lake				
Verde River	Coldwater	NA	2003	NA
Reach 2: Bartlett – Horseshoe				
Bartlett Lake	Warm/Cold	1939	1977	
Reach 3 – Horseshoe				
Horseshoe	Warmwater	1977	1977	
Reach 4: Horseshoe - Beasley Flat				
[Bonita Creek][4]	Coldwater	1935	1969	
[Dude Creek][4]	Coldwater	1935	1999	Coldwater (Native)
[Ellison Creek][4]	Coldwater	1933	1939	
[East Verde River][4]	Both, Native	1933		Coldwater
Fossil Creek	Coldwater, Native	1965		
Middle Verde River	Both, Native	1968	1994	
[Stehr Lake][4]	Both	1961	1980	
[Weber Creek][4]	Both	1933	1957	

Reach 5: Beasley Flat – Allen Diversion				
Camp Verde Reach	Warmwater, Coldwater, Native	1935		Coldwater, Native
[Deadhorse Lake][4]	Both	1977		Both
Lower West Clear Creek	Both, Native	1933		Coldwater
Lower Wet Beaver Creek	Both	1933		Coldwater
Middle Wet Beaver Creek	Coldwater	1933		Coldwater
[Montezuma][4]	Warmwater	1986	1995	
Oak Creek	Both, Native	1933		Coldwater
[Peck's Lake][4]	Warmwater	1935	1988	
[Willow Valley Lake][4]	Both	1936	1965	

[1] Generally included one or more of the following species: largemouth bass, redear sunfish, bluegill, channel catfish
[2] Generally included one or more of the following salmonids: rainbow, brown, or brook trout (but also see Table 3.9).
[3] Mostly razorback sucker.
4 Reach outside of the action area but within the watershed.
Source: R. Sorenson pers. comm.

Table 6. Species stocked within the action area along the Verde River and tributaries between ~1930 – present; numbers and species stocked varied over time and stocking locations.

Warmwater	Coldwater	Native
Black crappie[1]	Artic grayling	Razorback sucker[4]
Bluegill[1]	Brook trout	Colorado pikeminnow[4]
Channel catfish[1,2]	Brown trout	Apache trout
Fathead minnow[1]	Cutthroat trout	
Flathead catfish	Rainbow trout[1,2,3]	
Largemouth bass[1]		
Northern pike		
Redear sunfish		
Smallmouth bass		
Striped bass		

[1] Currently stocked at Mingus Lake south of Cottonwood
[2] Currently stocked at Deadhorse State Park
[3] Currently stocked in coldwater locations
[4] Currently stocked in mainstem Verde River near Childs
Source: R. Sorenson, AGFD, pers. comm.

Table 7. Numbers of rainbow trout stocked in select tributaries, 1999-2003.

Tributary	1999	2000	2001	2002	2003	5-year Total	Season
Oak Creek	60,967	63,626	67,051	54,643	64,202	310,489	Monthly, 12 months per year
Wet Beaver Creek	2,700	3,447	3,603	3,600	4,565	17,915	April to June, November
W. Clear Creek	3,600	3,600	2,700	3,600	3,639	17,139	April to June
E. Verde River*	20,739	8,300	18,300	4,050	5,562	56,951	April to June, later if there is stream flow

*Note: Numbers of fish stocked in E. Verde fluctuate; distribution of fish in this system is greatly influenced by water pumped into the river from the Blue Ridge Reservoir.
Source: R. Sorenson, AGFD, pers. comm.

There may have been stocking efforts within the FMYN boundaries between 1979 and 2002, but specific information is not available.

Reach 2: Bartlett Dam – Horseshoe Dam. AGFD first stocked Bartlett Lake in 1939 with largemouth bass and bluegill. Black crappie (*Pomoxis nigromaculatus*) were stocked in 1962, and channel catfish and rainbow trout were stocked in 1977. The last year AGFD stocked fish into Bartlett Lake was 1979 (R. Sorenson, AGFD, pers. comm.).

Reach 3: Horseshoe. AGFD stocked Horseshoe in 1977 with largemouth bass, flathead catfish, and black crappie. There have been no stockings since 1977 (R. Sorenson, AGFD, pers. comm.).

Reach 4: Horseshoe – Beasley Flat. Most stockings along this reach have included rainbow and brown trout in higher elevation tributaries (e.g., Bonita, Ellison, Weber, and Dude creeks, and East Verde River) outside of the action area. Stocking along the mainstem (middle Verde River) included pikeminnow and razorback during the late 1980s and early 1990s, and one stocking of northern pike in 1968. Currently, AGFD stocks the East Verde River (above the action area) with rainbow trout when water is available.

Reach 5: Beasley Flat – Allen Diversion. AGFD stocking activities began in this reach of the Verde River and its tributaries in 1933. Since then, numerous coldwater species (i.e., brown, cutthroat, rainbow, and brook trout, and arctic grayling), warmwater species [i.e., bluegill, channel catfish, flathead catfish, largemouth bass, northern pike (*Esox lucius*), redear sunfish, smallmouth bass, and striped bass (*Morone saxatilis*)], and native fish [i.e., razorback sucker, Colorado pikeminnow, and Apache trout (*Onchorhynchus apache*)] have been stocked. AGFD's stocking program currently focuses on providing rainbow trout angling opportunities in the mainstem Verde River (near Camp Verde) and along main perennial tributaries (i.e., Oak, Wet Beaver, and West Clear creeks). In 2002, approximately 27,525 trout were stocked in the Camp Verde area (Bonar et al. 2004; AGFD files). Warmwater and coldwater species are stocked in lagoons at Deadhorse Ranch State Park. These lagoons have no hydrological connection to the Verde River but are located adjacent to the river in the 100-year floodplain.

Flycatcher and Cuckoo Mitigation Areas

Verde Valley

The Verde Valley occurs within Reach 5 as described above. Riparian vegetation in the Verde Valley is characterized by patches of cottonwood, willow, and mixed broadleaf riparian vegetation on a broad alluvial floodplain of sand, gravel, and cobble, with a relatively low stream gradient. Riparian vegetation varies in width from approximately 500 to 1,600 feet. The Verde River Management Plan for the flycatcher (SWCA 2000a) describes the following riparian communities along the Verde River: 1) salt cedar association consisting mainly of pure salt cedar with small bands of cottonwood and willow near the river; 2) cottonwood association, which includes trees up to 70 feet tall; 3) cottonwood/velvet ash (*Fraxinus velutina*)/Goodding willow/boxelder (*Acer negundo*) association, which is dense and ranges from approximately 60 to 70 feet in height; and 4) strand community within the active floodplain, which is dominated by sparsely vegetated salt cedar with some thick, young cottonwood interspersed with willow. Wetland communities include cattails (*Typha* sp.), sedges (*Carex* sp.), rushes (*Juncus* sp.), and grass associations (SWCA 2000a). The cottonwood groves have a fairly open understory due to the 1993 flood, which removed much vegetation, although regrowth is occurring (Castillo, pers. comm. 2001). These groves are often fragmented and interspersed with urban areas. The Camp Verde Riparian Preserve (CVRP) protected as part of the Roosevelt Habitat Conservation Plan to mitigate the effects of reservoir operation on flycatchers and cuckoos at Roosevelt Lake encompasses nearly 1 mile of the Verde River just downstream of the I-17 bridge near Camp Verde (SRP 2005a). The floodplain on the CVRP is about 2,000 feet wide at its broadest point and is dominated by a mature cottonwood-willow woodland, with smaller areas of salt cedar, mixed riparian woodland, young cottonwood-willow, and other vegetation communities. Management issues on the CVRP and nearby lands include invasive plant species, fire, recreation trespass, and nearby urban development (SRP 2005b).

Safford Valley

The Safford Valley extends about 45 miles along the Gila River from the confluence with Bonito Creek downstream to the San Carlos Apache Indian Reservation (Fichtel and Marshall 1999). The Gila River is generally perennial through the Safford Valley, gaining flow as it moves downstream, although it can be intermittent during extended drought (Reclamation 2005). Peak flows have exceeded 130,000 cfs and minimum flows in June occasionally approach 0 cfs (Reclamation 2005). Fires and water diversions are the primary threats to riparian habitat in this area (Fichtel and Marshall 1999).

The Gila River floodplain is up to 1 mile wide in many locations and the river frequently shifts laterally (Reclamation 2005). Riparian vegetation is characterized by dense stands of salt cedar with occasional patches of cottonwood, willow, and mixed riparian vegetation on a broad alluvial floodplain of sand, gravel, and cobble, with a relatively low stream gradient (Reclamation 2005). Dense patches of salt cedar and other woody riparian vegetation are typically 1,000 or more feet in width. Common shrub species found in the riparian communities include seepwillow (*Baccharis salicifolia*), coyote willow *(Salix exigua*), arrowweed (*Pluchea* sp.), burrobrush (*Hymenoclea monogyra*), quailbush (*Atriplex lentiformis*), and desert broom (*Baccharis sarothroides*) (Reclamation 2005; Dockens and Ashbeck 2005). Additional information on the mitigation areas is described in the EIS (FWS 2008) and HCP (ERO 2008).

Status of Covered Species and Critical Habitat within the Action Area

<u>Southwestern Willow Flycatcher</u>

Horseshoe Reservoir

In 2006, flycatcher surveys within and immediately upstream of Horseshoe identified 30 adult residents, 18 territories, 12 pairs, and 23 nests (Dockens and Ashbeck 2006), which was slightly lower than 2005. Flycatcher surveys at Horseshoe in 2005 identified 35 adult residents, 20 territories, 15 pairs, and 23 nests, including the birds near Ister Flat just upstream of Horseshoe (Dockens and Ashbeck 2005). In 2004, surveys identified 24 adults, 17 territories, and seven pairs in the Horseshoe lakebed (Munzer et al. 2005). This was an increase over 2003, when 19 adult resident flycatchers, 11 territories, and eight pairs (including 1 polygynous male) were identified (Smith et al. 2004). In 2002, eight resident flycatchers, six territories, and two pairs were located in Horseshoe (Sferra, pers. comm. 2002). Most of the Horseshoe territories have been found at the upper end of the reservoir, with base elevations of trees at approximately 1,980 to 2,000 ft. Through 1997, flycatchers were found just above Horseshoe at Ister Flat (three resident flycatchers, one pair, and two territories in 1997); after which the habitat appeared to become degraded and decadent due to prolonged drought until the high runoff year in 2005 (Dockens and Ashbeck 2005; Smith et al. 2003).

Nest monitoring was conducted at Horseshoe in 2005 to assess the impacts of inundation on habitat use and reproductive rates (Dockens and Ashbeck 2005). The first pair and nest were documented on May 20. Nesting attempts were documented for all 15 pairs; females were not detected for the remaining eight territories, and the males in those territories may have been unpaired through the breeding season. Of the 23 nests, 15 were renesting attempts. Twelve nests were successful, nine were depredated, one failed due to weather (strong monsoon storm), and one failed due to human disturbance (i.e., nest abandonment presumed to be caused by color banding activities at the nest). There was no incidence of brown-head cowbird parasitism. Potential predators observed within the habitat patches during monitoring activities included various species of potentially arboreal snakes, Cooper's hawk, and great-tailed grackles. Of eggs laid, 72 percent hatched (n=54), and 52 percent of all nests were successful (i.e., fledged at least 1 flycatcher young). The Mayfield nest success rate was 62 percent. Overall, nest productivity was 1.41 fledges per nest (n=22, nests with eggs laid). Productivity of successful nests was 2.58 fledges per nest. Nest success and productivity estimates were higher than a number of other sites in 2005 and statewide long-term average.

Short-term inundation had no apparent detrimental impact to habitat quality during the 2005 breeding season. Inundated patches were used by the flycatcher throughout the nesting season and nest productivity levels were similar or higher compared to other flycatcher breeding areas.

Downstream of Horseshoe Reservoir

In 2005, no flycatchers were observed at the previously occupied Davenport site about one mile below Horseshoe because a fire burned through the area in June 2005 (Dockens and Ashbeck 2005; EEC 2005). One migrant flycatcher and no resident flycatchers were at the Davenport site in 2004 (Munzer et al. 2005). In 2003, three flycatchers, two territories, and two failed nesting attempts by one pair were documented at the Davenport site (Sferra, pers. comm. 2003; Smith et al. 2004). In 2002, new flycatchers were documented at the Davenport site for the first time, and included nine resident flycatchers, (five territories and four pairs) were located (Smith et al. 2003).

Although surveys were conducted in 2003, 2004, and 2005, flycatchers have not been documented below Bartlett (Dockens and Ashbeck 2005). No suitable flycatcher habitat has been found in or surrounding Bartlett and is unlikely to occur in the future due to the steep, rocky shoreline and reservoir operations.

Verde Valley

Willow flycatcher were documented in the Verde Valley prior to focused survey efforts using standardized protocols in 1993 (Paradzick and Woodward 2003). The distribution and abundance of flycatchers has changed over time both due to bird population fluctuations, response to habitat changes, and survey effort. Occupied sites have included riparian forest near

Tuzigoot Bridge, Tavasci Marsh, and Camp Verde. The greatest abundance (10 territories) was detected at a site in Camp Verde in 1997 (Paradzick and Woodward 2003). The most recent detection in the area was in 2004 (Munzer et a. 2005), no birds were detected in 2005 and 2006 (English et al. 2006).

Safford Valley

Willow flycatcher were documented in the Safford Valley prior to focused survey efforts using standardized protocols in 1993 (Paradzick and Woodward 2003). The distribution and abundance of flycatchers has changed over time both due to bird population fluctuations, response to habitat changes, and survey effort. Between 1993 – 2000, nine sites in the area had flycatchers territories and the most territories (17) were documented in 1997. In 2006, surveys located 65 territories in the area, with most (59) detected on the SRP/USBR Roosevelt Lake HCP mitigation properties. In 2007, 56 territories were located. Nesting was confirmed in 2006 and 2007 on the mitigation properties. The birds used tamarisk and cottonwood as nest trees, and surrounding habitat also included Gooddings and coyote willow substrates. Nest parasitism by brown-headed cowbirds was estimated to be 15 – 18 % in 2006 - 2007.

Critical Habitat

Critical habitat for the flycatcher was designated along several segments of the Verde River in the vicinity of Horseshoe and Bartlett. One segment is a four-stream mile reach located immediately below Horseshoe. This habitat consists of a mixture of cottonwood-willow and tamarisk of varying age-classes and patch densities. Along the river channel cattail and other emergent vegetation persists. On elevated terraces, mesquite dominates along with other xeric riparian trees and shrubs. A portion of the designated critical habitat, which supported nesting flycatchers burned in 2005 (See Davenport Site above). Another segment is a 23- stream mile reach from the upper end of Horseshoe Reservoir upstream to the confluence with the East Verde River. Two other segments are located farther upstream in the Verde Valley (see Verde Valley mitigation land environmental baseline description). The Gila River in the Safford Valley is also designated critical habitat (see Safford Valley mitigation land environmental baseline descriptions).

Bald Eagle

There are 7 bald eagle pairs that nest (or forage) on the Verde River between the Allen Ditch diversion and Horseshoe (one breeding area, Camp Verde, is vacant and not included in the 7 pairs). One pair of bald eagles has a breeding area at Horseshoe. Nine nesting pairs of bald eagles nest along the Verde River from Horseshoe downstream to its confluence with the Salt River. Eagles at Horseshoe Lake (Horseshoe Breeding Area) nest on cliff ledges and cottonwood trees. At the Cliff Breeding Area, eagles have used pinnacles and ledges. At the Bartlett Breeding Area, trees and cliff ledges have supported nests, but now only cliff nesting persists. All remaining breeding areas on the lower Verde River (Needle Rock, Box Bar, Fort McDowell, Doke, Sycamore, and Rodeo) are dependent on cottonwood and a few sycamore trees for nesting and perching.

Hunt et al. (1992) and AGFD (annual bald eagle nest watch reports) reported bald eagle nest success and productivity data intermittently between 1970-2006 for various nests in the action area. Mean bald eagle nest success in the action area for all active nests that had known outcomes was 61.7 percent (n = 264). Nest success has varied among breeding areas; generally the nests downstream of Bartlett have had higher success. However, those nests have been in existence for shorter periods of time. Between 1970 and 2006, mean productivity (number of young fledged / occupied breeding area) was 0.98 (± 0.89). Productivity has also varied among breeding areas and years.

Considering all years of data for occupied breeding areas, the Cliff breeding area, located between the reservoirs has had the lowest rate of success (12 percent) since its discovery in 1983. The bald eagle breeding areas upstream of Horseshoe have had lower rates of overall success compared to some of the breeding areas below Bartlett. For breeding areas upstream of Horseshoe Lake, there does not appear to be an overall long-term spatial relationship between success and distance to the reservoir; between 1970 and 2006, success rates were similar along the entire reach (Horseshoe to the Allen ditch diversion) with the exception that Table Mountain has had slightly lower success: Horseshoe (58 percent), Table Mountain (39 percent), East Verde (61 percent), Coldwater (56 percent), Ladders (60 percent), and Oak Creek (60 percent).

Similarly, for these sites over this same time period, breeding area productivity (fledges per breeding area) was not significantly correlated with distance to Horseshoe. However, over time among breeding areas, there have been differences in productivity and success rates, especially for the breeding areas upstream of Horseshoe Reservoir, and the Cliff breeding areas just downstream of the reservoir.

In the area upstream of Horseshoe in the last 10 years, nests that were closer to the reservoir had lower success than those further upstream. However, during other time periods, breeding areas closer to the reservoir were more successful. The Cliff breeding area has had no successful nesting attempts since 1989 and was successful only twice in the 17 years it was occupied (in 11 of the 17 years the female failed to lay eggs). There is not a consistent pattern of inter-annual success or failure within or among breeding areas. Successful nesting was often punctuated by years with failures, but there was no evidence that suggests all nests within the Horseshoe to Allen Ditch diversion reach are responding to one specific environmental factor. Two breeding areas, East Verde and Table Mountain, have had low success rates in recent years (2000-2006). However, six out of the 16 years, the nest outcomes for the two nests differed, suggesting that more than one factor was influencing individual nest success rates.

The number of nest trees available for each pair of eagles below Bartlett Dam has been reduced through the increase in territories, degradation of existing trees, and lack of riparian recruitment in the late 1970s (McNatt et al.1980, Hunt et al. 1992 Beauchamp and Stromberg 2001, USFWS 2002a). Following the institution of instream flows, recruitment of cottonwood and willow trees has occurred below Bartlett dam (Stromberg et al. 2007a). Bartlett cottonwood nest tree #3 was found in 1973, used in 1977 and 1980, and supporting limbs broke underneath the nests in 1978 and 1985 (Hunt et al. 1992). No nests were ever again built in the tree and the nest tree fell prior to 1989 (G. Beatty, USFWS, personal observation). A few large cottonwood trees exist at the campground below Bartlett Dam (Hunt et al. 1992), however little opportunity for large tree replacement exists to support bald eagle nests in the Bartlett nest area downstream to Needle Rock (J. Driscoll, AGFD, personal communication, G. Beatty, USFWS, personal observation).

The Bartlett eagles exploit resources at Bartlett Reservoir and below Bartlett Dam on the Verde River (Hunt et al. 1992). More recently, Bartlett eagles have not been detected using the regulated river as often, but are more often observed returning from the lake with food (J. Driscoll, AGFD, pers. comm.). All the other eagles are dependent on the regulated Verde River below Bartlett Dam for food.

Based on anecdotal evidence, it is believed that only two to three nest trees are available for the Needle Rock eagles to use (J. Driscoll, AGFD, pers. comm., G. Beatty, USFWS, personal observation). The Box Bar Breeding Area has primarily one cottonwood grove to use (J. Driscoll, AGFD, pers. comm., G. Beatty, USFWS, personal observation). Supporting branch for the Box Bar tree nest #2 fell in 1998. The Fort McDowell eagles used to have nest and perch trees available to them for most of the lower Verde River from the Forest/Tribal boundary to Highway 87 bridge, but the establishment of the Doka and Sycamore breeding areas has reduced the size of Fort McDowell's territory. Fort McDowell has had a total of 17 known nest trees used since the 1970s; currently, nests (#15, #16, and #17) are known to exist in three trees (Hunt et al. 1992, J. Driscoll, AGFD, pers. comm.). Many of the supporting branches or trees have fallen as the trees degrade or die (Hunt et al. 1992, J. Driscoll, AGFD, pers. comm.). The Doka nest snag #1, previously a live cottonwood used by the Fort McDowell eagles, fell after the 2001 breeding season. Sycamore nest tree #1 supporting branches also have fallen. These lower Verde River nesting eagles use a variety of unregulated, lake, and regulated river habitat for foraging. Horseshoe eagles use the Verde River upstream of Horseshoe Lake and the conservation space of Horseshoe Lake for prey (Hunt et al. 1992). The Cliff eagles primarily use the regulated river between Horseshoe Dam and Bartlett Lake (Hunt et al. 1992).

Occupancy of bald eagle territories on the lower Verde River has been almost 100 percent since each territory was discovered, but productivity has been variable. Of the 134 nest years tracked since 1971, 133 have been recorded as occupied (Horseshoe-28, Cliff-19, Bartlett-32, Needle Rock-1, Box Bar-8, Fort McDowell-31, Doka-5, Sycamore-6, Rodeo-3). Productivity (1.40) and nest success (0.61) peaked in the 1980s, but declined significantly (productivity = 0.53, nest success = 0.40) in the 1990s (Table 8). Since 2000, reproductive performance has surged (productivity = 1.12, nest success = 0.64) (Table 8). The annual number of fledglings from the lower Verde River ranged from 0 to 4 during the 1970s (mean = 2.2), 1 to 8 in the 1980s (mean = 5.1), 1 to 8 in the 1990s (mean = 3), and 8 to 10 (mean = 9.3) in the 2000s.

Over recent years in Arizona, the greatest increase in breeding areas has occurred along the lower Verde River below Bartlett Dam. Almost 25 percent (5 of 21) of all new breeding areas discovered since 1994 occurred on this 24.5 mile stretch of river. While two sites are re-occupied historical sites (Hunt et al. 1992), the other three are new. From 1970 to 1994, only one to three breeding areas were known below Bartlett Dam. Now, seven breeding areas (eight if the Orme breeding area is included) can be found using this portion of the river. This has modified the previous belief in Arizona that eagles required about 10 river miles for a territory (Hunt *et al.* 1992).

The increase in territories that has occurred on the lower Verde River below Needle Rock is likely due to current availability of nesting structures, perches, food, past productivity, and management. Large mature cottonwood trees are presently distributed throughout the lower Verde River from Needle Rock downstream to the Salt River providing nesting and foraging opportunities. Some of the most productive sites in Arizona (Blue Point and Fort McDowell breeding areas) exist on or near the lower Verde River (J. Driscoll, AGFD, pers. comm.). Since 1991, 70 percent of all known identity breeding eagles returned within 62 miles of where they hatched to breed (J. Driscoll, AGFD, pers. comm.). Native suckers and river riffles, important components to successful breeding areas, are abundant below Bartlett Dam (Hunt et al. 1992). Hunt et al. (1992) hypothesized that cold water released from Bartlett Dam may promote the maintenance of a native sucker population. Bonar et al. (2004) suggests a combination of factors that could be supporting natives including: 1) the lower Verde River winter-spring flows from Bartlett Dam have mimicked natural flooding, which may trigger spawning by natives and provide more spawning and rearing habitat for natives during the spring and summer (Bryan et al. 2000); 2) warmer temperatures in the lower Verde River may trigger spawning suckers to emigrate from the Salt River to the Verde River; and 3) native fishes may be concentrated in the lower Verde River due to Bartlett Dam, which precludes upstream movement. It is not clear which of these factors is the driving ecological mechanism supporting the sucker population in the lower river – no study has been completed to specifically test or examine these hypotheses and relationships, but sampling by Bonar et al. (2004) suggests that under the current flow regime, reproduction, recruitment, and abundance of native suckers is high in this reach. Trout stocking on tribal land near the time eagles lay eggs may have provided a surge in food availability at critical times early in the nesting cycle. Also a contributing factor, the Fort McDowell Yavapai Nation closed the river area to non-tribal members and hired their own Police Department in the 1997. This reduced human activity, recreation, and camping on tribal land that could have prevented establishment of eagle territories.

Table 8. Bald eagle productivity summary for pairs using lower Verde River from Horseshoe Lake, Arizona through 2002.

Productivity summaries	1971-79	1980-89	1990-99	2000-02
Total nest years	23	36	50	25
Total occupied nest years	22	36	50	25
Total active nest years	22	34	39	22
Total failed nest years	7	12	19	6
Total successful nest years	15	22	20	16
Total occupied nest years, no eggs laid	0	2	11	3
Total unoccupied nests	1	0	0	0
Total number of fledglings	22	51	30	28
Mean brood size (young per successful nest)	22/15 = 1.5	51/22 = 2.3	30/20 = 1.33	28/16 = 1.75
Young per active nest	22/22 = 1.0	51/34 = 1.5	39/30 = 1.30	28/22 = 1.27
Nest Success (% occupied nest successful)	15/22 = 0.68	22/36 = 0.61	20/50 = 0.40	16/25 = 0.64
Productivity or Reproductive rate (mean brood size x nest success)	1.02	1.40	0.53	1.12

Additional monitoring and education from Arizona Bald Eagle Nestwatchers have helped protect nesting attempts and rescued eagles in life threatening situations. The combination of available nesting structures, perches, food availability, nearby productivity, and management likely promoted the increase of territories below Bartlett Dam and Needle Rock on the lower Verde River.

There is not likely a single primary factor that led to the decline in bald eagle productivity on the lower Verde River in the 1990s, but rather a combination of human and eagle related factors. As previously stated, the Cliff breeding area is the poorest reproductive performer on the lower Verde River. The Cliff breeding area fledged only 4 eaglets since 1988 and has not laid eggs since 1994. Constant nest failures and observation of the Cliff male stealing food from the nest, being chased away by the adult female, and eventually eating the nestling may be indicative of a territory missing a steady food component (G. Beatty, USFWS, personal communication). Hunt et al. (1992) hypothesize that warm water releases from Horseshoe Lake combined with static reservoir levels in Bartlett Reservoir, may favor proliferation of exotic fish in the Cliff breeding area. However, Hunt et al. (1992) noted that carp were a major prey item for the bald eagle and were available throughout the breeding season in this breeding area. Based on their research and the research of others, Hunt et al. (1992) concluded that prey quantity, quality, or spatial or temporal availability did not appear to be a limiting factor in Cliff bald eagle reproduction. Instead, they noted that the area receives very high recreational use, which could be the cause of many of the nest failures. Inundation of a nesting attempt and consistent nest replacement in the Horseshoe pair throughout much of the 1990s may have led to five years of lowered productivity (G. Beatty, USFWS, personal observation; J. Driscoll, AGFD, pers. comm.).

Human disturbance, fishing line entanglement, nestlings falling or being blown from nests, nestlings disappearing, predation, nest trees falling over, shooting, contaminants, and birth defects all reduced reproductive performance on the lower Verde River in the 1990s (Hunt et al. 1992, G. Beatty, personal observation, J. Driscoll, AGFD, pers. comm.). The increase in territory establishment and competition, combined with first time breeding attempts may have also contributed to a temporary reduction in reproductive performance. In contrast to what occurred in the 1990s, bald eagle productivity has rebounded since 2000 on the lower Verde River. Twenty-eight fledglings were produced in 3 seasons since 2000 compared to 30 for the entire decade of the 1990s (Table 8). The increase was a result of more territories, increased breeding pair experience, and possibly increased food availability from stocking of rainbow trout prior to egg laying on the Fort McDowell Yavapai Nation (J. Driscoll, AGFD, pers. comm.). Management actions by agencies and tribes such as seasonal closures, nest surveys, nest monitoring, education, and rescues coordinated by the AGFD have helped reduce some of the impacts to nesting eagles and help productivity.

Dam operations and other land use activities have degraded eagle nesting, perching, and foraging habitat in various degrees (McNatt et al.1980, Hunt et al. 1992, Beauchamp and Stromberg 2001, USFWS 2002b). However, recent fisheries research (ERO 2008) and the most recent riparian vegetation research (summarized above in the Environmental Baseline, Past Reservoir Operations, Riparian Vegetation; and in ERO 2008) suggest that the existing eagle forage base and nesting habitat is currently being sustained. While the short-term status of bald eagles on the lower Verde River (with existing on-the-ground management) appears stable, the long-term prognosis (under current management) for maintaining nesting and foraging habitat is uncertain (Hunt et al. 1992, AGFD *in prep*., Beauchamp and Stromberg 2000, USFWS 2002b,).

Operation of Bartlett Dam has altered the hydrologic regime of the lower Verde River by reducing the magnitude, frequency and duration of high flow events (Beauchamp and Stromberg

2001, USFWS 2002b). However, dam operations (1939 to present), which change flow and sediment patterns, have had a lesser effect on tall woody vegetation (ERO 2004; Stromberg et al 2007). Horseshoe and Bartlett have relatively small storage capacities allowing large runoff events to pass through the reservoirs. Capture of sediment by Horseshoe and Bartlett operations affects the distribution of fine sediment along the Verde River below the dams (MEI 2004). In an un-dammed system, sediment deposition provides seed beds for establishing vegetation. In the current system, less fine sediment is available to support vegetation establishment, particularly in areas directly downstream of the two dams. However, flows that pass the dams and inflows from tributaries below the dams continue to provide sediment to the lower Verde (MEI 2004). Stromberg et al. (2007a) found that cottonwood and willow recruitment was occurring downstream of the Bartlett dam in similar amounts as compared to upstream reaches.

Many of the large trees present were there prior to construction of the dam (J. Stromberg, Arizona State University, pers. comm.). Directly below Bartlett Dam, the floodplain has been scoured by dam releases leaving rock cobble. Further downstream beginning near Needle Rock, riparian vegetation and larger nesting trees are primarily found on terraces further away from the active channel (USFWS 2002b). Some mature cottonwoods on the FMYN can be found perched at least 10 feet above the river bottom atop exposed banks. These banks are unprotected by vegetation due to heavy grazing and are subjected to infrequent, but heavy flood water releases, causing the banks to erode and the trees to fall. In 1995, the Fort McDowell nest tree, nest, and young were toppled into the river as a result of water releases from Bartlett Dam (G. Beatty, FWS, pers. comm.).

Old trees along the entire lower Verde River closer to the active channel that pre-date the dam, have significant root scouring, and more easily toppled during large flood events (J. Stromberg, Arizona State University, pers. comm.). Below Sycamore Creek, salt cedar is beginning to flourish as a result of the interrupted hydrologic regime (USFWS 2002b). This creates a significant fire risk to existing nest trees, not previously known to exist along southwestern rivers (USFWS 2002b). In addition to dam operations, scouring, off-road vehicles, development, grazing, woodcutting, and agriculture threaten lower Verde River riparian habitat (Hunt et al. 1992, Stromberg 1993, AGFD 2007).

MEI (2004) and ERO (2004) represent the most recent and site-specific studies on the effects of dam operations on riparian vegetation and fluvial geomorphology. Both studies concluded that effects from Bartlett Dam operation discussed above are tempered appreciably due to relatively low storage capacity of the reservoir system on the Verde River, as compared to the effects of other dam operations on other rivers in other western states that have been studied are frequently cited in the literature.

Hunt et al. (1992) specifically studied the influence of reservoirs and regulated flows produced by the construction and operation of water projects on nesting bald eagles in Arizona. They concluded, "[O]verall, reservoirs, dams, or regulated river reaches do not appear to have a negative affect on bald eagle reproduction." They found that the difference in reproductive rates between altered and unaltered habitats was not statistically significant. They also specifically tested if reservoir levels (i.e., operations) influenced bald eagle productivity and found no significant statistical relationships. They further suggested that management strategies to support bald eagle habitat should include "two or more of the following fish taxa occurring in substantial numbers: carp, suckers, catfish, and perciforms (in reservoirs)." Driscoll et al. (2006) notes that prey availability strongly influences bald eagle productivity and points to data collected from the upper Salt River where a sharp decline of native fish (suckers and roundtail chub), likely caused by a sharp increase of predatory flathead catfish, which overlapped a steep decline in bald eagle productivity. The Conservation Assessment and Strategy for the Bald Eagle in Arizona (Driscoll et al. 2006), which summarizes the conservation information, concluded that maintaining a diversity of fish species (native and/or nonnative) benefits bald eagle productivity and enhances survivorship. They also explained that nonnative fish in some river and reservoir systems may have replaced native fish in the diet of bald eagles (Driscoll et al. 2006).

Hunt et al. (1992) presented little information concerning the foraging ecology of the Table Mountain breeding area located upstream of Horseshoe, and no additional foraging or feeding specific data has been published since their report. It is assumed that these bald eagles utilized both native and nonnative fish species. The Table Mountain breeding area has had low success in recent years, but the cause of the low success is not known; declines in the native sucker population or other confounding factors (e.g., drought) may be responsible. No clear relationship between Horseshoe storage and bald eagle success is evident based on historical data.

Hunt et al. (1992) concluded that water levels were not related to bald eagle productivity and fish sampling also showed that populations in the river responded independently of reservoir operations. AGFD (Duffy 2005; Gill 2006) suggested that a number of factors, such as 2005 flood flows, changes in sampling techniques, or impacts of recent fires in the watershed, could be responsible for the variation in species composition or relative abundances. The fish sampling data show that the nonnative and native species have populations in the river, which are sustained by in-river spawning and recruitment, and may not be significantly influenced by lake spawning species that move from the reservoir.

The Horseshoe breeding area has had moderate success since it was discovered. Hunt et al. (1992) reported the bald eagles foraging in the mainstem and reservoir were taking nonnative fish and native suckers.

The Cliff nest foraging area has been dominated by, and managed by, the AGFD for nonnative sport fish since creation of the reservoirs (AGFD 1954; Committee Report 2006). Thus, since the bald eagle territory was found (1984), few native suckers have likely been present in this reach and their low abundance is part of the environmental baseline conditions. Hunt et al. (1992) noted that carp were a major prey item for the bald eagle and were available throughout the breeding season in this reach. Based on their research and the research of others, Hunt et al. (1992) concluded that prey quantity, quality, or spatial or temporal availability did not appear to be a limiting factor in Cliff bald eagle reproduction. Instead, they noted that the area receives very high recreational use, which could be the cause of many of the nest failures. Hunt et al. (1992) hypothesized that the warm water releases favor nonnative fish species, but no specific research has been conducted to test this or the other confounding factors – such sport fisheries management and past stocking in both lakes, which maintain high nonnative fish abundance and likely reduced native populations to very low levels since the reservoirs were constructed.

<u>Yellow-billed Cuckoo</u>

In the areas of Horseshoe Reservoirs, five cuckoos were documented during cuckoo surveys at Horseshoe in 2003 (EEC 2005). Five to six individuals were detected during three cuckoo surveys in 2004 (EEC 2004). In 2005, six cuckoos were detected at Horseshoe (EEC 2005). Riparian cottonwood-willow galleries and mixed riparian stands that may be suitable for cuckoos exist both above and below Horseshoe, although some of these stands occur as narrow strands along the Verde River. There is insufficient tall riparian forest near Bartlett for cuckoo habitat. Cottonwood groves that may be suitable for the species also occur on the Verde River below Bartlett at the Highway 87 crossing on the FMYN although none have been detected to date (FWS 2003a).

Verde Valley

Yellow billed cuckoos were detected in the Verde Valley during surveys conducted by AGFD and USGS in 1998 – 1999 (Corman and Magill 2000). Surveyors found cuckoos near Highway 260 and the West Clear Creek confluence. Surveys conducted on the Camp Verde Preserve by SRP in 2005 – 2006 found 1 – 3 pairs.

Safford Valley

Limited survey information concerning cuckoo abundance and distribution exists for the Safford Valley. Corman and Magill (2000) did not conduct surveys in this area. In 2007, SRP conducted surveys on the Ft. Thomas riparian preserve and recorded 76 detections, and documented breeding attempts.

<u>Northern Mexican Gartersnake</u>

During 2004 and 2005, Holycross et al. (2006) surveyed 15 stream reaches within the Verde watershed. An apparently stable population of northern Mexican gartersnakes was detected at Page Springs and AGFD's Bubbling Ponds hatcheries on Oak Creek and a single specimen was detected at Dead Horse Ranch State Park during this effort (Holycross et al. 2006). A single 2003 record exists for the species on the Verde mainstem above the Interstate17 crossing where the species is thought to be extant in low to very low densities. Non-native fish, crayfish, and/or bullfrogs were observed in 12 of the 15 areas surveyed (Holycross et al. 2006). Vegetative structure and composition appeared suitable in most locations (Holycross et al. 2006). Based on data provided in Holycross et al. (2006), the Page Springs area along Oak Creek appears to be the only location within the Verde watershed where northern Mexican gartersnakes can be reliably detected. Detailed information about survey effort and findings is available in Holycross et al. (2006).

At Page Springs and AGFD's Bubbling Ponds hatcheries, bullfrogs were observed as abundant and no native frogs were detected. In addition, nonnative trout and other fish have been introduced to the nearby stream. Crayfish were not observed in the hatchery ponds where the gartersnakes were found.

Holycross et al. (2006) surveyed five specific reaches along the Verde River within the action area that contained potentially suitable habitat for northern Mexican Gartersnakes, 1) Bartlett

Dam to Box Bar; 2) Beasley Flat to Horseshoe Dam; 3) the Dead Horse Ranch State Park area; 4) the area of Highway 260 in Camp Verde; and, 5) Interstate 17 – upstream.

Surveys from Bartlett Dam to Box Bar documented bullfrogs to be abundant and detected crayfish and nonnative fish species (Holycross et al. 2006). Holycross et al. (2006) stated, "Although it is likely at least *T. eques* occurred here pre-dams and other anthropomorphic impacts, they are likely now either extirpated or present in exceptionally low densities." From Beasley Flat to Horseshoe Dam, Holycross et al. (2006) detected bullfrogs in abundance and noted the presence of both native and nonnative fish species. No native leopard frog species were detected and Holycross et al. (2006) concluded that they may be extirpated in the Verde mainstem but may still be present in tributaries along this reach. Holycross et al. (2006) surmised that, "*Thamnophis eques* is documented from further upstream in the Verde, and likely previously occurred [from Beasley Flat to Horseshoe Dam], but appears to either be extirpated or only present in very low densities." In the area of Dead Horse Ranch State Park in the Verde Valley, Holycross et al. (2006) detected bullfrogs, crayfish, and nonnative fish in abundance, no native leopard frogs, and determined that the northern Mexican gartersnake "appears to be present in low densities at this site" with only one capture. At the Highway 260 crossing in Camp Verde Holycross et al. (2006) found nonnative fish and bullfrogs to be abundant and also detected crayfish. No native leopard frogs were observed in this survey area. Holycross et al. (2006) noted that northern Mexican gartersnakes "may be present in low densities" although none were detected. Along the Verde River from the Interstate 17 crossing-upstream, Holycross et al. (2006) declared nonnative fish to be "dominant" and found bullfrogs and crayfish in abundance. No native leopard frogs or northern Mexican gartersnakes were detected in this survey effort but a single 2003 record for the northern Mexican gartersnake suggests they may be present in low densities (Holycross et al. 2006).

Holycross et al. (2006) summarizes the status of northern Mexican gartersnakes in the Verde watershed with current and historic records in the following excerpt (note: some records are from locations outside the action area but indicate the potential for species presence within the action area):

> "The Page Springs/Bubbling Ponds Hatcheries locality along Oak Creek was documented in 1950 by specimens (UAZ 40502, UAZ 40503), again by Rosen and Schwalbe (1988), and again in 2004 (this study; ASU 34834). Additional specimens indicate *T. eques* once occurred much further up Oak Creek, at least as far as Midgley Bridge in 1975 (MNA 2804). An unvouchered sighting suggests the species may have occurred as far upstream as Manzanita Campground as recently 1992 (B. Pavlik, HDMS). Reliable unvouchered sightings (Rosen and Schwalbe 1988) suggest the species also occurred in Spring Creek, a tributary of Oak Creek. Two specimens (MNA 199, MNA 200) were collected in 1954 from Sycamore Canyon (upstream of Clarkdale). There are also specimens from the vicinities of Cottonwood at Verde River (CU 12514), Verde River above Tapco (ASU 26137), and Camp Verde (CM 66809, CM 66830, UCM 6525, and possibly AMNH 4200 and 4201). Recent (2003 and 2004) vouchers demonstrates that *T. eques* persists at "¼ mi NW of I-17 bridge" (UAZ 55578-PSV) and at Dead Horse Ranch State Park (ASU 34829; this study) along the upper Verde River. Unvouchered sightings are reported from Horse Creek "about 1 mile above Verde River" in 1986 (L. Simons *in* Rosen and Schwalbe 1988), and Verde River at Houston Creek (J. Burton, Rosen and Schwalbe 1988). There is an unvouchered sighting from 1992 in Sycamore Creek on the west flank of Sugarloaf Mountain (L. Myers, HDMS)" above the action area.

Narrow-headed Gartersnake

Holycross et al. (2006) provides the most current and thorough assessment of the status of narrow-headed gartersnakes in the Verde watershed. Holycross et al. (2006) did not capture a single narrow-headed gartersnake in two years of survey effort from 2004-2005 within the Verde mainstem or in any of the six tributaries that partially comprise the action area. The most current verified record of this species was documented within the Verde mainstem approximately one mile downstream of its confluence with Fossil Creek in May 2005 (Holycross et al. 2006). This specimen was captured and photo-vouchered by AGFD personnel while conducting a fisheries survey. This record indicates that while the narrow-headed gartersnake should be presumed as extant within the action area, it is present in an exceptionally-low density. From 1985-1986, Rosen and Schwalbe (1988) also surveyed numerous stream reaches within the Verde watershed from which narrow-headed gartersnakes were not known from but where potentially suitable habitat existed. Rosen and Schwalbe (1988) also failed to detect this species in their efforts within the action area.

The many factors which determine the suitability of habitat (and therefore likelihood of occupation) of a given area that are described above for the northern Mexican gartersnake (i.e. nonnative predators, condition of vegetative community, etc.) equally affect narrow-headed gartersnakes. For this reason, the status of the narrow-headed gartersnake with respect to the ecological conditions and perturbations that comprise the baseline for this species are analogous to those described for the northern Mexican gartersnake.

Holycross et al. (2006) summarizes the status of narrow-headed gartersnakes in the Verde watershed with current and historic records in the following excerpt (note: some records are from locations outside the action area but indicate the potential for species presence within the action area):

> "Two recent photographs (both resulting from this study) are the only vouchered evidence of *T. rufipunctatus* in the mainstem Verde River. These vouchers document persistence of populations from "*ca*. 1 mile downstream from confluence with Fossil Creek" (ASU HP-00043) and "at Mormon Pocket between Perkinsville and confluence with Sycamore Creek" (ASU HP-00016). Reliable (but unvouchered) sight records place the species in the Verde River in the immediate vicinity of Bear Siding in 1996 (P. Collins and M. Lopez, HDMS) and 2000 (R. Bettaso and J. Stefferud, HDMS), from near Childs in 1986 (R. Babb pers. comm.; Schwalbe pers. comm.), and from the vicinity of Clarkdale in 1988 (T. Jones, pers. comm.) and 1995 (T. Liles and B. Spicer, HDMS). Oak Creek (Yavapai and Coconino counties) harbors the most collected (> 80% of Arizona specimens) and accessible population in Arizona. Specimens (YCC 317, 318, and 660; UAZ 37035) and several sightings (Nowak and Santana-Bendix 2002) document a population in Oak Creek south of Sedona. A voucher collected in 1981 (SRSU 5766) and sight records (Sredl et al.1995; Rosen and Schwalbe 1988) substantiate a population in the East Verde River that persisted as late as 1992. Additional specimens from "Payson" and "Pine" (ASU 34 and 2681; CU 2086) might have been collected from the East Verde River and Pine Creek respectively, but are not plotted due to the vague locality information. Wet Beaver, West Clear, and Fossil creeks are perennial, offer seemingly suitable habitat for this species, and flow into the Verde River between its

confluences with the East Verde River and Oak Creek, both of which are occupied by *T. rufipunctatus*. Nevertheless, a lack of vouchers as well as results from surveys (Drost and Nowak 1997; Windes et al.1997; Rosen and Schwalbe 1988) suggest *T. rufipunctatus* is currently absent from these 3 frequently visited streams."

Lowland Leopard Frog

Rosen and Schwalbe (1988) documented lowland leopard frogs along two reaches of the Verde River mainstem, the three stream mile reach above Sheep Bridge and the 2.5 stream mile reach above "The Falls". Within the Verde River watershed, the species has most recently been documented in Lime and Fossil creeks, although no recent, comprehensive surveys have occurred. Of the 13 sites surveyed by Holycross et al. (2006) in the Verde River watershed, only Spring Creek which is a tributary to Oak Creek above its confluence with the Verde River contained strictly lowland leopard frogs (as compared to having bullfrogs as well); this equates to 8 percent of surveyed sites. Both species, lowland leopard frogs and bullfrogs, were detected in surveys along the Verde River itself, but leopard frogs were only found in tributaries in the absence of bullfrogs. No ranid frogs were detected at four (31%) sites (Holycross et al. 2006).

AGFD and Tonto National Forest personnel conducted annual float trips down the Verde River from 1999-2003 with the purpose of conducting an ecological and biological inventory. They had only detected lowland leopard frogs in tributaries to the Verde River, and never in the mainstem itself. As discussed previously with respect to the northern Mexican and narrow-headed gartersnakes, lowland leopard frogs also share similar sensitivities to ecological conditions and to stressors that affect those conditions. For this reason, inferences can be made as to the status of lowland leopard frogs within the areas surveyed by Holycross et al. (2006) and those survey data are incorporated by reference.

Razorback Sucker and Its Critical Habitat

Critical habitat for the razorback sucker has been designated on the Verde River from the Prescott National Forest boundary downstream through and including the full pool of Horseshoe Reservoir. In response to comments on the proposed designation of critical habitat, we indicated that state water law was considered in the designation, no changes in reservoir operations were foreseen as a result of recovery efforts, and maintenance of particular reservoir elevations were not implied by the designation. The conservation role of this razorback sucker critical habitat is an important one. The Verde River is a distinct basin, which provides structurally and hydrologically valuable habitat for the species upstream of Horseshoe Reservoir because the natural hydrologic regime generally remains intact, with the exception of existing water diversions. The Verde and other basins within the historical distribution of the species face an uncertain future in terms of demanding higher quantities of water. Such demands may ultimately dewater perennial streams reducing their long-term suitability in razorback conservation. However, the Verde Basin is a critically important water supply to the largest metropolitan area in Arizona.

The following assesses the primary constituent elements for razorback sucker critical habitat within the action area:

Water: While various surface diversions exist within and upstream of razorback critical habitat on the Verde River (see Environmental Baseline section), the amount of water in the mainstem channel within razorback critical habitat is not perceived as limiting. Historically, a few water quality sample parameters have experienced exceedances within the action area.

According to the Arizona Department of Environmental Quality's (ADEQ) "The Status of Water Quality in Arizona – 2004 Arizona's Integrated 305(b) Assessment and 303(d) Listing Report", the AGFD and the University of Arizona (U of A) collected a total of 19 water quality samples at four sites within Horseshoe Reservoir between 1999 and 2000 (ADEQ 2004). In one sample, the pH standard for the Aquatic and Wildlife (warm water) (A&Ww) designated use was exceeded at a pH of 9.3. Additionally, the former A&Ww turbidity standard [25 Nepholometric Turbidity Units (NTU)] was exceeded in four of eight samples with results ranging from (0.8 to 90 NTU). Lastly, core parameters such as total boron, mercury, manganese, copper and lead, and dissolved copper, cadmium and zinc were missing from the analyses for Horseshoe Reservoir. For these reasons, ADEQ assessed the A&Ww designated use for this reach as "Inconclusive".

For their surface water assessment purposes, ADEQ divided the Verde River into various reaches, one of which was delineated by the confluence of Tangle Creek to Ister Flat. The A&Ww designated use in this reach was assessed as "Inconclusive" due to exceedances of the former turbidity standard (5 of 24 samples). The turbidity parameter standard for the state of Arizona has since changed and is now measured as suspended sediment concentration, or SSC, and has units of mg/L. Currently, too few samples have been collected within this reach to assess the status of the water quality in terms of suspended sediment concentration. Water quality, in and of itself, has not been identified as a concern for razorback conservation in the Verde River Basin.

Physical Habitat: The physical habitat characteristics of critical habitat within the action area are not considered a limiting factor for feeding, breeding, and sheltering behaviors of razorback sucker, although successful reproduction and recruitment has never been observed in either the riverine portion of the critical habitat within the action area or within the full pool of Horseshoe Reservoir, the observation by Robinson (2007) in 2005 of seven ripe and tuberculate males in Horseshoe Reservoir when water levels were high suggests that these fish were a spawning aggregation. Robinson (2007) concluded, based on instream habitat sampling and successful razorback reservoir-spawning results elsewhere, that when Horseshoe Reservoir fills into the upper basin, razorback sucker spawning substrates (gravels) would be available in the upper and middle basins and rearing habitat would be available in the flooded vegetation..

Biological Environment: Within the action area, nonnative fish species (intentionally introduced as sportfish or forage species and/or unintentionally introduced through bait-bucket transfers) dominate the fish community. Specifically, black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), channel catfish, common carp, flathead catfish (*Plyodictis olivaris*), green sunfish, largemouth bass, mosquitofish (*Gambusia affinis*), red shiner, and yellow bullhead (*Ameiurus natalis*) are found in this reach of the Verde River (Warnecke 1988).

Competition with, and predation from, nonnative fish species within the Verde River Basin, and within razorback critical habitat in particular, is considered the most limiting factor in razorback sucker conservation within the Verde River Basin (Hyatt 2004). Razorback sucker spawn in the Verde River prior to any other fish species which makes razorback larvae especially vulnerable to predation as they represent the entire larval (prey) community during that period of time (Hyatt 2004). Additionally, the lower velocity habitats preferred by both adult and juvenile razorback (pools, slower runs, etc.) are also preferred and occupied by adult flathead and channel catfish which places razorback at a constant risk of predation (Hyatt 2004). Flathead catfish in particular are capable of reaching lengths of 55 inches and 100 pounds in weight and as adults are recognized as strictly piscivorous, capable of eating all size-classes of fish (Sublette et al. 1990, Moyle 1976).

Reintroduction efforts of razorback sucker, which began in 1981, continue annually in the Verde River through an AGFD stocking program. Razorback are produced at both the Bubbling Ponds State Fish Hatchery near Cornville, Arizona as well as at our Dexter National Fish Hatchery and Technology Center in Dexter, New Mexico (Hyatt 2004). Approximately 12 million fingerling-sized razorbacks were stocked into the Verde River from 1981 to 1991 (Hyatt 2004). However, very few stocked fish were recaptured in subsequent years despite considerable monitoring effort. Loss of these fish was primarily due to predation by nonnative fishes within hours after stocking (Marsh and Brooks 1989). Laboratory tests indicated that larger suckers may have had a better chance of avoiding predators and surviving (Johnson et al. 1993).

Since 1991, 22,869 razorback suckers generally $\geq$12 inches have been released into the Verde River near the Childs power plant or Beasley Flat (28 and 44.5 miles upstream of the action area, respectively); and at the Perkinsville Bridge between 1991 and 1993 (n = 830) (Hyatt 2004). However, in the last 14 years, only 283 razorback suckers (slightly greater than 1% of stocked numbers) have been captured though monitoring efforts, recruitment of young has never been documented in the Verde River, and survivorship of stocked razorback has remained low to very low, despite annual stocking efforts implemented by AGFD (Hyatt 2004).

Additionally, Clarkson et al. (1993) noted high infestation levels of the nonnative parasite *Lernaea cyprinacea* (anchorworm) on reintroduced razorbacks in the Verde River near Perkinsville, upstream of the action area. They suspected that high levels of parasitism increased mortality of the reintroduced fish, and considered that this could represent another obstacle to reestablishment of the species. Robinson et al. (1998) found levels of parasitism on both native and nonnative fishes were higher at Perkinsville than at Childs, but rated all fishes examined as "healthy", and concluded that parasitism was not seriously affecting Verde River fishes.

Bonar et al. (2004) encountered 17 razorback suckers during the 2002-2003 field season within the reach between Beasley Flats to Horseshoe Dam of the Verde River, within the reach and vicinity of where the majority of stocking has occurred. No razorbacks were encountered elsewhere in the Verde River during the 2002-2003 field season (Bonar et al. 2004). Hyatt (2004) reported that only four stocked razorback were captured in Horseshoe Reservoir between 1990 and 2003. Other monitoring efforts have documented the species in or just upstream of Horseshoe — at Sheep Bridge, approximately four to five stream miles above Horseshoe; one in Horseshoe in 2002; 7 in Horseshoe in April 2005, 2 in the spring of 2006, and 1 in the fall of 2006 (Robinson 2005; Robinson 2007). Bartlett is not considered to be suitable habitat for razorback sucker recruitment because of the lack of dense aquatic vegetation and the abundance of nonnative fish. Robinson (2007) conducted fish community surveys within Horseshoe Reservoir and upstream to Sheep Bridge during the spring and fall of 2005 and 2006 using numerous techniques including electro-fishing, gill nets, frame nets, minnow traps, and straight seines. This effort yielded 9,864 total fish captured with an astonishing 99.86 percent of fish captured being nonnative (Robinson 2007). The only native fish captured during the study were 10 razorback suckers, three Colorado pikeminnow, and one Sonora sucker (Robinson 2007).

Data from radio-telemetered razorback suckers in the Verde River showed they used shallower depths and slower velocities than in the upper basin. They avoided depths of less than 1.3 feet, but selected depths between 2.0 and 3.9 feet, which likely reflected a reduced availability of deeper waters compared to the larger upper basin rivers. However, use of slower velocities (mean = 0.1ft/sec) may have been an influence of rearing in hatchery ponds. Similar to the upper basin, razorback suckers were found most often in pools or runs over silt substrates, and avoided substrates of larger material (Clarkson et al. 1993).

In the Verde River, any significant in-channel movements of radio-tagged and stocked razorback suckers tended to be in the downstream direction after release. However, Hyatt (2004) indicates that most native fish that are stocked remain at or near introduction sites. Clarkson et al. (1993) stated that “larger” fish (presumably greater than 12 inches total length) did not move as much from the stocking site as did smaller fish introduced in prior stockings.

Arizona Game and Fish Department biologists collected seven adult male razorback suckers in spawning condition in the upper end of Horseshoe Reservoir while conducting a fish community survey in early April of 2005 (Robinson 2007). We partially attribute this unexpected discovery to the significant flows in the Verde River over the winter and spring seasons, which created a “new lake” effect that provides nutrient-rich backwaters that were previously dry. The high, sustained flood events likely adversely affected many species within the nonnative fish community that are both ill-adapted to such conditions and may have been displaced downstream as a result of higher flows (Minckley and Meffe 1987). A reduction in the abundance and distribution of nonnative fish may have temporarily relaxed predation on and competition with razorback suckers and allowed them an opportunity to disperse downstream and attempt to spawn in Horseshoe Reservoir. In general, survivorship of introduced razorbacks, and their eggs and young, is believed to be generally low due largely to the existing high levels of nonnative predatory nonnative fish throughout the action area.

Gila Topminnow

Gila topminnow no longer have extant, naturally occurring populations in the Verde River basin. Although the AGFD has been actively stocking the species in selected areas within the drainage, these efforts have met with variable success. Four re-established, extant populations of Gila topminnow occur in the Verde River basin; Dutchmen Grave Spring, Lime Creek, Mud Springs, and Walnut Spring (Voeltz and Bettaso 2003). Of these four, only the Lime Creek population occurs within the action area. Within Lime Creek, it is believed that Gila topminnow persist in the uppermost reach within this intermittent drainage as more springs enhance the number and permanency of pools and the presence of nonnative fish species is less likely because the intermittent nature of the drainage affects upstream migration. Bonar et al. (2004) did not detect Gila topminnow during surveys in the Verde River mainstem.

Colorado Pikeminnow

For assessment and analysis purposes, the habitat requirements and threats facing razorback sucker within the action area are the same as those for Colorado pikeminnow. Colorado pikeminnow, once common in the Verde River, were extirpated from this system. However, since 1981 and in addition to razorback sucker, repeated stocking efforts have occurred for the Colorado pikeminnow in the Verde River. Colorado pikeminnow are also produced at both the Bubbling Ponds State Fish Hatchery near Cornville, Arizona as well as at our Dexter National Fish Hatchery and Technology Center in Dexter, New Mexico (Hyatt 2004).

Similar to razorback propagation and rearing, Colorado pikeminnow are grown-out to a length equal to or greater than 12 inches, harvested, and stocked into the Verde River in the vicinity of the Childs power plant or Beasley Flat (28 and 44.5 miles upstream of the action area, respectively) (Hyatt 2004). Since 1992, 11,231 Colorado pikeminnow have been stocked into the Verde River; half of which equaled or exceeded 15 inches in total length; no individual specimen has ever been captured twice through monitoring (Hyatt 2004).

Success of the stocking effort in recovery of this species in the Verde River has not been realized. Since 1999, only four Colorado pikeminnow have been captured with a few additional reports of angling mortalities in the areas of Childs and Beasley Flat, at the original stocking locations (Hyatt 2004, AGFD, unpublished data). All four of these captured fish were previously introduced within two months prior to their capture and long-term survival has not been documented. Bonar et al. (2004) counted only two individuals during their sampling effort from March 2002 through January 2003 in the Verde River. Both individuals were observed within the reach between Clarkdale and Beasley Flat, a minimum of 45 miles upstream of the action area, and were captured within the immediate vicinity of stocking locations. Sampling efforts in 2005 and 2006 documented three Colorado pikeminnow in the reach from Sheep Bridge downstream to Horseshoe Reservoir (including the reservoir itself) (Robinson 2007). There is no critical habitat designated for the Colorado pikeminnow within the action area.

Loach Minnow

Loach minnow were considered extirpated from the entire Verde River system, with the last confirmed observations occurring in 1938 above Camp Verde (Girmendock and Young 1997) until the Fossil Creek stocking in 2007. The most recent, comprehensive assessment of the status of primary constituent elements for loach minnow critical habitat within the Verde River basin was performed in 2001 by the U.S. Forest Service, Prescott National Forest (USFS 2001). Within the Verde River drainage where the removal of permitted grazing has improved the habitat, the effect of the nonnative fish population is considered the most prominent factor in preventing the species' recovery as all other constituent elements were believed to be met (USFS 2001, USFWS 2002d).

Spikedace

The population in the upper Verde River (outside and upstream of the action area) appears to be declining in numbers as recent surveys have failed to locate spikedace. The last known records in the Verde River watershed are two fish found in 1999 by the AGFD in this reach. Bonar et al. (2004) failed to observe any spikedace during field activities on the Verde River. Although this species has been stocked into Fossil Creek above the fish barrier, spikedace are not expected to persist in the lower reach of Fossil Creek below the fish barrier or within the Verde River due to predation from the existing nonnative fish species. The tributary streams to the Verde are believed to be unoccupied at this time and additional survey work is needed to determine its current status within the entire Verde River drainage. Habitat destruction along with competition and predation from introduced nonnative species are the primary causes of the species range-wide decline (Miller 1961, Williams et al. 1985, Douglas et al. 1994). However, within the Verde River drainage where the removal of permitted grazing has improved the habitat, the effect of the nonnative fish population is considered the most prominent factor in preventing the species' recovery (USFWS 2002d). There is no spikedace critical habitat designated in the action area; the designated portion of the Verde River occurs upstream of reach 5 and is separated by the Allen Ditch diversion.

Roundtail Chub

Within the Verde River watershed, roundtail chub is thought to be extant in the following tributaries off the Verde River in the action area: Fossil Creek, Oak Creek, West Clear Creek, and Wet Beaver Creek; as well as the Verde mainstem. Currently, the reach of the Verde River immediately below Bartlett Reservoir is where the species is most numerous and evenly distributed, although significant declines have been observed (Bryan and Hyatt 2004). Roundtail chub were observed by Bonar et al. (2004) in all sections of the Verde River, all year long, and was the fourth-most common native species observed (n = 158).

Voeltz (2002) provided a status assessment of roundtail chub in the lower Colorado River Basin which includes a comprehensive discussion of museum records from the Verde watershed (and others). Within the Verde River mainstem, Voeltz (2002) concluded this species was "Unstable-Threatened". Within the upper Verde River, data on the status of roundtail chub were conflicted. Brouder et al. (2000) reported the species as fairly common but data collected by United States Forest Service (USFS) at fixed stations in the upper river suggested an alarming decline in abundance in the reach of river above Sycamore Creek which is above the action area but could act as a source for this species downstream. Below Bartlett, the species is thought to be relatively stable (Bryan and Robinson 2000) although Bonar et al. (2004) reported relatively low densities of roundtail chub in this reach suggesting a recent decline. Voeltz (2002) reported recruitment of roundtail chub as "sporadic and limited" and commented on the presence of nonnative fish and crayfish, as well as groundwater development, as posing significant threats to this species in the Verde River.

Voeltz (2002) also examined the status of roundtail chub in several tributaries that comprise part of the action area; Oak Creek (unstable-threatened), Wet Beaver Creek (unstable-threatened), West Clear Creek (stable-threatened), and the East Verde River (unstable-threatened). The species was considered rare in Oak Creek with nonnatives and water quality cited as possible causes (Voeltz 2002). Within Wet Beaver Creek, sampling efforts in the late 1980's found the age-class distribution of roundtail chub to be skewed towards adults and suggested displacement by smallmouth bass might be a primary cause although numerous other species of nonnative fish as well as crayfish were also detected (Barrett and Maughan 1995). Voeltz (2002) reported roundtail chub to be more common in the uppermost reach of West Clear Creek but that residential development, grazing, sand and gravel activities on private lands, nonnative fishes, crayfish, and water depletion threatened the species in the creek's lower-most reach. Roundtail chub in the East Verde River have been significantly impacted by the 1990 Dude Fire and dewatering, although other threats to this species in the East Verde River include groundwater pumping, recreation, residential development, municipal development, livestock grazing, agriculture, water diversion, timber production, and recreation (Voeltz 2002).

<u>Other Non-listed, Covered Fish Species</u>

Of the species that were observed during Bonar et al.'s (2004) research on the Verde River, desert suckers were the most abundant species observed (n = 10,022) at a ratio of 2.5:1 to the next most abundant native species, the Sonoran sucker. The majority of desert suckers were observed during spring and summer, and were distributed throughout the entire length of the Verde River in both riffle and run habitats (Bonar et al. 2004).

Bonar et al. (2004) counted 316 longfin dace in riffle habitat in the Verde River between Bartlett Dam and the confluence with the Salt River; observed consistently through all four seasons of the calendar year. No longfin dace were observed by Bonar et al. in any other reach within the Verde River mainstem. However, the species is likely present in most perennial, and potentially intermittent, tributaries to the Verde River within the watershed.

The Sonora sucker was encountered by Bonar et al. (2004) in all reaches of the Verde River during their sampling effort from March 2002 through January 2003. Sonoran sucker was the second-most abundant native species observed (n = 4444).

Bonar et al. (2004) did not observe any speckled dace during their work on the Verde River mainstem because the species' preferred elevation range (above 3,800 ft) is above that of the Verde River. However, the species is assumed to occur in several perennial drainages. This species is reported by AGFD HDMS (2003) as occurring below Bartlett Dam on the Verde River. They are recognized to have been widespread in both the Verde mainstem and its tributaries (Minckley 1973; Bettaso and Paradzick, pers. comm. 2005).

Additional information pertaining to the status and distribution of native fish within the action area is included in the previous discussion on "Fish Community Composition".

EFFECTS OF THE ACTION

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

Effects to Southwestern Willow Flycatcher and Yellow-billed Cuckoo

Operation of Horseshoe and Bartlett reservoirs over the 50-year life of the permit is expected to result in periodic unavailability, modification, or loss of occupied habitat and may indirectly injure or kill flycatcher eggs or nestlings. Below, we discuss the adverse and beneficial effects of the action on these two migratory songbirds, on their habitats, and specifically on flycatcher critical habitat. Effects of the action on the flycatcher and its habitat are considered analogous to those effects expected for cuckoo and its habitat. Therefore, we address effects to both species and their habitats together in the following discussion.

Injury or Mortality of Eggs or Nestlings

Injury or mortality of flycatchers or cuckoos could occur if an active nest tree has been undermined as a result of being inundated, and actually falls into the water. Such an event would be unlikely to kill or injure adults, since adults in such cases would likely escape the tree prior to its impact with the water surface. However, eggs or nestlings would almost certainly be lost or would drown. The most likely circumstance in which this might occur would be where a living tree is felled, for example, by high winds. The likelihood of death or injury of flycatchers or cuckoos in this manner overall is relatively small. Direct inundation of active flycatcher or cuckoo nests may occur as a result of extremely high flow events in a low-capacity reservoir system. These two factors combined result in the potential for relatively rapid fill events that would be followed in most cases by rapid draw down events. The erratic nature of low-capacity reservoirs in a watershed known for flashy precipitation events further increase the potential for active nest inundation.

Effects to Flycatcher and Cuckoo Habitat

Riparian habitat at Horseshoe Reservoir will be periodically created and destroyed as a result of fluctuating water levels resulting from runoff and dam operation. The amount of occupied habitat affected by the proposed action is expected to vary over time in Horseshoe Reservoir as existing tall dense vegetation matures and is replaced, as sediment is deposited, and as new riparian habitat becomes established lower in the reservoir. Over the long term, operation of Horseshoe Reservoir is likely to promote the growth of greater amounts of flycatcher and cuckoo habitat within Horseshoe Reservoir and is also expected to help maintain habitat, which would be available for flycatcher occupancy except during years of high runoff. After two successive dry years (based on runoff projections occurs once every 13 years on average), the proposed action prescribes the filling of Horseshoe Reservoir at the earliest opportunity in order to relieve the drought stress on willow trees at higher elevations in the reservoir. It is also likely that at least some suitable habitat would be available for flycatchers and cuckoos at the upper end of the reservoir in all years, and the amount of habitat that is always available is likely to increase as sediment accumulates over the next 50 years. Therefore, the proposed operation of Horseshoe Reservoir serves to minimize the long-term effects of periodic inundation by supporting greater average levels of flycatcher and cuckoo production in the Horseshoe Reservoir footprint than would occur if the reservoir was operated differently.

In the next five to 10 years, no significant adverse impacts on flycatcher and cuckoo habitat availability are anticipated from operating the reservoirs. Based on 2005 observations at Horseshoe when the reservoir was full in late spring, it is likely that the flycatcher and cuckoo population at Horseshoe will sustain itself because there is sufficient habitat even when the reservoir is full. ERO (2008) concluded that this habitat is likely to remain viable for at least the next five to 10 years.

A habitat model was used to evaluate the effects of the proposed operation of Horseshoe over the long-term (ERO 2008) which indicated the maximum amount of flycatcher and cuckoo habitat (450 acres) would be available almost 50 percent of the time; available flycatcher and cuckoo habitat would range from 60 to 450 acres about 20 percent of the time; a minimum of 59 acres would be available about the remaining 30 percent of the time; and the average annual amount of flycatcher and cuckoo habitat available would be 260 acres (ERO 2008). The maximum amount of unavailable habitat would be about 390 acres. The average annual amount of occupied habitat that would be unavailable at Horseshoe over the life of the permit was predicted to be 190 acres, which is rounded up to 200 acres for purposes of this analysis; the same number of acres to be acquired in off-site mitigation property (ERO 2008).

The temporary unavailability of occupied habitat is likely to result in site abandonment or delayed breeding by some flycatchers and cuckoos, or reduced productivity (if birds are displaced from nest sites). Some flycatchers and cuckoo may successfully relocate to other areas of suitable breeding habitat, but some flycatchers and cuckoos are likely to be disrupted because searching for alternative nesting sites can lead to a loss of breeding opportunities or reduced productivity, increasing individuals' risk of mortality from competition, starvation, or predation and resulting in reduced recruitment and reproduction in some years.

The degree to which Horseshoe flycatchers and cuckoos would disperse to other areas on the Verde, Gila, San Pedro, or other rivers is difficult to predict, although banding studies (for flycatchers) have documented movement among these sites (USFWS 2002a; Newell et al. 2005). While we are uncertain of the fate of flycatchers or cuckoos when they are unable to breed at Horseshoe Reservoir because of unsuitable habitat conditions from nest tree inundation, flycatchers are known to migrate to and from Costa Rica and other distant sites twice a year (USFWS 2002a), and thus are capable of long-distance flights. Although sparse data exists regarding cuckoo migration distances, we expect that species to also be capable of similar long-distance flights. Flycatcher movement observations have been made as part of rigorous research completed on this species at Roosevelt Lake. In 2002, a flycatcher banded at Roosevelt in a previous year moved to the Lake Mead delta, and birds banded on the lower Colorado River bird moved to Roosevelt and to the Kern River in California. Flycatchers have even made considerable movements within the same breeding season. In 2001, one female flycatcher nested on the Tonto Creek arm of Roosevelt, then moved to the Winkelman study area of the middle Gila River and nested again. These movements suggest that at least some of the flycatchers displaced by rising waters at Horseshoe are likely to relocate and may even nest successfully. Cuckoos may or may not relocate. Birds dispersing from Horseshoe may colonize unoccupied suitable habitats, resulting in new or increased populations outside of Horseshoe Reservoir.

If the flycatcher density at Horseshoe increased to levels observed at Roosevelt, which were about one bird per two acres (SRP 2002), about 195 birds could occupy the 390 acres of maximum predicted occupied habitat at Horseshoe that would be unavailable due to a complete fill of the reservoir (ERO 2008). It is more likely, however, that the number of birds occupying vegetation at Horseshoe Reservoir will vary over time and, on average, be less than the high density recently observed at Roosevelt because the habitat will likely be dominated by willow in narrow linear patches in Horseshoe rather than the extensive stands of tamarisk at Roosevelt, which supported the exponential growth of flycatchers and high peak densities.. Similarly, the amount of occupied habitat affected by higher reservoir levels would also vary depending on the extent, height and elevation within the reservoir, and the degree and duration of fill in a particular year. Based on historical hydrology, the predicted frequency of inundation resulting in effects to some occupied flycatcher habitat at Horseshoe averages about one-half of all years during the life of the permit (ERO 2008).

Estimates of periodic lost productivity for cuckoos at Horseshoe are difficult to make because little is known about the population. However, for purposes of the HCP, assuming an average territory size of about 50 acres (based on the reported range of 10 to 100 acres), about 4 pairs could occupy the average predicted occupied habitat of 190 acres affected by inundation (ERO 2008). If occupied habitat increased to 390 acres (and the territory size remains at 50 acres), approximately eight pairs could be impacted.

Predicted effects on flycatcher and cuckoo habitat during the first 10 to 15 years of the permit are expected to be less than the maximum possible levels because reservoir operations are not likely to significantly impact flycatcher or cuckoo productivity at Horseshoe (i.e., impact existing tall dense vegetation) (ERO 2008). As observed in 2005, partial inundation of occupied habitat is likely to have a less significant impact to flycatcher and cuckoo habitat and reproductive success if water levels drop during nesting (Dockens and Ashbeck 2005). It is expected that in many years, as trees establish, grow, and become occupied, depending on their location in the reservoir, Horseshoe operations would have little or no impact on habitat or nesting flycatchers and cuckoos. If circumstances change and occupied habitat doubles, up to another 195 birds (390 total) could be present at a density of one bird per two acres of habitat (ERO 2008).

Effects on Flycatchers and Cuckoos Downstream of Reservoirs

Flycatchers occurred downstream of Horseshoe Dam in 2002 to 2004. A fire burned the occupied habitat and no flycatchers were detected during surveys since then. The presence of cuckoo is not known but habitat could be suitable for breeding in the future. Colonization and use of habitat by flycatchers downstream of the reservoir shows that historic dam operations supported the creation and persistence of suitable breeding habitat for these species. No significant adverse effects to flycatchers or their habitat are expected from the implementation of Optimum Operations.

No suitable flycatcher habitat has been found in or surrounding Bartlett and is unlikely to occur in the future due to the steep, rocky shoreline and reservoir operations. Although no flycatchers or cuckoos have been detected below Bartlett Dam, habitat suitable for breeding could develop in the future for these two species. As described below (and in the Environmental Baseline Section for Past Reservoir Operations) no significant adverse impacts to flycatcher or cuckoo habitat is anticipated below Bartlett dam due to the implementation of the Optimum Operations.

Effects to Flycatcher Critical Habitat

Critical habitat for the flycatcher occurs along several segments of the Verde River in the vicinity of Horseshoe and Bartlett (70 FR 60886; October 19, 2005). One segment is a 4-mile reach located immediately below Horseshoe. Another segment is a 23-mile reach from the upper end of Horseshoe upstream to the confluence with the East Verde River. Two other segments are located within the action area, farther upstream in the Verde Valley. The primary constituent elements defined in the critical habitat designation rule (FR 70: 60912; October 19, 2005) and described in the Status of the Species section include: 1) riparian habitat in a dynamic successional riverine environment with suitable woody plant species composition, foliage density, canopy cover, and surrounding habitat mosaic with water or short stature vegetation; and 2) a variety of insect prey populations.

We do not expect that the proposed operation of Horseshoe or Bartlett reservoirs is likely to adversely affect designated critical habitat along the Verde River above the reservoirs. With respect to the segment of critical habitat below Horseshoe Reservoir, operations are not expected to significantly affect riparian habitat downstream from the dams (ERO 2004; MEI 2004). Research results of Stromberg et al. (2007a) found that the floodplain and riparian habitat is dynamic below the dams, and woody plant species composition and structure were similar above and below the dams (willow, cottonwood, and tamarisk were recruiting and forming new patches over time). Thus, no significant adverse impacts to woody plant species composition, vegetation density, canopy cover and vegetation structure, or patch mosaic are anticipated due to future operations of Horseshoe and Bartlett reservoirs. This dynamism, and the associated vegetation community and flows, supports the insect food base essential to the conservation of the flycatcher; thus, no measurable impacts to the insect community are anticipated.

Effects of Mitigation and Minimization Measures

Mitigation and minimization measures were designed to offset, to the maximum extent practicable, the effects to the flycatcher and cuckoo. To offset these effects, the HCP proposes a comprehensive mitigation program consisting of a reservoir operation plan that promotes the growth and maintenance of riparian vegetation, riparian land acquisition and restoration, riparian vegetation creation, and riparian land management. These mitigation measures address the impacts to 200 acres of occupied habitat on an average annual basis over the life of the permit.

The HCP's mitigation program has been designed to be consistent with the Southwestern Willow Flycatcher Recovery Plan (USFWS 2002a). These include: 1) that maintaining or augmenting existing populations is a greater priority than allowing habitat loss and replacement (p. 75); 2) that any replacement habitat acquired (i.e., when existing habitat cannot be preserved) should be situated close to existing flycatcher breeding sites to increase the chance of colonization of that habitat (p. 75); 3) that replacement habitat should be located within the same Management Unit as that where the original habitat was lost (p. 82); and 4) that replacement habitat should be acquired based on the following descending priority order—a) occupied, unprotected, habitat; b) unoccupied, suitable but currently unprotected habitat; and c) unprotected, potential habitat (p.83).

The HCP satisfies these recommendations by incorporating the following requirements: 1) habitat supporting flycatcher populations will continue to be maintained or promoted at Horseshoe Reservoir as part of reservoir operations; 2) all currently proposed mitigation sites under the HCP (e.g., the Verde River and Safford Valley sites) will be protected by enhanced management and are within or near existing flycatcher populations or contiguous with existing flycatcher populations; 3) while 150 acres of the 200 mitigation acres total are not within the Verde River Management Unit (because mitigation opportunities on within the unit are limited), the highest priority sites were selected to provide the best recovery benefit to the species; and, 4) all mitigation habitats targeted by the HCP have been (or will be) selected on the basis of current occupancy by flycatchers or, if unoccupied, of suitability for flycatchers (ERO 2008). HCP-targeted mitigation sites are also generally consistent with the habitat focus areas recommended in Table 10 of the Recovery Plan (USFWS 2002a).

Although mitigation will greatly benefit these species, implementation of mitigation measures has some potential to harm or harass flycatchers or cuckoos. Surveys involving playback recordings have potential to harass flycatchers or cuckoos, but such activities are regulated (for flycatchers) by Federal and State permitting processes to remove and reduce effects to the bird. Activities such as fence construction, driving cattle out of a riparian area, removal of brush piles that pose a fire threat, removal of unneeded structures, and other management activities may remove or damage small amounts of habitat, or could harass nearby flycatchers or cuckoos. Protocols for avoiding or reducing these effects, to the extent possible, will be built into the management plans for acquired properties, and separate Act compliance will be obtained if needed.

Summary of the Effects to Flycatchers and Cuckoos

Taking a long-term perspective in regard to effects, and considered in addition to baseline conditions, the flycatcher and cuckoo should benefit from implementation of the HCP and modified operation of Horseshoe and Bartlett dams. The reservoirs will continue to be operated at full capacity, and the extent and quality of flycatcher and cuckoo habitat will continue to vary with water levels, but is expected to improve over time. Mitigation measures will reduce threats to and ensure continued availability of extant occupied habitats, and provide management in perpetuity for riparian habitats to become occupied. Minimization of impacts through enhanced management and riparian restoration at Horseshoe will improve baseline conditions in the action area. Protection and management of riparian habitats on the Verde River (in the action area), in the Safford Valley, or elsewhere will improve the status of the flycatcher in those areas. Mitigation and minimization measures will fully offset the weighted average amount of habitat expected to be unavailable, modified, or lost at Horseshoe during the next 50 years. If we have underestimated the extent of occupied habitat that may be unavailable, modified, or lost at Horseshoe Reservoir, the HCP includes adaptive management for additional mitigation up to a loss of 400 acres of occupied habitat on average annually. Thus, the HCP and modified operation of Horseshoe and Bartlett reservoirs will provide significant benefits to the status of the flycatcher and cuckoo over the long term.

Effects to the Bald Eagle

Prey Base Implications

The proposed operation of the reservoirs is intended to reduce the nonnative fish produced in the reservoir as compared to the historical operations, and thus reduce potential predation and competition on native fish including suckers. Hunt et al. (1992) reported that East Verde and Ladders nesting pairs utilized native and nonnative fish species, as well as other prey items. No specific foraging data is available for the Coldwater breeding area, but the pair likely utilized both native and nonnative species. We expect that the prey base will be maintained for the bald eagle in these breeding areas. Additionally, potential stocking efforts (especially stocking of native suckers) are expected to have beneficial effects for bald eagle foraging success.

While reservoir storage does influence the fish community composition in the reservoir (Robinson 2007) and fish from the reservoir are likely to move up or downstream, the changes are not likely to measurably impact the reproductive success of bald eagle in relation to prey availability for reasons discussed above. When the reservoir is held high for extended periods, perciforms, carp, and other species are likely to become abundant, whereas when the lake is low or storage is minimized, carp will likely dominate the fish community (Committee Report 2006). Data provided in ERO (2008) show that bald eagle success varied independently of storage elevation in the past – in years when the reservoir was high, the Horseshoe bald eagles were both successful and unsuccessful, and in other years when storage was near zero, the bald eagles were both successful and unsuccessful. Thus, local changes to the fish community due to future operations may occur but are not expected to significantly limit prey availability for the Horseshoe bald eagle pair; a diverse and abundant fish community will continue to be present in the future.

The Cliff breeding area between the reservoirs has had low productivity and nest success since it was discovered in the 1980s. Because of the current predominance of nonnative species in the river below Horseshoe, and the management emphasis of AGFD to maintain sportfish in Bartlett and in this reach of the river, future operations are expected to have little if any effect on the fish community composition within this reach.

Similarly, the Yellow Cliffs breeding area, which utilizes a portion of the river between the reservoirs, will not be impacted for the same reasons as described above for the Cliff breeding area. Because the Bartlett bald eagle pair has had relatively high success, prey availability does not appear to be a factor limiting nest success. Thus, we do not expect Bartlett operations to have any significant effect on the bald eagle forage base in this reach.

The relationship between the influence of Bartlett releases (i.e., downstream hydrograph) and future native/nonnative fish abundance and distribution is unclear (Committee 2006). USFWS (1980) found that habitat carrying capacity for both native and nonnative fish would be enhanced by maintaining a minimum continuous flow below Bartlett, but the abundance of some nonnative fish (e.g., carp and red shiner) could be reduced with minimum flows below 150 cfs. Hunt et al. (1992) hypothesized that relationships among temperature of water releases, periods of low or no flow, and sucker spawning habits and physiology could influence prey species availability for bald eagles and recommended further study. Hunt et al. (1992) suggested that the cool summer water releases from the hypolimnion layer within a reservoir (e.g., Bartlett) may favor the sucker population, whereas warm water (or water temperature near ambient air temperature), such as those released from Horseshoe, would favor nonnative species. Bonar et al. (2004) found a high abundance of adult and larval Sonora and desert suckers below Bartlett, and they suggested that the hydrological mechanisms (e.g., flood flow magnitude, timing, and duration) supported recruitment and population maintenance of these two native fish. However, these same studies also hypothesized, based on research by Bryan and Robinson (2000), that warm water temperatures in the lower reach caused some native species (e.g., native suckers and roundtail chub) to emigrate from the Salt River and concentrate in the reach below the dam. Bonar et al. (2004) also found the highest densities of carp in this reach compared to the other three reaches studied, suggesting that the FWS (1980) conclusions for the species may not be accurate. Bonar et al. (2004) further concluded that managers should focus on controlling nonnative predatory fish (e.g., largemouth bass) in the reach because they observed the highest amount of nonnative predation on native species in this reach, and they recommended the continued study of hydrology-species relationships.

Bryan and Hyatt (2004) documented a declining population of roundtail chub below Bartlett and suggested that lack of flood flows may be the cause. However, Bryan and Robinson (2000) and Brouder (2001) found similar age-class structure of roundtail chub in the upper Verde River compared to the lower Verde River. Similarity in population structure would suggest that both upper and lower Verde River roundtail chub populations are responding to a common environmental condition (possibly large-scale flood events). As Bonar et al. (2004) noted, "the lower Verde River winter-spring flows from Bartlett have mimicked natural flooding, which may trigger spawning by native fishes and provide more spawning and rearing habitat for native fishes during the spring and summer (Bryan et al. 2000)." This conclusion, explained by low storage to runoff ratio for these reservoirs, was also reached by Stromberg et al. (2007a) in their study of vegetation responses to flow alteration on the lower Verde. This suggests that flow alteration below Bartlett has not significantly reduced the frequency of roundtail chub recruitment events, and that the recent population decline below Bartlett may reflect a broader Verde River basin (e.g., there were no large-scale flooding events in the few years prior to the fish studies) or statewide trend, which is exacerbated in some areas by other stressors (i.e., high abundance of nonnative fish). Evidence of high native sucker recruitment by Bonar et al. (2004) in the lower Verde River also suggests that current releases and flood frequencies are not negatively impacting the sucker populations.

Low flows are also important and can influence the fish community. Current data suggest that native sucker populations are abundant below Bartlett and recruitment events continue to occur. Rinne et al. (1998) concluded that nonnative fish have responded favorably to a further stabilized hydrograph. However, these nonnative species are also utilized and considered important food resources and part of the diverse prey base for eagles (Hunt et al. 1994, Driscoll et al. 2006). Although the minimum flow releases have been in place for 14 years (instituted in 1994) and native suckers are long-lived, a delayed response by suckers to this flow regime could occur in the future. Bonar et al. (2004) suggest that there is high abundance, reproduction, and recruitment of suckers within this reach of the river. The eagles seemed to have had a positive response to this abundant food resource as new breeding areas have been established and success has been high since 1995, thus no significant effects to eagle prey base are anticipated due to optimum operations.

Based on these data, the proposed operations of Bartlett are expected to continue to support the current fish community composition and prey base for bald eagles in the future. There is a small increase in predation and competition on covered native fish by nonnative fish produced in the reservoirs that move downstream, but no measurable impacts on bald eagle forage base or productivity are expected because these effects will not appreciably change community composition (i.e., diversity of the fish population) or the spatial and temporal abundance or distribution of individual species (e.g., Sonora and desert suckers). As Driscoll et al. (2006) explained, nonnative fish in some river and reservoir systems have replaced native fish in the diet of bald eagles. Further, there are indirect benefits to bald eagles and their prey base due to the implementation of covered fish proposed conservation measures, which include rearing and stocking native fish and watershed improvement in the action area.

Nest Inundation

Currently no eagles nest within the conservation space of either reservoir. The last nest that occurred within Horseshoe Reservoir was in the early 1990s. Thus, it is unlikely that reservoir operations under the Optimum Operation Alternative will affect a bald eagle nest in the near future. However, over the term of the permit, one or more pairs of bald eagles could move their nests into the active conservation space of the reservoirs below the high water mark and inundation of the nests could occur. Based on past nesting data (Hunt et al. 1992, G. Beatty pers. comm.), there have been 3 inundations of nest in trees over the 30-year history in the Horseshoe breeding area. Based on this frequency of nest inundation, a maximum of 5 nests might be affected by inundation over the 50-year term of the permit. In circumstances when an occupied nest is not inundated, but rather surrounded by high water, injuries or fatalities can occur to fledglings. For example, in 1983, young eagles prefledged, fell into the open water, and were returned to the nest with human intervention (Hunt et al. 1992). Without intervention, these bald eagle fledglings may not have survived.

The proposed action includes adaptive management measures to coordinate rescue efforts of eagle nestlings if a nest is built in trees within the conservation space of Horseshoe and Bartlett Reservoirs an if inundation is expected. Also, an artificial nest structure would be built and maintained for the duration of the permit to promote safe nesting out of the conservation space of the reservoir. The act of intervention itself (rescue of eggs, nestlings, or fledglings) also could result in potential harm and/or harassment of bald eagles, but these impacts would be addressed through coordination with FWS and the AGFD and other parties and necessary permit would be obtained at that time.

Effects to Flycatcher, Cuckoo, and Bald Eagle Habitat Downstream of Bartlett Dam

In the sub-heading "Past Reservoir Operations" within the "Environmental Baseline" and Effects to Flycatchers and Cuckoos section above, we review and discuss findings within the literature pertaining to effects of reservoir operations on downstream riparian vegetation. Riparian vegetation conditions are essential to habitat requirements of flycatcher, cuckoo, and the bald eagle as stated previously. Numerous peer-reviewed, scientific articles have confirmed the importance of timing, duration, magnitude, and frequency of flow on the maintenance, longevity, and overall health of riparian vegetation within riverine systems (Poff et al. 1997, Holling and Meffe 1996, Hughes 1994, Pickett et al. 1992, USFWS 2002a, Stanford et al. 1996, Arthington et al. 1992, Castleberry et al. 1996, Hill et al. 1991, Johnson et al. 1976, Richter et al. 1997, Sparks 1995, Toth 1995, Tyus 1990, Poff and Ward 1989, Richter et al. 1996, Walker et al. 1995). In short, literature concludes that perturbations to the timing, duration, magnitude, and frequency of flows may adversely impact downstream riparian vegetation by altering scouring events, seed bed deposition, and lowering water tables across the floodplain by altering these components to stream flow from the hydrograph through stabilization of flows; however, the magnitude of alteration and concomitant affects on riparian vegetation, and in turn wildlife species, are river system specific (Auble et al. 1994, Shafroth et al. 2002, Lytle and Merritt 2004, Stromberg et al. 2007a, Stromberg et al. 2007b). Stromberg et al. (2007a) provides important analysis on the impacts of flow variation on riparian vegetation communities within the southwestern United States, specifically including the Verde River. Among some of those findings were:

- Flood flows influence vegetation along channels and floodplains by increasing water availability and by promoting disturbance;

- Perennial stream flow, shallow groundwater within the floodplain, and frequent flooding induce higher species diversity and habitat heterogeneity;

- Lower stream flows favor establishment of *Tamarix* and tends to shift the community away from wetland pioneer species such as cottonwood and willow;

- Reduction in flood magnitude or frequency may increase density of downstream riparian vegetation;

- Changes in flood timing can shift species composition from cottonwood and willow communities which have narrow regenerative windows to those more dominated by *Tamarix*; and,

- Sediment retention behind dams contributes to reductions in vegetation cover and herbaceous species richness by reducing nutrient holding capacity of soils.

Many of these trends in vegetation community composition are based on the physiology of cottonwoods and willows. That is to say, both of these species are relatively shallow-rooted, drought intolerant tree species that are sensitive to fluctuations in water table depth which is in turn dependent upon the soil nutrient and water holding capacity determined by soil particle size (fine sediment versus course soils) (Stromberg et al. 2007a). Considering these findings, the minimum flow of 100 cfs below Bartlett and the reduction in frequency of mid-sized flows by dam operations may actually benefit the maintenance of the downstream riparian vegetation community. However, it remains difficult to ascertain how Bartlett Dam operation will affect recruitment of cottonwood and willows as lateral channel migration, sediment transport, water-table depths will be affected across the floodplain from the reduction of mid-sized flows.

Many of these publications referenced immediately above pertain to research performed on other systems in other states. The site-specific and most current research of ERO (2004), MEI (2004), and Stromberg et al. (2007a) found no significant impact to downstream riparian vegetation; in fact, the reduction in flood frequency and magnitude may enable vegetation to become better established and withstand higher flows. Their conclusions are also summarized in the sub-heading “Past Reservoir Operations” within the “Environmental Baseline” section above. Because proposed operation of Bartlett Dam is not expected to differ significantly from its historical operation, we expect trends in the downstream riparian vegetation below Bartlett Dam to remain generally consistent over the life of the permit.

Based on the discussion of effects to riparian vegetation downstream of Bartlett Dam as a result of the proposed action, we anticipate that proposed operations will not significantly adversely affect the current or future suitability of breeding habitat for flycatchers, cuckoos, or bald eagles on the lower Verde River. Under the operations proposed, we do not anticipate a significant change in the suitability of habitat for flycatcher/cuckoo nesting, thus we do not anticipate nesting habitat for these species to become established below Bartlett. Should nesting of either or both of these species occur below Bartlett, operations will be perceived as compatible. We base this assessment on the fact that flycatchers have not been known to breed within this reach and are not expected to within the life of the permit. However, while we do not expect habitat downstream of Bartlett Dam to become suitable for flycatcher or cuckoo nesting purposes, we do anticipate that it will retain characteristics suitable for migrating flycatchers or cuckoos throughout the life of the permit.

Effects to Aquatic Species

Due to the nature of the effects of the action to the aquatic species that occur within the action area, the following discussion collectively addresses effects to all aquatic species, unless otherwise specified. The effects from nonnative species on the native fish community most frequently occurs to Horseshoe Reservoir and all habitat upstream within the action area. We use this rationale because: 1) the current environmental baseline for Bartlett Reservoir is defined by the wholly nonnative fish community that resides within the reservoir and the upstream reach of the Verde River to Horseshoe Dam; 2) the proposed action does not include any significant deviation in operational protocols of Bartlett Reservoir operation; and 3) downstream movement of nonnatives from Bartlett Reservoir (with the exception of spillage during large flood events) is less significant due to the mortality associated with passage through the outlet works and the existing nonnative fish community downstream of Bartlett Reservoir.

In order to provide a framework from which to assess the effects of nonnative species on the native fish community that are reasonably certain to occur within the action area over the life of the permit, we briefly describe the natural histories for the nonnative species that occur, or are expected to occur within the reservoir system on the Verde River during the life of the proposed action. The most important considerations in each species' natural history that result in effects to covered aquatic species include: reproduction requirements and habits [i.e. spawning temperatures, seasons, substrates preferences, nest-guarding (which increases hatching success) and depths]; fecundity; incubation/gestation times; dispersal (or migration) capacity; and diet (to discern whether a given species preys upon native fish, competes against native fish, or both). We expect the most favorable conditions for nonnative species reproduction and recruitment, and thus the most significant adverse effects to covered aquatic species, to occur during the years when Horseshoe Reservoir is maintained at higher levels for longer durations in order to maintain flycatcher and cuckoo habitat.

<u>Bluegill</u>

Bluegill generally prefer static, clear water of ponds, reservoirs and sluggish streams. Adult bluegills prefer warm waters with rooted aquatic vegetation and may benefit from rising reservoir levels and the associated influx of organic matter that becomes submerged and tend to prefer structures such as weedbeds, fallen timber, etc. (Minckley 1973). The habitat preferences for this species are found in both Horseshoe and Bartlett reservoirs.

Spawning begins in late May and continues through August where this species occurs in New Mexico (Sublette et al. 1990) or when water temperatures reach 65-67˚ F at depths of up to nine feet (C. Paradzick, AGFD, pers. comm.). In Horseshoe Reservoir, we expect suitable water temperatures to exist for bluegill beginning in March. There does not appear to be a substrate preference for spawning behavior in this species as they have been reported using all substrates, including mud, for spawning (La Rivers 1994). Minckley (1973) cites egg spawn numbers of up to 49,000 per female. Males will continue to guard the newly hatch fry for another day after which the male may begin to feed on the fry. Due to their need to build and guard nests, fluctuating reservoirs levels may disrupt breeding and can destroy eggs and larvae. Draw down of reservoirs may also concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival for both nonnative species and smaller size classes of stocked native species such as razorback sucker. No other parental care is provided after hatching.

Bluegills compete with and prey upon native fish feeding mainly on aquatic insects and fish, but will attempt to eat almost anything that will fit in their mouths including fish eggs, snails, worms, and aquatic plants. Smaller invertebrates, zooplankton and aquatic insects are all utilized (Minckley 1973). Young bluegills feed primarily on plankton, switching to insects, eggs and fry of other species with adulthood.

Bluegills are largely territorial and do not tend to migrate. The species may exhibit seasonal movements between habitat types by aggregating in larger groups in deeper water in the winter and moving to shallower waters during the warmer seasons both to spawn and to avoid displacement during high flows (Lucas and Baras 2001).

Bonar et al. (2004) considered bluegill a less significant piscivore in the Verde River with less than 4 percent fish in their diet. Bonar et al. (2004) confirmed bluegill distribution throughout the Verde River below Tavasci Marsh in the pool environment types, year-round, indicating that bluegills may recolonize the reservoirs from other locations over time should populations disappear from these areas periodically throughout the duration of the permit. Robinson (2007) documented very few bluegill within Horseshoe Reservoir (< 1% of the fish community), and none immediately upstream in 2005-2006.

We expect reservoir operations to continue to provide spawning habitat at depths shallower than 9 feet for bluegill in years when water levels provide available habitat at water temperatures between 64.1-80.1˚ F, for 2.5 days or longer (see Table 11), to allow for egg hatching. We also expect bluegill from the reservoirs (and their future progeny) to be released from the reservoirs into adjacent reaches of the Verde River from pool contractions and potentially during flood events which could adversely affect covered aquatic species through predation and competition, throughout the life of the permit.

<u>Channel Catfish</u>

Channel catfish live in a wide array of habitats including swift flowing streams, large reservoirs such as Horseshoe or Bartlett, lakes, ponds, and some sluggish streams (Sublette et al. 1990, La Rivers 1994). Moyle (1974) notes the ideal habitat for all sizes of this species is clear, rapidly flowing, warmwater streams with sand, gravel or rubble bottoms. While channel catfish generally prefer clear water streams, they alternatively do well in turbid water.

Sexual maturity is generally reached at age three (Wellborn 1988). Channel catfish are cavity spawners and spawn only in secluded, semi-dark areas with temperatures generally ranging from 75 and 85° F at depths between six and twelve feet (Sublette et al. 1990). In natural waters, male catfish build nests in holes in the banks, undercut banks, hollow logs, logjams or rocks (areas that be protected by the male). The female lays a gelatinous egg mass which is protected and cared for by the male until eggs are hatched and fry leave the nest. Thus, declining reservoir levels can desiccate eggs, and concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival. Fecundity is correlated with body size as females lay 3000-4000 eggs per pound of body weight (Wellborn 1988). Eggs hatch in five-ten days, depending on water temperature. Optimal growth of adult catfish occurs in warm waters of about 85°F, which is above the expected water temperature in Horseshoe Reservoir at full pool during primary storage periods. However, as the pool size is reduced, depending on time of year, water temperatures may become suitable for spawning channel catfish for a limited time especially in shallow water.

Channel catfish compete with and prey upon native fish and feed at day or night on a variety of both plant and animal material (mollusks, crustaceans included) is taken (Moyle 1974). Young catfish feed primarily on aquatic insects. Adult diets include insects, snails, crawfish, green algae, aquatic plants, seeds and small fish (La Rivers 1994). Adults that obtain lengths greater than 12 inches tend to become piscivorous (Moyle 1974). Growth rates of channel catfish seem closely related to population densities, with the most rapid increases in size associated with relatively low numbers of fish per unit area (such as during rapid reservoir fill events associated with heavy inflows) (Minckley 1973). In Arizona, channel catfish 20 inches long and weighing ten pounds are not uncommon, especially from the larger reservoirs (Minckley 1973).

While, as a taxonomic group, the Ictalurids are widely considered sedentary, the channel catfish is considered a seasonally migratory species. Members of this species have recorded long distance movements of up to 78.3 miles within drainage in the lower Wisconsin River and adjacent waters of the upper Mississippi, with larger fish showing more home-site fidelity than smaller individuals (Lucas and Baras 2001). Considering such migratory capabilities, an individual channel catfish may move from Horseshoe Reservoir to near the Oak Creek/Verde River confluence. According to Lucas and Baras (2001), this strategy allows them to exploit spawning and feeding habitats of smaller tributaries in the summer months and retreat to the safety of deeper water habitats during the winter months.

Bonar et al. (2004) considered channel catfish a significant piscivore in the Verde River with greater than 4 percent fish in their diet (including Sonora and desert sucker) and found it in all reaches and all environment types of the Verde River, during all seasons of year which indicates the potential for the species to recolonize a downstream reservoir following any extirpation. Additionally, according to Bonar et al. (2004), channel catfish were the second largest nonnative fish species encountered with a median length of 10.7 inches, within the size class associated with strong piscivory. Robinson (2007) documented channel catfish both within Horseshoe Reservoir and immediately upstream in 2005-2006.

We expect reservoir operations to continue to provide spawning habitat and recruitment opportunities for channel catfish in years when reservoir operations provide suitable habitat at water levels between 8.2-13.1 feet in water temperatures within the range of 69.8-84.2˚F for a duration of 5-10 days (see Table 11). We expect adverse effects to covered aquatic species from channel catfish and their progeny which benefit by these operational conditions through predation and competition over the life of the permit, both within the reservoirs and elsewhere in the action area over the life of the permit.

Common Carp

Carp arrived in Arizona prior to 1885 being stocked into ponds, then into rivers, and have since spread to almost all waters of Arizona below an elevation of 6,500 feet (Minckley 1973). Carp appear to thrive in a wide variety of conditions, preferring warm lakes, streams, ponds, and sloughs with a lot of organic matter but proliferate in large, turbid rivers. The habitat within both Horseshoe and Bartlett reservoirs is well-suited for this species.

In Arizona, common carp begin spawning in late February (when Horseshoe Reservoir is most likely to be at, or near, storage capacity) and continue through June or July in water temperatures between 64 – 73° F at depths of up to six feet deep but vegetated areas in water depths between one and four feet are most often selected (Minckley 1973). Females lay between 100,000 up to as many as two million eggs depending on the body size of the female (Minckley 1973). Young carp remain in these vegetated areas until they are 3 to 4 inches in length and eat primarily small crustaceans.

Adults compete with and may prey upon native fish, but mainly eat insect larvae, crustaceans, annelids, mollusks, weed and tree seeds, wild rice, aquatic plants and algae mainly by grubbing in sediments (Moyle 1974), however Bonar et al. (2004) documented fish in their diet as well. Carp usually live between 9 and 15 years. Adults may uproot and destroy submerged aquatic vegetation and therefore may be detrimental to duck and native fish populations (La Rivers 1994). They are extremely adaptable species with broad tolerances to chemical conditions, temperatures, currents, foods, and spawning condition, and therefore probably influence most species (directly or indirectly) with which they occur (Minckley 1973).

Within the Verde River, carp were the largest (median = 15.6 inches in length) nonnative species observed, were found in pool habitat, in all reaches of the Verde River but in highest concentrations in the uppermost and lowermost reaches during all seasons of the year (Bonar et al. 2004). Carp are also a highly mobile species, capable of moving great distances of up to 683 miles without a seasonal influence (Moyle 1974).

Bonar et al. (2004) considered the common carp as predominantly an insectivore and/or herbivore in the Verde River confirming that fish comprised less than 0.5 percent of their overall diet, and found them in all reaches of the Verde River, in pools, year-round. Robinson (2007) found common carp to be the most abundant fish documented in both Horseshoe Reservoir and immediately upstream in 2005-2006.

The common carp was found in high abundance during recent Horseshoe reservoir surveys (Robinson 2007). This species is likely successful and has a large population because it is able to spawn in inundated vegetation when the reservoir is high, and in stream reaches when the reservoir is empty (Robinson 2007). Because of the lack of impact from fluctuating reservoir levels, and that the carp is a habitat generalist, we expect reservoir operations to continue to provide spawning habitat and recruitment opportunities for common carp in most years over the life of the permit when suitable habitat occurs at water level of 6 feet or shallower in water temperatures within the range of 59-73.4˚F for a duration of 3-16 days (see Table 11). We expect that common carp which benefit from reservoir operations, including its future progeny, to continue to prey upon the eggs and juvenile of covered aquatic species as well as compete with covered aquatic species for food and habitat both within the reservoir pools and elsewhere within the action area.

Flathead Catfish

Adult flathead catfish may inhabit streams, lakes and reservoirs such as Horseshoe and Bartlett preferring large quiet pools with logs and other debris but are considered largely sedentary. Within tributaries, flatheads will generally occupy only the larger pools that reside close to the confluence with the mainstem water body (Sublette et al. 1990). Preferred habitat for the flathead catfish includes areas under rocks, logs, or other rigid objects when found in faster-flowing water (Moyle 1974). This species is also known to favor turbid waters and avoid streams with higher gradients or intermittent behavior (Sublette et al. 1990).

Flatheads generally spawn in early spring and summer when water temperatures reach 70° F at depths between six and 15 feet deep. They build nests in dark secluded shelters such as natural cavities, undercut banks, or near large submerged objects. Gelatinous, adhesive eggs are laid in a compact golden-yellow mass, which is fanned continuously and guarded by the male (Sublette et al. 1990). The egg mass may contain between 4,000 and 59,000 eggs (Sublette et al. 1990). After hatching, the young remain near the nest for several days in a large compact school that is also guarded by the male. Pre- and post-hatch guarding behavior exhibited by male flathead catfish may result in increased adverse effects to covered aquatic species that concurrently use these habitats at these depths within the reservoir, such as stocked razorback suckers. Fluctuating reservoir levels are expected to adversely affect the nesting and guarding behavior of flathead catfish and lower successful recruitment and survivorship of young.

Flathead catfish are mostly nocturnal feeders with young preferring insect larvae, crayfish, mollusks, and worms gradually shifting with age and growth to a strict piscivorous, even cannibalistic, diet (Moyle 1974). Feeding behavior in this species has also been noted during daylight hours, particularly during higher turbid flows (Sublette et al. 1990). Adult flathead catfish are impressive predators, lying in wait and ambushing large-bodied fish with a sudden, enormous inhalation through their large mouth (Sublette et al. 1990, Moyle 1974).

Bonar et al. (2004) considered flathead catfish a significant piscivore in the Verde River with greater than 4 percent fish in their diet (including Sonora and desert suckers) and were found in all reaches of the Verde River in the riffle environment year-round which indicates that recolonization of reservoirs could occur in the unlikely event this species becomes extirpated from the reservoirs. Robinson (2007) documented very few individuals of this species in Horseshoe Reservoir, and none immediately upstream in 2005-2006.

We expect that flathead catfish will continue to benefit from reservoir operations in years when water temperatures range from 71.6-84.2˚F at depths ranging from 6.6-16.4 feet for 6-8 days or longer (see Table 11), to provide suitable conditions and allow recruitment into the extant population. In years when water levels and other habitat variables provide a suitable environment for flathead catfish, such as during years when Horseshoe Reservoir is maintain at high capacity for maintenance of flycatcher habitat, we expect significant adverse effects to covered aquatic species, specifically to any juvenile razorback sucker that may be stocked into the Horseshoe Reservoir during the same year because of the flathead catfish's highly piscivorous behaviors and large gape. Although these fish are largely sedentary and territorial as adults, we expect some adults or their progeny produced in the reservoirs to disperse elsewhere into adjacent reaches due to reservoir contraction or flooding, and compete against and prey upon covered aquatic species, over the life of the permit.

Goldfish

The goldfish thrives in fertile, warmwater habitats such as warmwater reservoirs (Moyle 2002) with heavy growth of aquatic vegetation, which is present in Horseshoe Reservoir in conditions other than minimum pool. In reservoirs, the species prefers shallow, vegetated habitat (Minckley 1973). In flowing water, the goldfish occupies pool habitat (Minckley 1973).

Goldfish are omnivorous in their diet, preferring algae and organic detritus, but will also consume zooplankton, aquatic macrophytes, planktonic diatoms, insects and their larvae, as well as small fish (Moyle 2002).

The species can withstand water temperatures between 32˚F and 105˚F, but populations generally become established in water temperatures ranging between 81˚F and 99˚F in climes where winters are mild (Moyle 2002), such as central Arizona. The goldfish is considered a prolific egg layer and will spawn repeatedly, laying 2,000-4,000 eggs each occasion for as long as conditions remain suitable (La Rivers 1994; Sublette et al. 1990; Moyle 2002). Spawning behaviors in goldfish commence when water temperatures reside between 61˚F and 79˚F; in California, the first spawning coincided with the months of April and May (Moyle 2002). In Horseshoe Reservoir, these water temperatures are expected to occur in March and April due to the climate and shallow profile of the reservoir. Fertilized eggs are highly adhesive and hatch rapidly in just 5-7 days (Moyle 2002).

Bonar et al. (2004) did not observe goldfish in their data collection. Robinson (2007), however, found goldfish to be the second-most observed species in Horseshoe Reservoir at 30 percent of the total catch in 2005-2006. The goldfish was also observed immediately upstream of Horseshoe Reservoir but in far less abundance (AGFD 2007). Goldfish are not expected to move outside the reservoirs except during flooding or drawdown. Many individuals will be stranded, scavenged, or die.

The goldfish is a predominate species in Horseshoe Reservoir, and presumably Bartlett Reservoir, and because of the lack of impact from fluctuating reservoir levels, and that the goldfish is a habitat generalist (similar to the common carp), we expect it will continue to persist in at least Horseshoe Reservoir over the life of the permit. During years when reservoir operations provide adequate spawning habitat at appropriate depths with water temperatures between 60.8-78.8˚F for a duration of 5-7 days (see Table 11), we expect this species to benefit through repeated, successful spawning and recruitment, which will adversely affect covered aquatic species within the reservoir through predation and competition. However, drawdown of the reservoir may desiccate some egg masses, and the minimal carry-over decreases the amount of available spawning habitat through summer. We do not expect the species to persist for any significant amount of time in the riverine portions of the action area, as these areas are not suitable habitat for the species.

Green Sunfish

Green sunfish were earliest of the smaller sunfishes to be introduced into Arizona (Minckley 1973). They utilize lakes, reservoirs such as Bartlett or Horseshoe, and streams (particularly areas with little flow such as streams that become intermittent in the summer) and are tolerant of turbid water unlike most other sunfish species (Sublette et al. 1990). Moyle (1974) points out that green sunfish are "generally rare" in habitats that contain four or more fish species and are frequently found in streams that have been heavily impacted by human activity where the native species have been lost. Moyle (1974) also states that part of the success of this nonnative species comes from its ability to withstand high water temperature (over 96° F), low oxygen levels (less than 3 ppm), and high alkalinity; these conditions are common in several tributaries to the Verde River (especially at lower elevations). Green sunfish appear to have no preference for a particular habitat substrate, but they are usually associated with some type of structure such as brush, vegetation or rocks (La Rivers 1994).

Green sunfish are colonial breeders with males constructing nests in shallow water from mid-May to August or when water temperatures are suitable (Sublette et al. 1990). Males mate with numerous females in the same or different nests and continue to guard the nest for a short period after the eggs hatch (Sublette et al. 1990). This species is noted for its extremely aggressive nature and subsequent territoriality, which are believed to be partly responsible for its success as a nonnative species (Moyle 1974). Nest guarding of this species may limit feeding or sheltering opportunities for covered aquatic species (e.g. stocked razorback sucker in Horseshoe Reservoir), especially considering that preferred shallower habitat for the green sunfish is also preferred and likely to be utilized by juvenile razorback sucker. Due to their need to build and guard nests, fluctuating reservoirs levels may disrupt breeding and can destroy eggs and larvae. Draw down of reservoirs may also concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival for both this species and for stocked native species of smaller size classes.

Adult green sunfish compete with and prey upon native fish and tend to be solitary, secretive, and highly predaceous. Green sunfish have overtly large mouths and eat primarily insects, crayfish, small fishes and occasionally plant material, but is more of a fish eater than its relatives (La Rivers 1994, Moyle 1974, Sublette et al. 1990). Juvenile green sunfish feed on crustaceans, aquatic insects, larvae, and terrestrial insects. Bryan et al. (2000) observed the strongest negative correlation of juvenile fish species occurrence between the green sunfish and the desert sucker.

Lucas and Baras (2001) found that adult sunfish in general are not generally migratory but may move between habitat types, such as between open, deeper water and the shallow areas within reservoirs. Juveniles of the species show a pelagic behavior, drifting in surface waters for weeks, before finally swimming ashore and staking claim to a territory in shallower water (Lucas and Baras 2001). Therefore, surveys conducted primarily along shorelines may not represent an accurate assessment of the population depending on when the survey is conducted.

Bonar et al. (2004) considered green sunfish a less significant piscivore in the Verde River with less than 4 percent fish in their diet and found them in all reaches of the Verde River in pool and run environment types and predominantly during the spring and summer seasons. Because the species is widely distributed within the action area, it is likely that recolonization of the reservoirs could occur over time should the species become intermittently extirpated in those areas. Robinson (2007) documented very few green sunfish in Horseshoe Reservoir, and none immediately upstream in 2005-2006.

During years when reservoir operations provide adequate spawning conditions [water temperatures ranging from 59-87.8˚F at depths ranging from 0.13-11.5 feet for 5-7 days (see Table 11)], we expect this species to benefit through successful spawning and recruitment which will adversely affect covered aquatic species within the reservoir through predation (specifically on the egg, larval, and juvenile age classes) and competition. Flood events or contraction of the reservoir pool may force individuals into adjacent reaches where similar effects to covered aquatic species could occur. Progeny of green sunfish that are produced in favorable years within the reservoirs may affect covered aquatic species through similar mechanisms.

Largemouth Bass

The largemouth bass is a habitat generalist and can live in a wide variety of habitats but prefers sluggish waters, particularly in larger, warmer streams and lakes with lower turbidity levels and beds of aquatic vegetation (Sublette et al. 1990, Moyle 1974), similar to habitat found in Horseshoe and Bartlett reservoirs. This species often centers around large rocks or logs or is found close to soft bottoms, stumps, and extensive growths of a variety of emergent and sub-emergent vegetation, especially waterlillies, cattails, and other pondweeds in water depths generally less than 18 feet which may pertain to its ambush-style hunting tactics (Moyle 1974, Sublette et al. 1990).

The largemouth generally spawns from late spring to mid-summer or when water temperatures range between 65 to 75° F in water depths of six inches to 25 feet. According to Sublette et al. (1990), nests are constructed preferably on firm substrate such as gravel or sand but will also occur over soft, muddy bottoms or other substrata and are often located along the shallow margins of rivers and lakes such as Horseshoe or Bartlett reservoirs. Fecundity of females varies greatly with size and location, ranging from 2,000 to more than 25,000 in Arizona waters (Minckley 1973). After the eggs are deposited, they hatch between 13-20 days and the fry disperse (Sublette et al. 1990, La Rivers 1994). Due to their need to build and guard nests, fluctuating reservoirs levels may disrupt breeding and can destroy eggs and larvae. Draw down of reservoirs may also concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival of both this species and for stocked native species of smaller size classes.

Largemouth bass are not known to move extensively within a drainage. Most movements are equal to or lesser than 5 stream miles in length and are believed to occur due to behaviors pertaining to spawning and home range (Lucas and Baras 2001).

Largemouth bass compete with and are significant predators on native fish. Juvenile largemouths begin feeding on zooplankton and macrobenthos until reaching the length of 1.5 to 2.0 inches where the diet becomes predominantly piscivorous (Sublette et al. 1990). In addition to fish, the adult diet of this predatory species includes insects, crayfish, frogs (i.e. lowland leopard frogs), snails, young mammals, reptiles (i.e. gartersnakes), and young waterfowl. This wide range of prey items combined with the species' large gape and aggressive predatory behavior makes it particularly harmful to covered aquatic species.

Bonar et al. (2004) considered the largemouth bass to be the most significant piscivore in the Verde River with 16.8 percent fish in their diet (including Sonora sucker, desert sucker, and longfin dace) and was found in all reaches of the Verde River below Tavasci Marsh in pool and run environment types, year-round. Native fish were found in the diet of largemouth bass in the Verde River at all sampling locations downstream of Tavasci Marsh but the highest native fish predation occurred downstream of Bartlett Dam (Bonar et al. 2004). Robinson (2007) documented very few largemouth bass in Horseshoe Reservoir and immediately upstream in 2005-2006.

We expect that largemouth bass will continue to benefit from reservoir operations in years when water levels are maintained high enough, combined with suitable water temperatures and other habitat variables to provide suitable spawning habitat and allow recruitment into the extant population. To the extent the species occurs in Horseshoe Reservoir, this will likely occur often, considering the largemouth bass' wide range of tolerable spawning water temperatures and depths and the fact that eggs can hatch in less than two weeks after deposition. Horseshoe Reservoir has a shallow profile which undermines to a certain extent, the ability for rapid drawdown of water levels to expose nests and adversely affect recruitment of this species because the water level will decline slower over time than would occur in a steep-sided reservoir. During the years when water levels and other habitat variables allow for recruitment of largemouth bass within Horseshoe Reservoir [water temperatures ranging from 57.9-75.2 at depths ranging from 4.9-23 feet for 2 or more days (see Table 11)], we expect significant adverse effects to covered aquatic species, specifically to any juvenile razorback sucker that may occur in Horseshoe Reservoir at the same period. Although this species' migratory movements are generally known to be eight stream miles or less, we expect some of the progeny produced in the reservoirs during favorable years to disperse outside of this range and elsewhere into the action area and compete against and prey upon covered aquatic species over the life of the permit.

Mosquitofish

Minckley (1973) found that mosquitofish became introduced into Arizona in 1926 and have since spread to almost all suitable, warm water habitats in Arizona due to its adaptability to almost any conceivable habitat "ranging from clear, cool springs through turbid, hot, stock tanks."

Mosquitofish inhabit lakes, rivers, creeks, ponds, springs, and ditches, with denser populations occurring in shallow water with thick vegetation (Sublette et al. 1990). Despite being capable of tolerating water temperatures from 40° F to over 100° F, this species is sensitive to temperatures and will select thermally fluctuating sites in the summer and more thermally stable sites in the winter, such reservoirs (La Rivers 1994, Sublette et al. 1990). Moyle (1974) noted this species' tolerance for low dissolved oxygen levels, which might be expected in water temperatures approaching its upper limits.

Mosquitofish reproduce from March to October using internal fertilization and ovovivipary, with females capable of giving birth to up to 226 young (brood size varies with size of female) (Sublette et al. 1990). La Rivers (1994) indicated that five is the expected average number of broods a female can produce over her lifespan. Mosquitofish become sexually mature at 1 to 1.5 inches, and most do not live more than two or three years. Sex ratios for offspring tend to be equal but male fatality generally comes sooner in this species as females are larger and hardier than males, which leads to older cohorts having noticeably more females than males (Sublette et al. 1990).

Mosquitofish compete with and prey upon native fish feeding chiefly on insect larvae (its affinity for mosquito larvae led to the common name), crustaceans, algae and fish fry (Moyle 1974, Sublette et al. 1990). This species has been noted to have cannibalistic behaviors, turning its appetite on its own offspring, sometimes immediately after birth, which may provide reproductive and growth advantages (Sublette et al. 1990, Minckley 1973). The species feeds opportunistically at the surface and invades water only a few inches deep, thereby permitting the fish to prey effectively on wriggling mosquito larvae, or whatever prey item is most abundant at the time (Moyle 1974). Minckley (1973) noted this species as particularly harmful to Gila topminnow which is predictably only found where the mosquitofish has not yet gained access or has been removed.

In the Verde River, Bonar et al. (2004) considered the mosquitofish as predominantly an insectivore and/or herbivore documenting that fish comprised less than 0.5% of their overall diet. Mosquitofish were the second-most common nonnative species observed by Bonar et al. (2004) and were observed in all reaches of the Verde River but principally in the headwaters above Sycamore Creek confluence and in the lower Verde River below Bartlett Dam in riffle and run habitats year-round. Robinson (2007) found mosquitofish in both Horseshoe Reservoir and immediately upstream in 2005-2006.

Considering the stable populations of mosquitofish that are maintained within the reservoirs and areas immediately upstream, and that that they can spawn in both lentic and lotic habitats, we do not expect this species to be impacted from fluctuating reservoir levels. The species may benefit when the reservoir is held high by exploiting the additional habitat. In most years, the amount of available spawning habitat would be reduced due to the absence of carry-over storage. However, the species will likely use the remaining minimal pool and stream habitat to spawn. Therefore, this species is anticipated to continue to adversely affect covered aquatic species within and outside the reservoir pools through competition pressures exerted by both adult mosquitofish and their dispersing progeny. Alternatively, whatever benefit this species receives from reservoir operations may, in turn, provide a benefit as an alternative prey item for covered gartersnake species because of its small size and soft fins (Holycross et al. 2006).

Red Shiner

The introduction of this species into the waters of Arizona, where extremes in physical and chemical features are the rule, resulted in the expansion of this species into most waters at lower elevations below 5,000 ft. The present range of the red shiner in Arizona almost exactly complements the presently-reduced ranges of the spikedace and loach minnow, essentially displacing these native minnows (Minckley 1973). Minckley (1973) further concluded that there seems little doubt that the red shiner has contributed significantly to the decline in native Arizona fish populations.

This ubiquitous species is well adapted to survive in high silt and turbidity streams with extreme flow variability and is tolerant of fluctuations in dissolved oxygen, pH, and salinity; often very successful in intermittent streams with high water temperatures (Sublette et al. 1990, Moyle 1974). The red shiner is a habitat generalist and occupies perennial rivers, ephemeral or intermittent streams, canals, and lakes. In the Colorado River drainage (within which the action area occurs), which has been highly modified by anthropogenic activities, red shiner has become well established in several river systems, often becoming the numerically dominant species which could be the result of not only bait transfers or intentional stocking, but also from the species' aggressive colonizing nature (Minckley 1973).

Red shiner spawning occurs from April through September, usually peaking during June and July in the states of New Mexico and California (Sublette et al. 1990, Moyle 1974). The spawning season for this species in Arizona may be earlier because of the possibility for warmer water temperatures. Red shiner nests may be found in riffles, sunfish nests, submerged roots, and crevices with substrata for nesting varying from gravel to silt (Sublette et al. 1990). This species is quite prolific as each clutch has an average of 585 eggs and upwards of 19 clutches per year (Sublette et al. 1990).

Red shiner compete with and prey upon native fish feeding on smaller fishes, insects, filamentous algae, diatoms, crustaceans, and a variety of microorganisms and plant material. Juvenile red shiner feed on small crustaceans, aquatic insects, larvae, and algae (Sublette et al. 1990, Moyle 1974).

Minckley's (1973) assessment of the effect of the red shiner on the native fish community (in particular loach minnow and spikedace) will likely be a primary influence during the life of this permit. Bonar et al. (2004) discovered that red shiner were the most commonly encountered nonnative fish species in the Verde River by almost four-fold and found the species to be present throughout the Verde River year-around, but noted the highest numbers in the reach between Beasley Flat to Sheep Bridge above Horseshoe Reservoir in riffle habitats. Bonar et al. (2004) considered red shiner as predominantly an insectivore and/or herbivore in the Verde River confirming that fish comprised less than 0.5 percent of their overall diet. Robinson (2007) documented this species in Horseshoe Reservoir, but predominantly, immediately upstream in 2005-2006.

Given the high tolerance of red shiner to fluctuating habitat conditions, their highly prolific nature, ability to use lentic and lotic habitats, and their persistence and expansion within the action area, we expect reservoir operations to provide varying degrees of reproduction and spawning opportunities in most years over the life of this permit, especially when water temperatures range from 59-86˚F at suitable depths for 4.4 days or longer (see Table 11). We expect adverse effects to covered aquatic species from the competitive pressures associated with red shiner produced in the reservoirs, as well as their progeny, on the native fish community. Alternatively, red shiner and their progeny which benefit from reservoir operations may provide a beneficial effect as an alternative prey item for covered gartersnake species because of its small size and soft fins.

Yellow Bullhead

Minckley (1973) described them as most abundant in clear, rocky-bottomed, intermediate-sized streams. The species will also occur in clearer, shallow, warm and weedy bays of mainstream reservoirs of Arizona (Sublette et al. 1990; Minckley 1973; Moyle 1974).

Yellow bullhead spawn in the spring and early summer months and shape round nests which are located under protective cover such as overhanging banks or large debris (Sublette et al. 1990). The eggs, numbering from 1,650 – 7,000, adhere together in a clump-like mass and upon hatching, are protected by the adult. Due to their need to build and guard nests, fluctuating reservoirs levels may disrupt breeding and can destroy eggs and larvae. Draw down of reservoirs may also concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival of both this species and stocked native species of smaller size classes.

The yellow bullhead diet consists of plant material, crustaceans, mollusks, aquatic insects, and fish (Moyle 1973). Sublette et al. (1990) noted the species to be primarily piscivorous. Bonar et al. (2004) considered yellow bullhead a significant piscivore in the Verde River with greater than 4 percent fish in their diet (including longfin dace, Sonora sucker, and desert sucker) and found the species in all reaches of the Verde River in riffle and run environment types year-round. Bryan et al. (2000) found yellow bullhead below Bartlett Dam in low gradient riffle, glide, side channel – run, and backwater pool environment types at the Needle Rock, Box Bar Ranch, Rio Verde Estates, Sycamore Creek Confluence, Sycamore Creek, Doka Ranch, and Salt River Indian Community sampling locations. Robinson (2007) documented very few yellow bullhead in Horseshoe Reservoir, and none immediately upstream in 2005-2006.

We expect adverse effects to covered aquatic species through both competition and predation from yellow bullhead that benefit from reservoir operations during years when water levels and other habitat variable provide opportunities for yellow bullhead reproduction and recruitment. These conditions are assumed to occur when water temperatures and depths are suitable for 5-10 days or longer (see Table 11). As stated previously, we expect these conditions to be most commonly present within Horseshoe during years when the reservoir is maintained at higher levels for longer durations in order to maintain flycatcher and cuckoo habitat. We expect adverse effects to covered aquatic species to occur through the same mechanisms, both within and outside the reservoirs, from dispersing progeny, over the life of the permit.

Nonnative Species Not Commonly Observed in Horseshoe and Bartlett Reservoirs

Black Crappie

Black crappie habitat includes warm sloughs, lakes, reservoirs and large, slow rivers. Black crappie are one of the most common, larger centrarchids in Arizona impoundments which could be attributed to fluctuating lake levels creating a large amount of submerged vegetation occasionally referred to as the "new lake effect". Fluctuating water levels seem to have a detrimental effect on crappie populations, but they seem to be able to persist during low water and readily reproduce when water levels increase (Minckley 1973).

Black crappie do not tend to move long distances, but may exhibit seasonal movements between habitat types by aggregating in larger groups in deeper water in the winter and moving to shallower waters during the warmer seasons to spawn (Lucas and Baras 2001).

Spawning begins in May or June when water temperatures reach 62-68° F, in depths of one to three feet, and often at a very young age of one to two years (La Rivers 1994). Crappie often spawn in large groups near submerged bushes or banks and are prolific egg layers as a typical two-pound specimen can lay 150,000 eggs (La Rivers 1994). The reproductive guild of black crappie is guarder, nest spawner. Spawning takes place over mud, sand, or gravel bottoms (Minckley 1973). Due to their need to build and guard nests, fluctuating reservoirs levels may disrupt breeding and can destroy eggs and larvae. Draw down of reservoirs may also concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival of both this species and native species stocked at smaller size classes.

Black crappie compete with and prey upon native fish (preferring minnows and small sunfish) but will use planktonic crustaceans and various larval and adult insects. In Arizona waters, as soon as the fish achieve a length of about 4 inches, they seemingly shift almost entirely to threadfin shad (Minckley 1973). Young feed on invertebrates and insect larvae. Black crappie are one of the few members of the sunfish family that continue to feed during winter.

Black crappie were historically found in Horseshoe Reservoir when reservoir levels were relatively static (Warnecke 1988). Bonar et al. (2004) did not find black crappie in the Verde River. Bryan et al. (2000) found one black crappie below Bartlett Dam at Rio Verde Estates. Robinson (2007) did not document this species in Horseshoe Reservoir or immediately upstream in 2005-2006.

Although this species has not recently been documented in the action area in appreciable numbers, if the species regains a viable population in the Verde River, it is likely to benefit by habitat provided by Horseshoe and Bartlett reservoirs during periods when, over the life of the permit, operations favor the reproduction and recruitment of this species whose progeny could continue to adversely affect covered aquatic species within the reservoirs and other areas within the action area. These conditions include water temperatures ranging from 57.2-68˚F at 1-3 feet in depth for 2.4 days or longer (see Table11). In such an event, we expect black crappie will adversely affect covered aquatic species through competition and predation.

<u>Fathead Minnow</u>

Fathead minnows prefer muddy, turbid, warmwater brooks and creeks, as well as ponds and small lakes with good amounts of floating and submerged vegetation, such as that present in Horseshoe Reservoir; however, they can tolerate a wide range of water conditions, including low dissolved oxygen (Sublette et al. 1990). During drought, the fathead appears to be one of the last species to expire in small pools of intermittent streams, and one of the first to invade typically dry streams when rains occur making it an exceptionally hearty species (Minckley 1973).

Fathead minnows spawn in the spring and may continue into August, which is usually accompanied by significant dimorphism between the sexes (Sublette et al. 1990). Males select the spawning site, usually under logs, branches or rocks in shallow water at water depths of one to three feet deep; such habitat can be found in either reservoir. Females lay adhesive eggs which the males guard. Due to their need to guard eggs, fluctuating reservoirs levels may disrupt breeding and can destroy eggs and larvae. Draw down of reservoirs may also concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival. Fatheads have short life spans, seldom living more than two years but are extremely prolific as they can spawn repeatedly when conditions allow (Moyle 1974). Moyle (1974) noted one occasion where a female of this species spawned twelve times in eleven weeks, producing 4,144 eggs.

Fatheads in Arizona waters compete with native fish by eating mainly organic debris, including detritus and algae, small invertebrates, and diatoms (Moyle 1974, Minckley 1973). Bonar et al. (2004) did not encounter fathead minnows during sampling activities in 2002-2003 but cited Bryan et al. (2000) in suggesting that fathead minnow exist in the Verde River. Robinson (2007) did not document this species in either Horseshoe Reservoir or immediately upstream through their two-year survey effort in 2005-2006. Not much is known about fathead minnow movements within drainages.

Fathead minnows have not recently been documented in the action area, although we are not certain it does not occur in low numbers. Should the species regain a viable population in the reservoirs, it is likely to benefit by habitat provided by Horseshoe and Bartlett reservoirs during periods when operations provide suitable conditions for reproduction and recruitment of fathead minnow [water temperature ranging from 59-86˚F at depths of 1-3 feet for 5 days or longer (see Table 11)], and progeny, which could adversely affect covered aquatic species within the reservoirs and other areas within the action area through competition. In such an event, we expect fathead minnow to adversely affect covered aquatic species through competition. Alternatively, a population of fathead minnow within the action area may provide a beneficial effect as an alternative prey item for covered gartersnake species because of its small size and soft fins, although it has not been documented as prey for either species.

<u>Smallmouth Bass</u>

Smallmouth bass will occupy mid-order streams and lakes that are cooler in temperature, relatively free of turbidity, boulder and broken rock substrata and appear to prefer shady areas with submerged stumps, trees or crevices in clay banks for retreat (Sublette et al. 1990, Moyle 1974).

Spawning in this species occurs from March through May in Arizona, or typically when water temperatures reach between 59 to 64° F at depths ranging from one to 23 feet (Minckley 1973). Female smallmouth bass produce between 2,000 and 20,825 eggs based on body weight (Sublette et al. 1990).

Smallmouth bass compete with and prey upon native fish. Young smallmouth bass generally possess a predominantly invertebrate diet consisting of chironomid pupae and larvae, and tiny crustaceans. However, when an individual smallmouth bass reaches a total length of 8 inches, the diet shift almost exclusively to fish given sufficient amounts of prey, otherwise crayfish and amphibians (i.e. lowland leopard frogs) will supplement the diet of the adult smallmouth (Sublette et al. 1990, Moyle 1974).

As early as the mid-1970s, smallmouth bass were abundant in the Verde River, but rarely attained large sizes and seemed unusually susceptible to external parasitism by *Learnea cyprinacea*, a parasitic crustacean common in that area (Minckley 1973). Bonar et al. (2004) considered smallmouth bass a significant piscivore in the Verde River with greater than 4 percent fish in their diet (including Sonora sucker) and found the species in all reaches of the Verde River above Horseshoe Dam in all environment types during the spring and summer. Robinson (2007) did not document this species in Horseshoe Reservoir but did immediately upstream in 2005-2006. There are no records of smallmouth bass in Bartlett.

While most nonnative species that could occur within the reservoirs are expected to benefit from reservoir operations through reproduction and recruitment opportunities, the smallmouth bass does not, based on the species' preference for lotic habitat for reproduction. However, smallmouth bass in reaches adjacent to reservoirs may indirectly benefit from reservoir operations through increases in available prey species which benefit from operations and are made available to the smallmouth bass when they migrate out, or are forced out of the reservoirs through pool contraction or flooding. This indirect benefit may assist in maintaining the smallmouth bass in adjacent reaches where it can adversely affect covered aquatic species (such as stocked razorback sucker) through predation and/or competition. However, we expect the overall benefits to smallmouth bass from reservoir operations to be less significant compared to those species which occupy and reproduce within the reservoirs themselves.

Threadfin Shad

Threadfin shad, a competitor with native fish, inhabit large lakes, reservoirs, or rivers with moderate currents spending the daylight hours schooled-up feeding on plankton in deep water and moving to shoreline habitats during the evening hours feeding on organic detritus and encrusted organisms on sand (Sublette et al. 1990, Minckley 1973).

Spawning may occur in spring but summer spawning is more likely, particularly when water temperatures are between 69° and 78° F (Sublette et al. 1990). Large schools of shad move along the shoreline (preferred habitat for some covered aquatic species), 6-8 feet from the bank in water about 3 feet deep when females detach from the main school and are followed closely by males (Minckley 1973). Threadfin eggs (800-9,000 per female) become adhesive soon after spawning, attaching themselves to grasses or other objects and hatch rapidly in four to five days.

Threadfin shad was introduced in 1959 into reservoirs of the Salt and Verde rivers where they spread to inhabit all bodies of water in central Arizona below 3,280 ft elevation which indicates that threadfin shad is a colonizing species. The introduction of this species was for the purpose of providing a relatively small, plankton-feeding species with a high reproductive rate, as forage for sportfish (Minckley 1973). Bonar et al. (2004) detected only one individual shad in the Verde River, which was below Bartlett Dam. However, Warnecke (1988) did document the species in Horseshoe Reservoir at 1 percent of the total catch per unit effort. Although threadfin shad spawn exclusively in lentic water, the species was observed some 29 miles upstream of Horseshoe Reservoir in the vicinity of Pete's Cabin Mesa, which confirmed this species' ability to move out of Horseshoe Reservoir in single-season movements because the species is believed to spawn annually (B. Broscheid, AGFD, pers. comm.). Robinson (2007) did not document this species within Horseshoe Reservoir or immediately upstream in 2005-2006.

Threadfin shad specifically reproduce only in habitat produced by the reservoirs with water temperatures ranging from 57.2-80.6˚F at depths ranging from 0.16 to 0.82 feet for 3 days or longer (see Table 11) and, should this species regain population viability in the action area over the life of the permit, we expect some adverse effects from competitive pressure to be exerted on covered aquatic species within and outside the reservoirs when operations permit reproduction and recruitment of this species in the reservoirs. Alternatively, threadfin shad may provide an additional prey species for gartersnake species which could therefore benefit from there re-establishment within the action area.

<u>*Tilapia*</u>

Tilapia were primarily introduced for aquatic weed control the canal systems and reservoirs primarily, and secondarily as a game fish (Moyle 1974). All *Tilapia* species are nest builders whose nests resemble those of sunfishes and are constructed in sand or mud bottoms with the exception that the nest building effort appears to more for courtship purposes than functionality for egg incubation (Moyle 1974). Fertilized eggs are guarded in the nest by a brood parent and fanned until hatching when the parent then transports the fry to a second nest that was recently constructed to house the fry until yolk sacs are absorbed (Moyle 1974). Due to their need to guard eggs and nests, fluctuating reservoirs levels may disrupt breeding and can destroy eggs and larvae. Draw down of reservoirs may also concentrate larvae and young fish which can increase predation and lower recruitment and between-year survival.

Tilapia compete with and prey upon native fish primarily eating vegetation and algae, although at younger ages they will take insects, worms, plankton, larval fish, detritus and decomposing organic matter (Moyle 1974). *Tilapia* are well equipped to feed on vegetative matter.

In the Verde River, *Tilapia* consumed other fish in less than 0.5 percent of their overall diet. *Tilapia* were found only in the reach below Bartlett Dam in all environment types during the summer months (Bonar et al. 2004). Robinson (2007) did not document *Tilapia* in Horseshoe Reservoir or immediately upstream in 2005-2006. There are no records of *Tilapia* in Bartlett.

Tilapia are expected to remain extant within and below Bartlett Reservoir. Given the species' ability to occupy new areas, the species may appear within or above Horseshoe Reservoir over the life of the permit. If this occurred, we expect adverse effects from reservoir operations to occur to covered aquatic species through benefits to *Tilapia* from Bartlett Reservoir operations into the future, specifically if water temperatures are at or below 68˚F at approximately 3 feet deep for 11-12 days in suitable spawning habitat. The most likely impact will occur to covered aquatic species that occur downstream of Bartlett Reservoir when flood pulses release additional *Tilapia* into downstream habitat. Since *Tilapia* largely depend on detritus and vegetative matter as a food source we expect the most significant effects from *Tilapia* on covered aquatic species to occur through competition, although to a minor extent (<0.5%), some predation on larval covered aquatic species could occur.

Summary Discussion of Reservoir Operation – Nonnative Fish Community Relationships

In consideration of the species-specific information presented immediately above, we consider species that have the widest range of suitable spawning depths and temperatures, the shortest incubation/gestation times, the highest fecundity, and the longest inter-drainage movements to be of particular concern with respect to the adverse effects to covered aquatic species within the action area.

The operation of Bartlett and Horseshoe reservoirs over the 50-year permitted time frame is expected to adversely affect covered aquatic species in two primary ways: 1) from stranding or passage through dam outlet works during drawdown; and/or 2) from the effect of increased predation by and/or competition with nonnative species (or their progeny) which benefit from the existence of or increase in suitable habitat for reproduction and recruitment and/or prey base as a result of reservoir operations. With respect to item 2, factors such as the timing, amount, duration, and drawdown of water storage in the reservoir affects the reproduction and recruitment potential differently for each nonnative species that may be present over the life of the permit. In addition, habitat parameters such as the amount of underwater habitat available at specific depths, the quality of that habitat (presumed to be excellent due to the amount of vegetation which grows within the bed of the reservoir while water levels are low, and then flooded by subsequent filling events), and the temperature of the water are key to the success or failure of reproduction and recruitment of nonnative fish.

Water temperature is a key environmental parameter affecting the reproductive opportunities in fish. Temperature data are lacking for Horseshoe Reservoir in agency files and the literature. We visited Horseshoe Reservoir on June 02, 2005, to collect water temperature data at various depths (surface, mid-column, and bottom) in various locations within the reservoir pool while it was at full or near-full capacity. Our data indicated that water temperatures fluctuated little at the surface and at mid-column (to ~ 20 feet deep). Only in the deepest water (> 25 feet deep) did we detect significantly lower temperatures. Water temperatures within the surface and mid-column range, zones where much fish activity is expected to occur in the reservoir, averaged approximately 77-78˚F. These data suggest that suitable water temperatures for spawning of many species will be present in Horseshoe Reservoir during periods of water storage which may occur from November through May proposed under the proposed action, although additional water temperature data should be collected from Horseshoe Reservoir during the months of October through May to fully determine the potential for nonnative fish reproduction and recruitment within the reservoir.

Because the amount of suitable habitat available for nonnative species in a reservoir directly influences the propensity for successful reproduction and recruitment of nonnative fish, water level fluctuations are widely recognized to have the most significant effect to on reservoir fishes and their success (Sammons and Bettoli 2000). Water level fluctuation can alter available spawning habitat, trophic interactions and food webs, and water quality (e.g., temperature, oxygen levels, and turbidity), which in turn may impact the fish community composition, structure, reproduction, and recruitment (Irwin and Noble 1996; Annet et al. 1996; Summerfelt 1999; Hayes et al. 1999; Cowx 2002). We therefore expect reproduction and recruitment of nonnative fish in Horseshoe to be most successful during years when storage levels are the highest for the longest periods of time, which includes the rare scenario of carry-over storage (no draw-down during two or more successive years). Alternatively, we expect reproduction and recruitment of nonnative species within the reservoirs to be reduced during years of rapid drawdown of water levels within the reservoir.

Nonnative fish that occur in Horseshoe Reservoir and Bartlett Lake on any given year will attempt to reproduce, but an individual species' success depends on its specific spawning temperatures, habitat preference, environmental conditions (e.g., available cover, lake temperature), and reservoir operation (i.e., drawdown rates/timing, lake stability, storage carry-over). Species that spawn during reservoir drawdown are likely to be adversely affected, but due to spawning variation among individuals and species, and inter and intra-annual variation of environmental conditions, spawning success could vary widely in any one year and among years. As noted previously, the shallow reservoir profile of Horseshoe Reservoir results in warmer water temperatures within the reservoir that shorten incubation periods of deposited eggs, lessen the detrimental effects of water level fluctuation, and thus could increase egg survival and the amount of larvae successfully produced, particularly when the reservoir is maintained at higher levels for a longer duration in high runoff years or in years when maintaining flycatcher habitat is a primary objective (AGFD 2005c).

The cross-section profile of reservoirs affects the pool depths and dimensions during the filling and lowering of water levels over time. Horseshoe Reservoir has a comparatively shallow cross-section profile. This shallow profile may lessen the adverse effect of rapid reservoir draw-down on reproduction and recruitment of nonnative species to a certain extent in that the rate of change in water depths will be slower, as compared to a steeper and deeper reservoir profile, such as that found in Bartlett Reservoir. On the other hand, a given reduction in volume from a shallow reservoir such as Horseshoe results in increased area of the reservoir bed that is exposed in comparison to steeper sloping reservoirs such as Bartlett. Fluctuating water levels and portions of reservoirs that remain dry for extended periods can provide for growth of terrestrial vegetation and an increased level of submergent vegetation. The increased vegetation, when inundated in subsequent years, can provide additional cover and forage for many adult and larvae of nonnative and native fish species, which could increase survivorship of both (Warnecke 1988; AGFD 2005c).

However, in most years since the mid-1950s, water level fluctuations (annual draw-downs) at Horseshoe Reservoir have been identified as negatively impacting the reproduction recruitment of nonnative fish (Wagner 1954; Warnecke 1988). In 1954, Wagner (1954) described operations of Horseshoe as "not compatible to any degree with game fish production" and "[b]ecause of the nature of the paramount function of Horseshoe, nothing can be done with the reservoir itself to rehabilitate the fishery." Warnecke (1988), 30 years later, noted that the undependable nature of the reservoir and complete dewatering results in borderline survivorship and recruitment of sportfish. However, with respect to reproduction of sportfish, Warnecke concluded "If water is impounded for any length of time at Horseshoe during the spring and early summer months, fish will spawn and there will be lots of little ones all over the lake. Whether they stay in Horseshoe or are transported down to Bartlett will depend on a wide range of water management factors" (AGFD 2005b). However, Robinson (2007) summarizes the specific effects (fluctuating reservoir levels and minimizing carry-over storage) described above on the nonnative fish community in Horseshoe Reservoir during a two year sampling effort from 2005-2006:

> "The yearly fluctuation of surface levels of Horseshoe Reservoir likely favors species such as common carp and goldfish, which spawn during spring over submerged vegetation and are habitat and diet generalists…. Most runoff in the Verde River Basin occurs during late-winter and spring, and is hence when Horseshoe Reservoir reaches its peak elevation, submerging established terrestrial vegetation, and providing ideal spawning and rearing habitat for common carp and goldfish. It is likely that reproductive success of species that inhabit and spawn in both lentic and lotic environments (e.g., common carp, smallmouth bass, flathead catfish, channel catfish, mosquitofish) are less impacted by fluctuating reservoir levels, because when the reservoir levels drop, they can still spawn in the stream.
>
> Most fish species should benefit from high springtime lake levels, but rather than retaining water in Horseshoe Reservoir for long periods, water is released quickly after it comes into the reservoir. During years when reservoir levels drastically decrease during the spring-early summer….fish recruitment is likely to be poor, because nests, eggs, and young-of-year habitat become desiccated after reservoir levels drop."

In summary, while Horseshoe Reservoir may provide suitable conditions for reproduction of nonnative species to occur successfully, reservoir operations generally negatively affect recruitment of larval fish into the population. This latter effect is further exaggerated by an earlier and more aggressive proposed drawdown than what was done in decades past.

Rapid dewatering of the reservoir during spring will adversely affect spawning success and recruitment; alter forage abundance and availability; and influence movement and foraging behavior of some fish species. We consider water temperature, based on its fundamental effect on reproductive behavior of fishes, to be a more significant driving force on fish reproduction than calendar months or seasons of year, at least until water temperature data are collected and associated with calendar months.

For littoral-zone nest-building species (bass, sunfish), reductions in water levels can expose nests, eggs, and larvae to drying, greatly reducing reproductive success (Stuber et al. 1982a, 1982b, 1982c; McMahon and Terrell 1982; Wright 1991; Summerfelt 1999; Hayes et al. 1999) which is expected to occur in most years during the life of the permit. However, a wide range in suitable nesting depths and suitable spawning temperatures, combined with short egg incubation periods, can temper the influence of lowering water levels in some species under certain conditions. Dewatering during spawning periods can also raise water temperatures, oxygen content, and turbidity, which also may affect recruitment success both positively and negatively.

The low water levels typically maintained though the late summer and early fall at Horseshoe Reservoir will adversely affect nonnative species recruitment and survivorship because of a reduction in available habitat. Sammons et al. (1999) and Sammons and Bettolio (2000) found that survival of young-of-year largemouth bass was positively correlated to summer reservoir levels. Mid-summer drawdown will reduce the amount of habitat available for spawning, but also elevate water temperature at a critical time which can accelerate egg and larval development. Higher water temperatures can also suppress foraging, and reduce growth of certain species (McCauley and Kilgour 1990). These effects to nonnative reproduction may be carried forward into the next year's reproductive effort as the abundance of some species of nonnative fish could be reduced within the riverine portion of Horseshoe Reservoir as it begins to fill and become lentic habitat. Thus, multiple years of fluctuating reservoir levels and low summer pool levels can act to compound adverse effects on nonnative fish recruitment and survival over time by reducing the abundance of nonnative fish in reproductive condition.

As previously discussed, Bartlett Reservoir does not fluctuate as much as Horseshoe Reservoir. That is, fluctuation in Bartlett Reservoir levels is more gradual and the reservoir is almost never completely emptied. The operation of Bartlett Reservoir will continue to be advantageous to nonnative species (and will continue to be managed by AGFD as a sport fishery). We do not expect significant adverse effects to aquatic species downstream of Bartlett Reservoir as the proposed action for the next 50 years is generally consistent with its historical and current operation. However, in the event that high flows exceed the capacity of Bartlett Reservoir and spillage occurs, an unknown quantity and composition of nonnative species will be expelled from the reservoir and into the downstream reach where adverse effects to native fish species could occur through competition and predation. We do not consider the resultant influx of nonnative fish species downstream of Bartlett Reservoir to be additive to the downstream fish community but rather may replace a proportion of the previous standing crop of nonnative species as any flood event of such magnitude would simultaneously result in involuntary displacement further downstream of previously occurring nonnative fish. However, the replacement of nonnative fish species does reduce the recovery potential for native species within this reach. It is also important to note that influences from the Salt River and the activities of other land managers downstream of Bartlett Reservoir contribute significantly to the standing crop of nonnative fish below Bartlett Reservoir.

Quantification of Effects to Covered Aquatic Species

Because the precise levels of impacts are difficult to estimate and measure (i.e., observation of competition, predation or mortality in the field), we quantified the effects to covered aquatic in terms of the relative length of impacted miles of stream habitat. We first evaluated all natural and anthropogenic impacts that contribute to the existing and future condition of native fish habitat in the action area (including the information in USFWS 2008, and ERO 2008, and Committee 2006); and second, we estimated the severity, spatial extent, and duration of the impacts of the Optimum Operation on covered aquatic species. The approach (described in detail in ERO 2008 and Committee 2006), resulted in an estimate of relative impact in river miles to the covered species habitat – that is the effect (competition and predation) on covered aquatic species and their habitat due to the production of nonnative fish in the reservoirs caused by the implementation of the Optimum Operation. The direct effect to species caused by stranding or passage though the dam are captured in this estimate of affected habitat.

The effects of the Optimum Operation on covered aquatic species were estimated by reach (as described in the environmental baseline section) so that the varying baseline conditions, native and nonnative species distributions, and influences of the Optimum Operation of both reservoirs could be accurately assessed. Based on this analysis, we determined that the Optimum Operation would adversely affect a total of 33.9 river miles of aquatic covered species habitat (Table 9).

Table 9. Optimum Operation effects on covered aquatic species habitat.

Reach	River Miles (Including Tributaries)	Proportion of Reservoir Impact	River Miles Affected (Miles x % Impact)
1	28	20%	5.6
2	21	5%	1.1
3	16	72%	11.5
4a	8	55%	4.4
4b	55	18%*	9.1
5	55	5%*	2.2
Total	183	—	33.9

*The percent impact in the main stem reach is shown; the percent impact is less in the tributaries to this

Effects of Mitigation and Minimization Measures

SRP proposes to implement numerous measures to mitigate and minimize adverse effects of the action on covered aquatic species within the life of the permit. Effects of rapid drawdown of Horseshoe Reservoir are important to the control future nonnative fish reproduction in Horseshoe Reservoir and were discussed above.

We anticipate beneficial effects to razorback sucker from the creation of habitat within Horseshoe Reservoir for reproduction, grow-out, and recruitment opportunities when Horseshoe Reservoir levels are high during the species' reproductive period in late-winter months. This opportunity will occur in the event that above average runoff occurs and fills Horseshoe and when high water levels are created after two successive dry years to provide drought relief for the maintenance of flycatcher and cuckoo habitat at the upper end of Horseshoe Reservoir. These periods of reservoir fill will correspond with the razorback sucker spawning period. To facilitate reproduction of razorback sucker during these opportunities, stocking of this species may occur to increase the number of razorback suckers and therefore the likelihood of successful reproduction, recruitment, and/or grow-out. While this reservoir operation benefits razorback suckers, we anticipate that nonnative fish species will concurrently benefit by the creation of additional suitable habitat for reproduction, grow-out, recruitment, and increased foraging. However, because razorback suckers reproduce significantly earlier in the calendar year, we anticipate the beneficial effects to razorback sucker will outweigh the adverse effects of additional benefit to nonnative fish species.

Gila topminnow, longfin dace, and lowland leopard frog specifically will benefit from the construction of a fish barrier on Lime Creek to prevent upstream migration of nonnative fish from Horseshoe Reservoir. During barrier construction, Gila topminnow will likely be adversely affected by fish capture and temporary adverse effects to water quality downstream of the barrier construction site if they occur in the vicinity of the construction site or downstream. These short-term adverse effects are necessary for the long-term benefit to these covered native species that occur upstream of the barrier in Lime Creek during the life of the permit. Construction of the Lime Creek fish barrier requires additional permit issuance by the Tonto National Forest and the Army Corps of Engineers and will therefore undergo section 7 consultation in the future, prior to project implementation. That consultation will refer back to this one for part of its analysis.

SRP has committed to provide $500,000 in funding and in-kind support for planning, design, engineering, and fund-raising to improve and expand AGFD's Bubbling Ponds Native Fish Hatchery located along lower Oak Creek. In addition to increasing AGFD's ability to produce native fish for stocking projects, expansion of the hatchery complex will increase the amount of suitable habitat available to an important population of northern Mexican gartersnakes which are currently extant at the hatchery, particularly if precautions are made during the construction phase that reduce or eliminate any gartersnakes from being adversely affected by these activities. Lowland leopard frogs may also benefit from expanded amounts of available habitat. No specific plans for future hatchery expansion projects are available. Therefore, potential short-term adverse effects to northern Mexican gartersnakes and lowland leopard frogs can not be characterized or quantified. However, we anticipate conservation measures will be included in any construction plans to expand the hatchery.

Lastly, SRP has proposed to continue to conduct and expand watershed management activities (past and ongoing examples are provided in the "Description of the Proposed Action" section above) over the life of the permit that are intended to monitor, protect, and/or increase stream flow within the Verde watershed. While these activities do not specifically minimize or mitigate the effects of competition with or predation from nonnative species on covered aquatic species, they maintain and improve the future habitat conditions for these species in the face of impending long-term drought, global climate change, and future development, which are expected to pose serious threats to surface water flow. Mitigation and minimization activities that promote an increase of surface flows, and protection of existing surface flows, are critical to the future existence of the aquatic community within the Verde watershed, particularly given the long-term outlook of declining precipitation in the southwestern United States, and as a result of global climate change (Seager et al. 2007).

<u>Quantification of the benefits of Minimization and Mitigation Measures</u>

As with the effects analysis, we estimated the benefits to covered aquatic species in terms of river miles of covered aquatic species habitat. The detailed methodology is described in ERO 2008 and Paradzick et al. 2006. In short, we determined the relative benefit of mitigation measures in relation to offsetting the effects of the anticipated increase in competition and predation by nonnative fish produced due to the Optimum Operation of the reservoirs, and the effects of stranding and passage through the dams. We applied the relative benefit to appropriate stream miles in the action area (e.g., the Lime Creek barrier would benefit habitat only in Lime Creek, compared to stocking covered fish which would benefit a much larger area). Based on the evaluation methodology, the relative benefits of the mitigation measures to covered aquatic species are:

- Rapid Drawdown — 21.4 river miles.
- Stocking of Small (Sub-adult or Fingerling) or Adult Razorback Sucker Into Horseshoe or Elsewhere — 12.4 river miles.
- Install a Fish Barrier on Lime Creek — 3.4 river miles.
- Bubbling Ponds Native Fish Hatchery Improvements and Support — 15.7 river miles.
- Stocking of Native Fish in the Verde Watershed — 9.0 river miles.
- Watershed Management Efforts — 8.0 miles.
- <u>Total mitigation benefit to covered aquatic species: 70 river miles</u>

In summary, the 70 stream miles of mitigation benefits would fully offset the 33.9 river miles of impact from the proposed action.

<u>Effects to Razorback Sucker Critical Habitat</u>

In Horseshoe, future reservoir operations are not likely to adversely modify critical habitat for razorback sucker because the affected critical habitat would remain functional (or retain the current ability for the PCEs to be functionally established) to serve the intended conservation role for the species; i.e., space; necessary nutritional and physiological elements (e.g., water); cover or shelter; breeding and reproduction sites; and appropriate habitats. As noted in the designation, predation and competition are natural components of the razorback sucker's environment, but these components are out of balance in some systems due to nonnative fish. The increase in reproduction of nonnative fish would not appreciably diminish PCEs because of: 1) the current contribution to the environmental baseline due to the already saturated and self-sustaining populations of nonnative fish currently distributed throughout the Verde River critical habitat for the razorback sucker; and 2) the mitigation and minimization measures proposed to address effects associated with the proposed action. Additionally, we considered reservoir operations and state water law when designating critical habitat for the razorback sucker, and found that no changes in reservoir operations were contemplated as a result of recovery efforts, and maintenance of particular reservoir elevations were not implied by the designation.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, or local private actions that are reasonably certain to occur in the action 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 Act. Effects of past Federal and private actions are considered in the Environmental Baseline. Activities on Federal lands and/or federally funded or authorized projects on the tribal lands are subject to section 7, and thus effects of these activities are not considered cumulative.

Land ownership within the action area is largely non-private with the PNF, TNF, FMYN, and the Salt River Pima-Maricopa Reservation being the principle land owners. However, private, disjunct in-holdings do occur throughout the action area. The largest, contiguous, privately owned area is the community of Cottonwood and its suburbs, which are located in Reach 5 within the Verde Valley at the uppermost section of the action area. The town of Camp Verde, located downstream of the I-17 crossing in Reach 5, is the second largest area of privately owned lands in the action area. A small private community, Rio Verde, occurs downstream of Bartlett Dam in Reach 1. In total, private land occurs along more than 30 stream miles within the action area. Private land ownership and activities on private lands potentially affecting covered species also occur within the mitigation areas, as discussed below.

Table 10. Summary of life history information for nonnative species on the Verde River.

Species	Prey (adult)	Spawning Habitat	Spawning Temp. (°F)	Spawning Season	Seasonal Movement
Largemouth bass	Fish, crayfish[13]; frogs, large insects, snakes, mice, small birds[14]; "most significant piscivore", 16.8% fish in diet[24]	Prefer lentic[1] with protective cover[13]; <20ft (6 inches to 25 ft); nest <5ft, often destroyed by wave action[22,23]	60[1]; most by 64, end spawn at 75[23]	Starts late April to early May; ends mid-late July[23] (total nesting period, 19d)	Movements 5 miles, related to spawning[25]
Bluegill	Aquatic insects and their larvae[8]; small crayfish, fish eggs, minnows, snails, worms; aquatic plants if necessary; <4%fish in diet[24]	Shallow water (6-12 inches[14]) with gravel substrate[8]; 3-9 ft[22]; Fine gravel, sand preferred but will use other[22]; nearly any substrate used[28]	70[8,] -75[1]; 63-88[22,23]; peak 67-80[22]	May[8] through August[1,23]; (total nesting period 7 d[22,23])	No long-distance movement; seasonal movements to deep water in winter[25]
Channel catfish	Omnivorous; insects, mollusks, crustaceans, fish, plant material[10,26,28]; "significant piscivore," >4% fish in diet[24]	Nest in dark, secluded areas such as drift piles[10]; 6-12 ft, in cavities[22,23]	75[10, 14];70-84[22,23]	Late Spring to early Summer[10,22]; mid-June to July @ Elephant Butte Res.[23]; (total nesting period 14 d)	Migrate up to 78.3 miles; migrate up tributaries in summer, winter in deep water[25]
Flathead catfish	Fish[11]; crayfish, mice and frogs if available[15]; "significant piscivore," >4% fish in diet[24]	Nest in shallow depression near shelter such as logs[11]; 6-15 ft; cavities s/as logs or other cover[22,23]	68-84[22]	June to July[22]; (total nesting period 8 d)	Sedentary[29]
Carp	Fry are planktivorous. Adults are primarily benthic, feeding on both plant and animal material[19]; <0.5% fish in diet[24]	Prefer <1.5 ft, up to 6 ft[22]; prefer inundated terrestrial or aquatic vegetation; pools[27]	64-73[22]	February to June[22]; late April to June @ Elephant Butte Res.[23]; (total nesting period 3-16 d[23])	Move great distances; not tied to season[26]
Green Sunfish	Insects, crayfish, mollusks, small fish; <4% fish in diet[24]	Colonial nesters in shallow water with rocky or gravel bottom[2,23]; 2 inches to 1 ft[22]; firm substrate, gravel or sand[22]; <20 inches[23]	70[2]; 66-88; optimal 68 – 80[22]	Late Spring through Summer[2]; Spring to late Summer[23]; (total nesting period 10-15 d)	Generally no long distance movement[25]

Species	Prey (adult)	Spawning Habitat	Spawning Temp. (°F)	Spawning Season	Seasonal Movement
Red shiner	Small invertebrates[7]; small crustaceans, algae[21]; small fish, algae, diatoms, crustaceans[23,26]; <0.5% fish[24]	Riffles, submerged objects, vegetation beds[7, 23]; thrive in unstable environments such as intermittent streams; spawn in quiet water with submerged debris such as aquatic plants, tree roots or logs. May also use gravel and sand bottoms[21]	60-86[21]	April-September; peak in June-July[23,26]	unknown

[1]UC Davis 2001
[2]AGFD 2004b
[3]Texas Parks and Wildlife 2004a
[6]Texas Parks and Wildlife 2004b
[7]Texas Parks and Wildlife 2004c
[8]Texas Parks and Wildlife 2004d
[10]Texas Parks and Wildlife 2004e
[11]Texas Parks and Wildlife 2004f
[13]Ohio River Fisheries Management Team 2000
[14]Washington Department of Fish and Wildlife 2000
[18]Wlosinski and Marecek 1996.
[19]Texas Parks and Wildlife 2004b
[20]PFBC 2003
[21]Moyle 1976
[22]USFWS HSI models
[23]Sublette et al. 1990
[24]Bonar et al. 2004
[25]Lucas and Baras 2001
[26]Moyle 1976
[27]Minckley 1973
[28]LaRivers 1994
[29]Becker 1983

Table 11. Nonnative Fish Reproduction Temperatures, Depths, and Incubation Times

Species Common Name	Scientific Name	Temperature ˚F	Depth Feet	Incubation Time Time (Days)	@ Temp (˚F)
Largemouth Bass	*Micropterus salmoides*	57.9 - 75.2	4.9 - 23.0	2.0	72
				5.0	66
Smallmouth Bass	*Micropterus dolomieu*	54.5 - 74.3	< 16.4	9.5	55
				2.25	75
Bluegill	*Lepomis macrochirus*	64.4 - 80.1	< 9.0	2.5	≥70
Black Crappie	*Pomoxis nigromaculatus*	57.2 - 68.0	1.0 - 3.0	2.4	65
Channel Catfish	*Ictalurus punctatus*	69.8 - 84.2	8.2 - 13.1	5.0 - 10.0	70 - 84
Flathead Catfish	*Pylodictis olivaris*	71.6 - 84.2	6.6 - 16.4	6.0 - 8.0	72 - 84
Carp	*Cyprinus carpio*	59.0 - 73.4	< 6.0	3.0 - 16.0	59 – 73.5
Goldfish	*Carassius auratus*	60.8 - 78.8	NA	5.0 – 7.0	60 - 79
Green Sunfish	*Lepomis cyanellus*	59.0 - 87.8	0.13 - 11.5	5.0 - 7.0	59 - 88
Fathead Minnow	*Pimephales promelas*	59.0 - 86.0	1.0 - 3.0	5.0	73.5 - 86
Red shiner	*Notropis lutrensis*	59.0 - 86.0	NA	4.4	76
Yellow Bullhead	*Ameiurus natalis*	NA	NA	5.0 - 10.0	NA
Mosquitofish	*Gambusia affinis*	77.0 - 86.0	NA	Ovoviviparous	Ovoviviparous
Threadfin shad	*Dorosoma petenense*	57.2 - 80.6	0.16 - 0.82	3.0	80
Tilapia	*Tilapia spp.*	≥ 68.0	2.8	11.0 - 12.0	≥ 680

Source: Minckley (1973); Sublette et al. (1990); and Moyle (2002).
Temperature data collected on June 2, 2005 at Horseshoe Reservoir indicated a range from 58.2˚F at 64 feet below surface to 80˚F at the surface. NA = Information not available in references cited.

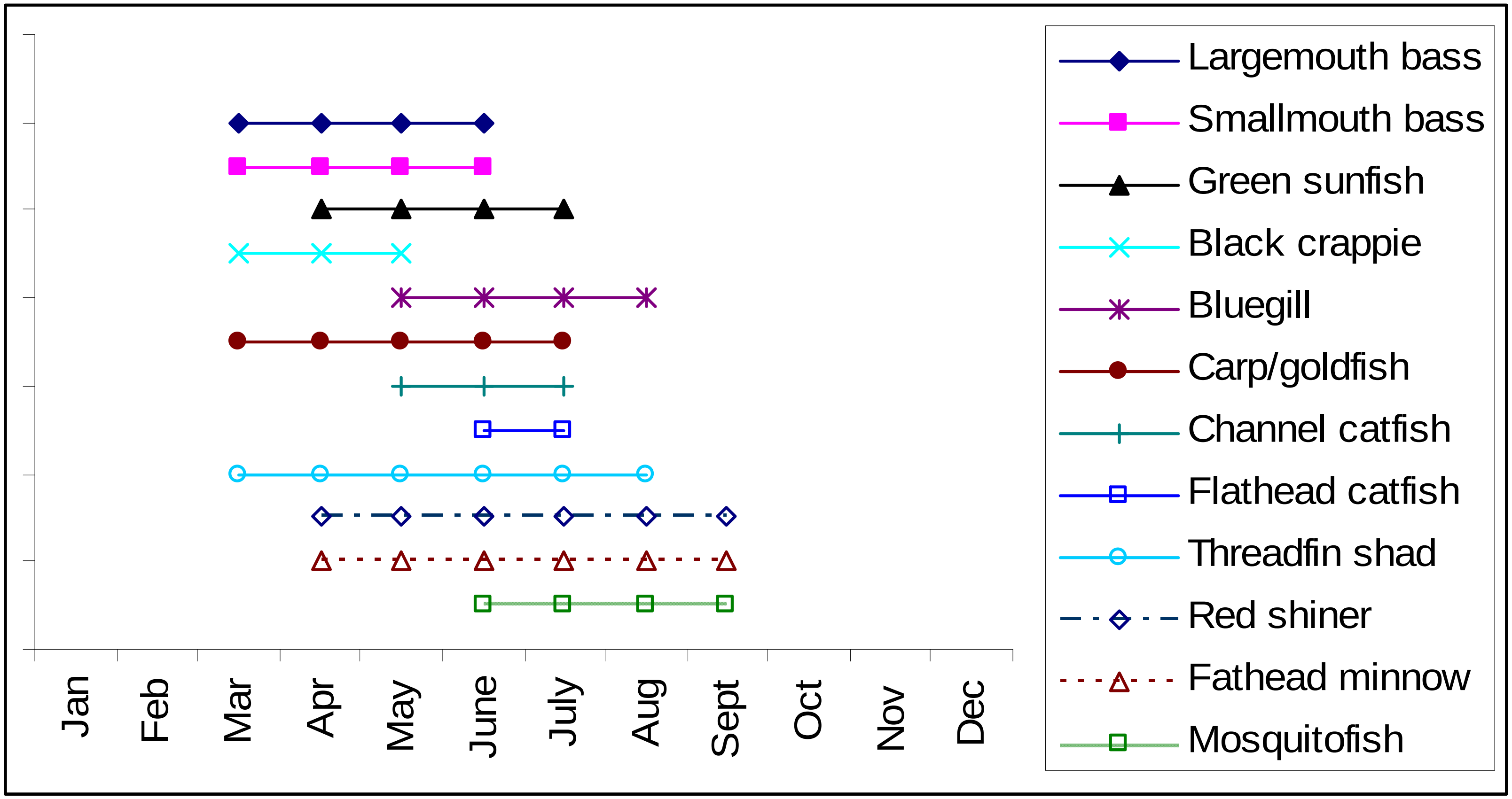


Figure 3. Estimated spawning periods of select nonnative fish found in the action area.

Verde River Within the Action Area

As described in the Environmental Baseline, several activities on private lands have adversely affected riparian and aquatic habitat on the Verde River within the action area, particularly within Reach 5. These include agricultural operations, urban development, bridge construction, road-building, agricultural diversions, extensive recreational use, sand and gravel operations, and historical and current removal of riparian vegetation (Sullivan and Richardson 1993). These land uses are expected to continue into the future as the area is experiencing significant population growth. These types of activities remove or alter riparian habitat from the floodplain, adversely affect water quality from increases in sedimentation and the introduction of non-point source pollution, and alter stream flow characteristics.

The Verde and many other basins within the current and historical distribution of all of the covered aquatic species face an uncertain future in terms of growing human populations demanding higher quantities of water. Such demands may ultimately reduce the flow in or dewater perennial streams reducing their long-term suitability for conservation of these species.

Forty-seven water diversions located on the Verde River, and Oak, Wet Beaver, and West Clear creeks, as well as groundwater pumping and irrigation ditches within these areas, exact a significant impact on surface flows of the Verde River, particularly in dry years, with a 66 percent reduction in overall surface flow of the Verde River below the Cottonwood Ditch (Alam 1997). These consumptive uses of water are also expected to continue into the future and will result in a continued reduction of surface flow downstream of where they occur, which will adversely affect riparian habitat for covered birds, as well as habitat for the covered aquatic species.

Human population growth within the Verde River watershed has a direct correlation to ground water development. As described in the environmental baseline, the pumping of ground water that is hydrologically connected to the Verde River has adversely affected river flows and associated riparian vegetation relied upon by species proposed to be covered by the ITP. We anticipate that these activities and their adverse effects will continue during the life of the ITP (Haney 2007; Springer and Haney 2007; Smith 2007). Further, as the human population grows, additional ground water pumping may occur, with resulting additional adverse impacts to Verde River flows, habitat and species. An example of one recently proposed large-scale ground water pumping project is the Big Chino Water Ranch and its associated 30-mile (48 km), 36-in (91-cm) diameter pipeline. The project proposes to deliver 2.8 billion gallons of ground water annually from the Big Chino sub-basin aquifer to the rapidly growing areas of Prescott and Prescott Valley for municipal use (McKinnon 2006c). The Big Chino sub-basin provides 86 percent of the baseflow to the upper Verde River (American Rivers 2006; McKinnon 2006a). This proposed project placed the Verde River on American River's "Ten Most Endangered Rivers List [of 2006]" (American Rivers 2006). The reduction or loss of baseflow in the Verde River potentially resulting from this or other future projects could seasonally dry up large reaches of the Verde River, adversely affecting the riparian community and the suitability of the habitat for extant populations of covered bird and aquatic species, as well as their prey species in these areas.

Impacts of ground water use and the corresponding demands of burgeoning population growth and infrastructure development on covered species could also be compounded by regional climate change. According to 18 of 19 regional climate models, the levels of aridity of recent drought conditions and perhaps those of the 1950s drought years will become the new climatology for the southwestern United States within years or decades and annual mean precipitation levels will continue to decrease over the next century (Seager et al. 2007). Quantitative predictors of future trends in annual precipitation are uncertain, but should current drought conditions persist or worsen over the next century, impacts to covered bird and aquatic species may affect their habitat and long-term persistence.

Wildfires in the Verde River watershed within or above the action area can cause flushes of ash and sediment into streams and cause fish kills in the action area tributaries and Verde River. A long-term watershed danger from these wildfires is the potential for soil damage through removal of organic matter, loss of surface layer, and changes to surface soil structure that result in reduced infiltration, rapid runoff, and increased sedimentation and peak flows in the stream channel (J. Warnecke, AGFD, pers. comm.; Barnett and Hawkins 2002).

Recreation and river use are expected to increase, reflecting the strong population growth trends in the Verde Valley, Phoenix metropolitan area, and other surrounding communities (USDA 2004). Noise and the presence of people and boats may cause flycatchers, cuckoos and bald eagles to temporarily or permanently abandon nests, or dissuade birds searching for nest sites from nesting in such areas (USFWS 2002a). Horseshoe Reservoir is not widely recognized as a recreational waterbody; further, the use of waterskis, parasails and personal watercraft is prohibited at Horseshoe. Because we expect flycatchers, cuckoos, and their habitat to occur predominantly in Horseshoe Reservoir, we expect the effects of recreational activities on these species to be minor, as compared to other reservoirs.

The long-term sustainability of suckers below Bartlett, and other native fish species in general in the Verde River below Bartlett and upstream of Horseshoe, is difficult to predict due to native/nonnative fish interactions, future land use changes, recreational uses and impacts, grazing impacts, future tribal policies and actions, and state and tribal sport fisheries management and actions

Other cumulative effects are expected to result from continued nonnative sportfish stocking efforts at various locations within or just upstream of the action area, although some of these activities are partially funded through our agency and not considered cumulative effects. The community of Rio Verde and the FMYN have stocked rainbow trout in the past and may again in the future. Adverse effects associated with stocking of nonnative fish vary with the species and whether that species is highly predatory or can survive long-term (see discussion of adverse effects to covered aquatic species associated with the presence of nonnative species earlier in this section). Particularly harmful species that may be stocked in the future include flathead or channel catfish, green sunfish, and largemouth and smallmouth bass because of their aggressive behaviors. Other species, such as rainbow trout, pose less significant threats to covered aquatic species because rainbow trout are not expected to survive year-round within the action area, are generally considered to have lower levels of piscivory, and may be a source of prey for narrow-headed gartersnakes and, potentially, Mexican gartersnakes. It is important to note that while stocking of nonnative species is anticipated to continue to occur throughout the action area, the fish community throughout the action area has self sustaining populations of many nonnative fish species that are not associated with reservoir operations. We expect these nonnative populations to persist into the future and continue to adversely affect covered fish species in various degrees, in various areas, over the life of the permit.

Mitigation Areas

Increasing development along rivers encompassing the mitigation areas is likely to have significant impacts on the covered bird species and their habitat. Habitat fragmentation can have direct impacts including mortality and overall changes in habitat suitability that can further reduce the carrying capacity of a particular area. Increased development also has the secondary impact of increasing predatory pets (e.g., cats). Increases or changes in the types of potential cowbird foraging sites (e.g., bird feeders, corrals, and stockyards) may increase the potential for cowbird parasitism of local flycatchers. Increased human disturbance, including recreational use of the river floodplains, particularly by off-highway vehicles or river floaters, may also adversely impact riparian habitat. Wildfires also destroy riparian habitat. In addition, the diversion of surface and ground water pumping may result in reduced river flows, which, in turn, would result in decreased habitat quality and quantity.

Consideration of Effects of the Proposed Action, Taken Together With Cumulative Effects

Loss or degradation of suitable habitat for flycatchers, bald eagles, and cuckoos is likely to continue inside and outside of the action area. Under the proposed Optimum Operation of Horseshoe and Bartlett, there would be no significant adverse cumulative effects on bald eagles because there is no anticipated significant adverse impact to eagles, their habitat, or their prey base. However, if eagles nest within the pool of the reservoirs, adaptive management (rescue of eggs or young, or construction of alternate nest structure) would be used to fully offset potential impacts. Periodic inundation of habitat at Horseshoe would result in occasional loss of available habitat and productivity for flycatchers and cuckoos. Over the long term, flycatcher and cuckoo habitat is likely to expand and be maintained by periodic inundation. The effects of the proposed Optimum Operation of Horseshoe and Bartlett, taken together with the cumulative effects of other actions described above, could result in the periodic loss of habitat availability. However, the acquisition and management of suitable riparian habitat under the HCP would compensate for this periodic loss of habitat availability. With full implementation of these conservation measures, the proposed action would not add appreciably to the regional cumulative effects because mitigation measures would be implemented. In addition, riparian habitat in the Verde watershed is likely to benefit from the watershed management efforts taken by SRP to offset impacts on native fishes, which would reduce the overall cumulative effects of other activities.

The effects of the proposed Optimum Operation of Horseshoe and Bartlett, taken together with the cumulative effects of other actions described above, could adversely impact the populations of covered native fish, frog, and gartersnake species. However, implementation of the minimization and mitigation measures that would be implemented under the HCP is expected to more than fully offset the impact from continued reservoir operations, and would provide for recovery opportunities for covered fish, frog, and gartersnake species.

CONCLUSIONS

Southwestern Willow Flycatcher

After reviewing the current status of the southwestern willow flycatcher, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the southwestern willow flycatcher or result in adverse modification of its designated critical habitat. We present our no-jeopardy, no-adverse modification conclusion for the following reasons:

1. Although issuance of an incidental take permit and associated effects of operating Horseshoe and Bartlett dams and implementing a mitigation and minimization program could have short-term adverse effects to the flycatcher, in the long term, the species is expected to benefit significantly, because the baseline condition at Horseshoe Reservoir will improve due to more targeted management objectives that promote the maintenance and creation of suitable nesting habitat, and the species will receive further conservation benefits through the acquisition, protection and permanent management of habitat in mitigation areas on the Verde, Gila and/or other rivers.

2. The anticipated adverse effects to flycatchers at Horseshoe Reservoir will be of short duration throughout the life of the permit. In addition, flycatchers that are unable to nest at Horseshoe Reservoir due to unavailability of habitat may nest elsewhere in the Verde Unit in the future.

3. Proposed land acquisition and management for the flycatcher (200 acres, up to 400 acres with adaptive management) will occur primarily within large river systems and large habitat patches, and will be complemented by other ongoing riparian conservation efforts in the same areas as well as protection of water supply for those lands. Habitat acquired or restored as mitigation will be managed in perpetuity for the benefit of the flycatcher.

4. SRP has committed to mitigate 200 acres of occupied habitat that is unavailable, modified, or lost on average at Horseshoe. If we have underestimated the potential impacts of reservoir operation on occupied flycatcher habitat, SRP has committed to adaptive management to mitigate loss of up to twice that amount by acquiring and managing in perpetuity up to an additional 200 acres of suitable habitat to contribute to the conservation and recovery of this species.

5. We anticipate the quantity of nesting habitat that currently occurs, or could potentially occur, within Horseshoe Reservoir and upstream in the Verde Valley, is sufficient to meet the recovery goals outlined for the Verde Recovery Unit as prescribed in the flycatcher recovery plan (USFWS 2002a).

6. Mitigation proposed in the HCP is consistent with the flycatcher recovery plan.

7. The minimization and mitigation measures provided by the proposed action provide a net conservation benefit to the species.

Bald Eagle

After reviewing the current status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the bald eagle. No critical habitat has been designated for the bald eagle, thus none will be affected. We present our no-jeopardy conclusion for the following reasons:

1. In the event that an occupied bald eagle nest is threatened or becomes inundated within the conservation space of Horseshoe Reservoir there remains a variety of alternate nesting opportunities outside the conservation space but within the Horseshoe Territory that could be used by reproducing bald eagles.

2. The Horseshoe Territory has persisted for 32 years with inundation events occurring throughout the history of this territory.

3. Although issuance of an incidental take permit and associated effects of operating Horseshoe or Bartlett reservoirs may indirectly result in drowning risk to eggs or nestlings, damage or elimination of one or more nests, or injury or death to eagles that prefledge into open water over the life of the permit, SRP has proposed effective management and emergency measures to rescue eggs or nestling bald eagles, should they be necessary, thereby minimizing these impacts.

4. Proposed stocking of native fish species throughout the action area is expected to enhance the bald eagles foraging success by offering sufficient prey species that are available during various seasons of year, specifically with respect to potential stocking of razorback, desert, and Sonora suckers. The proposed action is likely to be an improvement over the current baseline, because of the mitigation proposed.

5. We will make a good faith effort to work with management entities and other partners within the action area to implement riparian restoration and/or provide alternative nesting or roosting opportunities should trees that are currently being used by eagles for these purposes be affected over the life of the permit.

Aquatic Species

After reviewing the current status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects pertaining to each of the covered aquatic species it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of Gila topminnow, spikedace, loach minnow, Colorado pikeminnow, razorback sucker, roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, or northern Mexican gartersnake, or result in adverse modification of designated critical habitat for the razorback sucker. We present our no-jeopardy, no-adverse modification conclusion for the following reasons:

1. Proposed operation of Horseshoe Dam stresses the importance of the earliest and most rapid drawdown of water annually and the maintenance of minimum pool conditions when operational, weather-based, or objective-driven conditions permit. This will reduce the foraging, reproduction, and recruitment benefits to nonnative species which is expected to result in improved habitat for covered aquatic species. It is anticipated that the greatest beneficial effect from operational objectives will be observed within Horseshoe Reservoir itself and the reach of the Verde River immediately upstream; both areas are designated as razorback critical habitat.

2. Improvements to the Bubbling Ponds fish hatchery will provide significantly greater opportunities to produce more native fish. The production of a varied array of native species could potentially include head-starting opportunities for lowland leopard frogs or either gartersnake species, although head-starting of covered herps is not a formal component of the proposed action. In addition to expected increases in production, additional habitat may be created for northern Mexican gartersnakes at the hatchery complex.

3. Financial support for stocking of razorback sucker and other native fish will expand the ongoing efforts by AGFD and others to reintroduce and maintain viable populations of the covered species.

4. Construction of a fish barrier on Lime Creek, a tributary to Horseshoe will provide protection for native fish populations and lowland leopard frog upstream of the barrier.

5. SRP has also proposed mitigation activities in the form of watershed management measures that will assist in maintaining suitable flow within the Verde watershed. This type of mitigation is particularly important because one of the largest threats facing the biotic community within the Verde watershed is the increasing demand for water spurred by forecasted regional population growth and current and long-term drought conditions.

6. Should native fish stocking or other activities proposed as mitigation under the proposed action not achieve expected results, SRP has proposed such measures as physical removal of nonnative species from the action area and other alternatives as adaptive management.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. Harm is further defined by the USFWS 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 USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take of a listed animal species that is incidental to, and not the purpose of, the carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of sections 7(b)(4) and 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by us 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. We have a continuing duty to regulate the activity covered by this incidental take statement. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the proposed Horseshoe and Bartlett HCP, associated reporting requirements, and provisions for disposition of dead or injured animals are described in detail in ERO (2008) and its accompanying section 10(a)(1)(B) permit.

Southwestern Willow Flycatcher

We use acres of occupied habitat anticipated to be unavailable, modified, or lost on average in any given year as a result of the proposed action over the term of the permit (50 years) as a surrogate to quantify take of flycatchers. An estimate of the number of flycatchers taken by effects on this habitat is presented in the Effects of the Proposed Action.

We anticipate that flycatchers occupying a weighted average of 200 acres of habitat may be taken annually as a result of the operation of Horseshoe Dam. Within this acreage, flycatchers may be harmed as a result of inundation of habitat, injured or killed if trees fall causing eggs or nestlings to drown. Flycatchers may be harassed due to unavailability of habitat due to inundation.

Harm. Flycatchers may attempt to nest in suboptimal habitats at Horseshoe, may relocate, or may die. Nest productivity is expected to decline to a certain degree in years when Horseshoe Reservoir levels remain high throughout the nesting season but are expected to recover in subsequent years when habitat is made available.

Flycatcher eggs and nestlings could also be injured or killed by high reservoir levels that inundate and undermine the base of nest trees. These trees may fall during storms or high winds, causing eggs and nestlings to drown.

Harassment. High water levels at Horseshoe Reservoir are expected to periodically cause harassment of flycatchers due to the temporary unavailability or modification of habitat.

No incidental take is anticipated to the flycatcher in the action area other than Horseshoe Reservoir.

EFFECT OF THE TAKE

In this biological opinion, we find that the level of take anticipated is not likely to jeopardize the continued existence of the southwestern willow flycatcher. The reasons for this conclusion are the same as described under "Conclusions", above.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The permittee's HCP (ERO 2008) contains all measures necessary to minimize incidental take to the maximum extent practicable. No additional reasonable and prudent measures or terms and conditions are necessary.

MIGRATORY BIRD TREATY ACT

The Incidental Take Permit that is the subject of this opinion shall constitute a Special Purpose Permit under 50 C.F.R. § 21.27 for take of flycatchers in the amount and subject to the terms and conditions specified in the permit, the Implementing Agreement, and the habitat conservation plan. We will not refer the incidental take of any migratory bird, including the flycatcher, for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712) if such take is in compliance with all conservation measures described in the proposed HCP, together with the terms and conditions described in the associated Implementing Agreement and section 10(a)(1)(B) permit.

Bald Eagle

AMOUNT OR EXTENT OF INCIDENTAL TAKE

We anticipate that the proposed action will result in incidental take, in the form of harm, of all bald eagles that may nest or use perch trees within Horseshoe Reservoir, in conjunction with the permitted activity and over the life of the permit. Harm is expected due to inundation of nest trees.

Additionally, we anticipate incidental take in the form of harm and/or harassment of no more than 10 eggs, nestlings, or fledgling bald eagles over the life of the permit in conjunction with the permitted activity, resulting from a maximum of 5 nest inundations over the life of the permit, which cause: 1) drowning of eggs, nestlings or young eagles that prefledge into open water; and/or 2) rescue attempts of nestlings or eggs as a result of inundation risks to nests constructed in the conservation space in Horseshoe Reservoir.

No incidental take is anticipated in the action area outside of Horseshoe Reservoir.

EFFECT OF THE TAKE

In this biological opinion, the Service finds that the level of take anticipated to bald eagles is not likely to jeopardize the continued existence of the bald eagle. The reasons for this conclusion are the same as described under "Conclusions", above.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

ERO (2008) contains all measures necessary to minimize incidental take of covered species to the maximum extent practicable. No additional reasonable and prudent measures or terms and conditions are needed.

REGULATORY COVERAGE FOR INCIDENTAL TAKE OF BALD EAGLES IF DELISTED

There is no currently existing mechanism within the Bald and Golden Eagle Protection Act or Migratory Bird Treaty Act to allow for incidental take of bald eagles. However, we believe the measures required to cover the bald eagle under the proposed incidental take permit, its associated implementing agreement, and the Horseshoe and Bartlett HCP are sufficient to protect the species relative to the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act standards of preservation of the species. Thus, take currently authorized under this incidental take permit is inherently "compatible with the preservation of the bald and golden eagle" as required by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

The FWS realizes that some birds may be “taken” even if all reasonable measures to protect them are used [take is defined in the Bald and Golden Eagle Protection Act as pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb (16 U.S.C. §§ 668-668) – take is also defined in the Migratory Bird Treaty Act as “to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird" (16 U.S.C. §§ 703)]. The FWS Office of Law Enforcement carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and industries that have enacted programs to minimize their impacts on migratory birds, and by encouraging others to enact such programs. Unless a *taking* is specifically authorized, it is not possible to absolve individuals, companies, or agencies from liability even if they implement avian mortality avoidance or similar conservation measures. However, the Office of Law Enforcement focuses its resources on investigating and prosecuting individuals and companies that take migratory birds without regard for their actions or without following agreements such as those described above.

Gila Topminnow, Spikedace, Loach Minnow, Colorado Pikeminnow, and Razorback Sucker

We use the number of stream miles that are reasonably certain to be affected as a result of the proposed action over the term of the permit as a surrogate to quantify take of Gila topminnow, spikedace, loach minnow, Colorado pikeminnow, and razorback sucker. This surrogate figure was developed after review of a myriad of activities that currently occur, and are expected to continue occurring into the future, all of which contribute to adverse effects to Gila topminnow, spikedace, loach minnow, Colorado pikeminnow, and razorback sucker. While reservoir operations contribute to these adverse effects, they are not solely responsible. Therefore, we ascribed a weighted percentage of effects that could be reasonably attributed to reservoir operations throughout the action area and multiplied those percentages by the number of stream miles associated with each reach.

We anticipate that 33.9 stream miles will be adversely affected by the proposed action, specifically as a result of individuals either passing through the outlet works of Horseshoe or Bartlett dams, or as a result of predation from and competition with nonnative species that benefit from the reservoirs within the action area over the life of the permit.

Harm. All age classes of Gila topminnow, spikedace, loach minnow, Colorado pikeminnow, and razorback sucker covered under this permit may become injured or killed as a result of stranding in pools or passage through the outlet works of Horseshoe and Bartlett dams, or predation by nonnative fish species, or their progeny. Additionally, Gila topminnow, spikedace, loach minnow, Colorado pikeminnow, and razorback sucker may starve, or have reduced reproduction success as a result of indirect competition from nonnative fish.

We anticipate incidental take of Gila topminnow, spikedace, loach minnow, Colorado pikeminnow, and razorback sucker to occur throughout the action area over the life of the permit.

EFFECT OF THE TAKE

In this biological opinion, we find that the level of take anticipated is not likely to jeopardize the continued existence of Gila topminnow, spikedace, loach minnow, Colorado pikeminnow, and razorback sucker or result in the adverse modification of razorback critical habitat. The reasons for this conclusion are the same as described under “Conclusions”, above.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

ERO (2008) contains all measures necessary to minimize incidental take to the maximum extent practicable. No additional reasonable and prudent measures or terms and conditions are necessary.

CONFERENCE OPINION

Western Yellow-billed Cuckoo

CONCLUSION

After reviewing the current status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our conference opinion that the proposed action is not likely to jeopardize the continued existence of the western yellow-billed cuckoo. No critical habitat has been proposed for the cuckoo, thus none will be affected. We present our no-jeopardy conclusion for the following reasons:

1. Although issuance of an incidental take permit and associated effects of operating Horseshoe and Bartlett dams and implementing a mitigation and minimization program could have short-term adverse effects to the cuckoo, in the long term, the cuckoo is expected to benefit significantly. Baseline condition at Horseshoe Reservoir will improve due to more targeted management objectives that promote the maintenance and creation of suitable nesting habitat, and the species will benefit from conservation measures in the form of acquisition, protection and permanent management of mitigation habitat on the Verde, Gila and/or other rivers.

2. The anticipated adverse effects to cuckoos at Horseshoe Reservoir are of short duration throughout the life of the permit. In addition, cuckoos that are unable to nest at Horseshoe Reservoir do to unavailability of habitat may nest elsewhere in the Verde Unit in the future.

3. Proposed land acquisition and management for the cuckoo (200 acres, up to 400 acres with adaptive management) would occur primarily within large river systems and large habitat patches, and will be complemented by other ongoing riparian conservation efforts in the same areas as well as protection of water supply for those lands. Habitat acquired or restored as mitigation will be managed in perpetuity for the benefit of the cuckoo.

4. SRP will mitigate for 200 acres of occupied habitat that is unavailable, modified or lost on average at Horseshoe. We estimate that on average, 200 acres will be affected or rendered unavailable for use in years when effects occur. If we have underestimated the potential impacts of reservoir operation on occupied cuckoo habitat, SRP has proposed adaptive management to mitigate loss of up to twice that amount by acquiring and managing in perpetuity up to an additional 200 acres of suitable habitat to contribute to the conservation of this species.

5. The minimization and mitigation measures provided by the proposed action provide a net conservation benefit to the species.

AMOUNT OR EXTENT OF INCIDENTAL TAKE

We use acres of suitable or occupied habitat anticipated to be unavailable, modified, or lost on average in any given year as a result of the proposed action over the term of the permit as a surrogate to quantify take of cuckoos. An estimate of the number of cuckoos taken by effects on this habitat is presented in the Effects of the Proposed Action.

We anticipate that cuckoos occupying a weighted average of 200 acres of habitat may be taken annually as a result of the operation of Horseshoe Dam. Within this acreage, cuckoos may be harmed as a result of inundation of habitat, injured or killed if trees fall causing eggs or nestlings to drown. Cuckoos may be harassed due to unavailability of habitat as a result of inundation.

Harm. Harmed cuckoos may attempt to nest in suboptimal habitats at Horseshoe Reservoir, may relocate, or may die. Nest productivity is expected to decline to a certain degree in years when Horseshoe Reservoir levels remain high throughout the nesting season but are expected to recover in subsequent years when habitat is made available.

Cuckoo eggs and nestlings could also be injured or killed by high reservoir levels that inundate and undermine the base of nest trees. These trees may fall during storms or high winds, causing eggs and nestlings to drown.

Harassment. High water levels at Horseshoe Reservoir are expected to periodically cause harassment of cuckoos due to temporary unavailability or modification of habitat.

No incidental take of cuckoos is anticipated in the action area outside of Horseshoe Reservoir.

EFFECT OF THE TAKE

In this conference opinion, we find that the level of take anticipated is not likely to jeopardize the continued existence of the cuckoo. The reasons for this conclusion are the same as described under "Conclusions", above.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The ERO (2008) contains all measures necessary to minimize incidental take to the maximum extent practicable. No additional reasonable and prudent measures or terms and conditions are necessary.

MIGRATORY BIRD TREATY ACT

If the yellow-billed cuckoo is listed as threatened or endangered, the Incidental Take Permit that is the subject of this opinion shall constitute a Special Purpose Permit under 50 C.F.R. § 21.27 for take of cuckoos in the amount and subject to the terms and conditions specified in the permit, the Implementing Agreement, and the habitat conservation plan. Any such take will not be in violation of the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712). Prior to listing as threatened or endangered, we will not refer the incidental take of any migratory bird, including the cuckoo, for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712) if such take is in compliance with all conservation measures described in the proposed HCP, together with the terms and conditions described in the associated Implementing Agreement and section 10(a)(1)(B) permit.

Roundtail Chub, Sonora Sucker, Desert Sucker, Longfin Dace, Speckled Dace, Lowland Leopard Frog, Narrow-headed Gartersnake, and Northern Mexican Gartersnake

We use the number of stream miles that are reasonably certain to be affected as a result of the proposed action over the term of the permit as a surrogate to quantify take of roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, and northern Mexican gartersnake. This surrogate figure was developed after review of a myriad of activities that currently occur, and are expected to continue occurring into the future, all of which contribute to adverse effects to roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, and northern Mexican gartersnake. While reservoir operations contribute to these adverse effects, they are not solely responsible. Therefore, we ascribed a weighted percentage of effects that could be reasonably attributed to reservoir operations throughout the action area and multiplied those percentages by the number of stream miles associated with each reach.

We anticipate that 33.9 stream miles will be adversely affected by the proposed action, specifically as a result of individuals either passing through the outlet works of Horseshoe or Bartlett dams, or as a result of predation from and competition with nonnative species that benefit from the reservoirs within the action area over the life of the permit.

Harm. All age classes of roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, and northern Mexican gartersnake covered under this permit may become injured or killed as a result of stranding in pools or passage through the outlet works of Horseshoe and Bartlett dams, or predation by nonnative fish species, or their progeny. Additionally, roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, and northern Mexican gartersnake may starve, or have reduced reproduction success as a result of indirect competition from nonnative fish.

We anticipate incidental take of roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, and northern Mexican gartersnake to occur throughout the action area over the life of the permit.

EFFECT OF THE TAKE

In this biological opinion, we find that the level of take anticipated is not likely to jeopardize the continued existence of roundtail chub, Sonora sucker, desert sucker, longfin dace, speckled dace, lowland leopard frog, narrow-headed gartersnake, and northern Mexican gartersnake. The reasons for this conclusion are the same as described under "Conclusions", above.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

ERO (2008) contains all measures necessary to minimize incidental take to the maximum extent practicable. No additional reasonable and prudent measures or terms and conditions are necessary.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to utilize their authorities to further the purposes of the Act 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 critical habitat, to help implement recovery plans, or to develop information on listed species. The recommendations provided here do not necessarily represent complete fulfillment of our section 2(c) or 7(a)(1) responsibilities for the covered species addressed within this biological opinion. We have no further conservation recommendations.

DISPOSITION OF DEAD OR INJURED LISTED ANIMALS

Disposition of dead or injured listed animals will be addressed in the terms and conditions of the section 10(a)(1)(B) incidental take permit.

REINITIATION NOTICE

This concludes formal consultation on our proposed issuance of an incidental take permit to SRP for operation of Horseshoe and Bartlett dams in Maricopa County, Arizona. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation, if it is determined that the impact of such taking will cause an irreversible and adverse impact to the species. If we may be of further assistance in this matter, please contact Jeff Servoss (x237) or Debra Bills (x239) of my staff.

/s/ Steven L. Spangle

cc (compact disc):
- Director, Arizona Game and Fish Department, Phoenix, AZ
- Regional Supervisor, Arizona Game and Fish Department, Mesa, AZ
- Regional Supervisor, Arizona Game and Fish Department, Flagstaff, AZ
- Forest Supervisor, Tonto National Forest, Phoenix, AZ
- Forest Supervisor, Prescott National Forest, Prescott, AZ
- Forest Supervisor, Coconino National Forest, Flagstaff, AZ
- Project Leader, Fisheries Resource Office, Pinetop, AZ
- Director, Arizona Department of Water Resources, Phoenix, AZ
- John Sullivan, Associate General Manager, Salt River Project, Phoenix, AZ
- Frank Fairbanks, City Manager, City of Phoenix, AZ

cc (hard copy):
- President, Fort McDowell Yavapai Nation, Fountain Hills, AZ
- President, Salt River Pima-Maricopa Indian Community, Scottsdale, AZ
- Governor, Gila River Indian Community, Sacaton, AZ
- Chairman, Yavapai-Apache Nation, Camp Verde, AZ

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