United States Department of the Interior
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In Reply Refer To:
AESO/SE
2-22-99-F-016R
000089ROR
2-21-92-F-500R
2-21-94-F-239R
2-21-92-F-404R
2-21-96-F-058R
2-21-01-F-124R
2-21-01-F-293
2-21-01-F-294
2-21-01-F-295
2-21-01-F-296

September 30, 2002

Mr. Jim Golden
Forest Supervisor
Coconino National Forest
2323 East Greenlaw Lane
Flagstaff, Arizona 86004-1810

Dear Mr. Golden:

This letter constitutes the U.S. Fish and Wildlife Service's biological opinion (BO) on the possible effects of on-going grazing activities on eight livestock grazing allotments and one sheep driveway. This BO evaluates the effects of the actions on loach minnow (*Tiaroga cobitis*) and spikedace (*Meda fulgida*) and their designated critical habitat, in accordance with section 7 consultation under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) and regulations at 50 CFR 402. No other listed species or critical habitat is evaluated in this biological opinion; the Forest Service has conducted separate consultations to achieve section 7 compliance for effects of the proposed action on other listed species.

The Forest Service made a determination that the on-going grazing "may affect" loach minnow and spikedace critical habitat. In a letter dated July 31, 2001, we informed you that we would consider the effects of your proposed action on the spikedace and loach minnow as well.

The proposed action includes the following livestock allotments and sheep driveway. In future correspondence on these projects please refer to the consultation numbers listed below:

- Thirteen Mile Rock (2-21-01-F-124R; 2-22-99-F-016)
- Apache Maid (2-21-92-F-500R)
- Beaver Creek (2-21-01-F-293; 000089RO)
- Buckhorn (2-21-01-F-294; 000089RO)
- Hackberry/Pivot Rock (2-21-01-F-295; 000089RO)
- Fossil Creek (2-21-01-F-296; 000089RO)
- Walker Basin (2-21-94-F-239R)
- Windmill (2-21-92-F-404R)
- Beaverhead/Grief Hill Driveway (2-21-96-F-058R)

This biological opinion is based on the information provided in the March 30, 2001, biological assessments (BA) for each allotment; our June 27, 2001 field visit to the Beaver Creek, Thirteen-mile Rock, and Hackberry Allotments; our meeting on August 14, 2001 with Jerry Bradley, range conservationist for the Beaver Creek/Sedona Ranger Districts; your comments on the November 2, 2001 draft BO; data in our files; and other sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern or the effects of livestock grazing and other subjects considered in this opinion. A complete administrative record of this consultation is on file in this office.

Consultation History

Table 1. Summary of the history of this consultation.

DATE	EVENT
January 25, 2001	Informal consultation initiated with interagency meeting.
April 2, 2001	We received your March 30, 2001 request for formal consultation.
May 16, 2001	We notified the Forest Service of our intent to issue a final biological opinion by August 4, 2001.
July 31, 2001	We requested a 60-day extension on completing the consultation.
August 14, 2001	We received verbal concurrence with our extension request.
October 9, 2001	We requested an additional 30-day extension.
October 12, 2001	30-day extension granted by FS and applicants.
November 2, 2001	Draft BO provided to FS.
March 11, 2002	We received the FS' comments on the draft BO.

Table 2. Summary of consultation history for effects on spikedace and loach minnow on each allotment and the sheep driveway.

ALLOTMENT	DATE	EVENT
Thirteen Mile Rock	March 30, 1998	FS requested informal consultation on spikedace and loach minnow as part of Regional Ongoing Grazing Consultation.
	December 13, 1999	Informal consultation concluded; allotment covered under section 7 through spring 2001.
	May, 2000	Formal consultation requested on spikedace and loach minnow critical habitat. No record that this consultation was completed.
Apache Maid	1995	FS made a "no effect" determination on loach minnow and spikedace. No consultation conducted.
Beaver Creek	June 6, 1996	FS made a "no effect" determination on loach minnow and spikedace. No consultation conducted.
	March 30, 1998	FS submitted this allotment to Regional Grazing Consultation team, which concurred with FS' "may affect, not likely to adversely affect" determination.
Buckhorn	March 30, 1998	FS submitted this allotment to Regional Grazing Consultation team, which concurred with FS' "may affect, not likely to adversely affect" determination.
Hackberry/Pivot Rock	March 30, 1998	FS submitted this allotment to Regional Grazing Consultation team, which concurred with FS' "may affect, not likely to adversely affect" determination.
Fossil Creek	March 25, 1995	FS made a "no effect" determination on loach minnow and spikedace. No consultation conducted.
	March 30, 1998	FS submitted this allotment to Regional Grazing Consultation team, which concurred with FS' "may affect, not likely to adversely affect" determination.

Walker Basin	March 30, 1998	FS submitted this allotment to Regional Grazing Consultation team, which concurred with FS' "may affect, not likely to adversely affect" determination. However, we have no record of this concurrence.
Windmill	June 6, 1995	Formal consultation completed for spikedace.
	October 27, 1997	We concurred with FS' "may affect, not likely to adversely affect" determination.
Beaverhead Grief Hill Driveway	November 7, 1995	FS made a determination of "may affect, not likely to adversely affect" based on compliance with conditions we had concurred with in May, 1995.

BIOLOGICAL OPINION

Description of Proposed Action

The action area considered in this consultation includes all areas affected directly or indirectly by the Federal action. Thus, the action area may be larger than the area of the proposed project because impacts may be carried downstream with flows and may also affect upstream areas. For the proposed project, the action area includes the Verde River mainstem from five miles upstream of the confluence of Sycamore Creek (Mormon Pocket area), downstream to a point 25 miles below the confluence of Verde River and Fossil Creek. Included within this action area are all perennial and non-perennial tributaries of the Verde River within the area described above, including Oak, Beaver/Wet Beaver, West Clear, and Fossil creeks, and the uplands that drain into these and the Verde River.

Specifics of the proposed action for each allotment and the sheep driveway, as provided by the Forest Service, are discussed below.

Thirteen Mile Rock Allotment

The Beaver Creek and Long Valley Ranger Districts of the Coconino National Forest propose to renew the livestock grazing permit for the Thirteen-mile Rock Allotment. The life of the permit is 10 years. The current grazing management was established in a 1987 Allotment Management Plan (AMP). The proposed AMP includes a plant phenology-based grazing strategy, a pattern of grazing use and permitted livestock numbers, and maintenance of existing range structures. Additionally, the AMP includes the addition of new range structures, soil and vegetation improvements, pinyon-juniper grassland maintenance, browse species maintenance and improvement, riparian vegetation monitoring and potential restoration at Cottonwood Spring, and general allotment monitoring. The AMP is described more specifically below.

- Maximum forage utilization levels would not exceed 40 percent average use within each pasture. This utilization level includes use by wildlife (e.g., elk). Livestock would be moved to the next pasture scheduled for grazing if the grazing use approaches 40 percent. Where livestock have access to West Clear Creek during the winter dormant period, a 20 percent or less utilization of woody species would be allowed if all three age classes of riparian vegetation are present. Only five percent use is allowed in riparian areas if the middle age class is absent.
- Livestock use would continue to be managed under the current plant phenology-based strategy with the graze-half/rest-half pattern in the high- and mid-elevation pastures and annual use in the low-elevation pastures. Pastures would be grazed for 20 days or less during the growing season and up to 60 days during the dormant season. The approximate duration of grazing for each pasture is planned during development of the annual operating plan (AOP) based on anticipated plant growth and resource needs; the actual duration of grazing could vary from the AOP schedule, depending on the actual plant growth stage encountered in each pasture.
- Wildlife breeding areas and key wintering habitat needs, soil conditions, and vegetative groundcover (plants and litter) would be specifically considered when planning annual livestock grazing use. During drought years, livestock would not be allowed to use pastures scheduled for rest that year.
- The Winter Unit would continue to be grazed for 60 days during the dormant season (January through February) each year until the proposed pasture-division fence is installed. When the division fence is complete, the grazing period would be reduced to approximately 30 days in each pasture during the dormant season. Existing livestock trails would be used to move livestock to the less steep country for grazing when livestock are moved into the Winter West Pasture in February.
- Livestock would be moved through the Winter West and Winter East Pastures during June within a maximum of 10 days using existing livestock trails. Livestock would be driven through the pasture and would not be allowed access to West Clear Creek.
- Livestock would be grazed in the Heifer Pasture for approximately 20 days in March. The two restricted access points to West Clear Creek would be used as the water sources for the herd during this grazing period. The herd would then be moved to the Wingfield Mesa group of five pastures.
- During June, livestock would be driven through the Heifer Pasture toward the summer grazing pastures over a maximum of five days. The main herd would move through the pasture in one to two days. The gates to the two restricted livestock access points on West Clear Creek would be closed during that time. If newborn calves cannot move through the pasture with the herd within the anticipated one to two-day move, the calves and their mothers would be allowed to stay for an additional two to three days while the remainder of the herd is moved through the Winter Unit(s). The gates to the water lanes would be opened while the calves and their mothers are allowed to stay in the Heifer Pasture. The calves and their mothers would be moved out of the Heifer Pasture to rejoin the main herd within three days.

- The Toms/Good Enough Pasture would be grazed every other year when the northern tier of pastures is being grazed to synchronize the graze-half/rest-half strategy with the four allotments to the north of the Thirteen-mile Rock Allotment.
- The Bob's and Cactus Pastures would not be grazed.
- Three of the four Wingfield Mesa pastures would be grazed under a rest-rotation strategy for 100 days each spring, with the sequence of use and rest altered each year among the pastures. The growth rate of cool season grasses would be monitored to determine the allowed length of the gazing period in each pasture.

No information was provided in the BAE for this allotment describing the specifics of range structure improvements, soil and vegetation improvements, or pinyon-juniper maintenance, nor about the frequency of monitoring in each pasture during use to ensure that utilization levels are not exceeded.

Summary of the Thirteen-mile Rock Allotment:

Period of Proposed Action: 10 years (through December 31, 2010).

Allotment Acres: 39,191 total; 30,931 acres of full and potential capacity range.

Permitted Use: 550 head cow/calf/heifer/bull; 6 horses.

Major Vegetation Types: Ponderosa pine; grassland; desert scrub.

Major Drainages/Riparian Waterways: Verde River; West Clear Creek; Toms Creek; Clover Creek; Meadow Canyon; Cottonwood Springs.

Type of Grazing System and Maximum Utilization: Year-round on allotment in three zones (winter, transition, summer); 24 pastures; winter pastures grazed with intensive deferred rest-rotation; summer and transition pastures grazed with singe herd, intensive rest-half/graze-half management strategy on alternative years; 40% utilization.

5th Code Watersheds: Fossil Creek; Horseshoe Reservoir; West Clear Creek.

Perennial and Non-perennial Streams: 6.4 miles perennial; 1.0 mile non-perennial riparian.

Range Condition and Trend: (1999) 15,384 acres poor condition and 3,612 acres fair condition; 71% of Parker three-step clusters have fair to poor range condition. The Forest Service indicates that this allotment is in a stable to upward trend.

Apache Maid Allotment

The current management for the Apache Maid Allotment was established in 1995. This is a large allotment that straddles the Mogollon Rim from the Verde River to the area southeast of Mormon Lake. The allotment has three grazing management areas: Winter Use Zone in the Verde Valley (3,300-foot elevation); the Transition Use Zone in the pinyon/juniper woodlands (5,500-feet elevation); and the Summer use Zone in the ponderosa pine type (7,000-foot elevation). Current management is intensive when compared to conventional standards. It is based upon the allotment's forage plant phenological growth and an intensive livestock-rotation system utilizing 37 pastures. This management strategy provides for grazing periods of approximately 20 days or less when plants are actively growing and approximately 30 days when plants are dormant.

Four key grazing-management criteria were employed with the implementation of the 1995 management decision for the allotment. These improved grazing-management criteria are:

1. The length of time livestock graze individual pastures during active plant growth periods is reduced from a variable 30-90 days or an over-all average of 48 days, down to a controlled maximum length of 20 days;

2. during the months of January to April when the forage plant growth is typically dormant, grazing periods would be reduced from 60 days to a maximum of 30 days;

3. the grazing period within the riparian pastures on Dry Beaver Creek is reduced from 60 days down to 20-25 days with total rest incorporated on half the riparian zone every other year, providing adequate rest to allow this important vegetative community time to establish, enhance, and sustain itself; and

4. rested pastures (half of the area) within the allotment's transition and summer use zones would not be grazed by livestock during alternate years; this guarantees rested pasture areas for use by wildlife species only.

Summary of the Apache Maid Allotment:

Period of Proposed Action: 5 years (through December 31, 2005) (permit expires).

Allotment Acres: 168,500 total.

Permitted Use: 1,045 head cattle; 600 yearlings.

Major Vegetation Types: Ponderosa pine; grassland; desert scrub.

Major Drainages/Riparian Waterways: Verde River; Oak Creek; Wet Beaver Creek; Dry Beaver Creek; Rarick Canyon.

Type of Grazing System and Maximum Utilization: Year-round on allotment in three zones (winter, transition, summer); 37 pastures; Intensive rotation system with use based on plant phenological growth; 50% utilization (Jerry Bradley, Sedona Ranger District, pers. comm.).

5th Code Watersheds: Wet Beaver Creek; Dry Beaver Creek; West Clear Creek; Oak Creek; Verde River.

Perennial and Non-perennial Streams: 10 miles perennial; 24 miles non-perennial.

Range Condition and Trend: (1992) Undesirable and downward trend. Riparian conditions on the allotment have improved following 1993 flooding, and riparian woody species are growing into early-intermediate size classes.

Beaver Creek Allotment

The current management for the Beaver Creek Allotment was established in 1996. This allotment also straddles the Mogollon Rim, extending 23 miles in length from Interstate 17 north of Rimrock to just south of Happy Jack. Elevations range from 3,600 feet to 7,639 feet. The allotment has three distinct management zones: Winter Use Zone in the Verde Valley (3,300-foot elevation); the Transition Use Zone in the pinyon/juniper woodlands (5,500-feet elevation); and the Summer use Zone in the ponderosa pine type (7,000-foot elevation).

This allotment was managed under a progressive rest-rotation system from the 1960s to 1991. This management resulted in fair to poor range conditions based on 1961 and 1977 range cluster transect data. The allotment was rested from permitted livestock grazing from 1992 through 1995. The 1996 Environmental Assessment for the Beaver Creek Allotment reduced permitted livestock numbers for a period of 5 years. This 5-year period allowed for installation of numerous structures (fences and watering sites) to improve livestock distribution and promote an intensive rest-rotation system (grazing periods are 20 days or less during active forage plant growing periods and 30 plus days during plant dormancy) that incorporates plant phenological growth criteria. In the Summer and Transition Use zones, one-half of the pastures within each area are completely rested from livestock grazing in alternate years to promote rested habitat for wildlife species.

The 1996 Decision Notice required certain portions of Wet Beaver Creek to be excluded from livestock grazing with use of creek-side water gaps at hardened (bank protected) sites to facilitate livestock watering. This management action was further strengthened through the 1998 On-going Grazing Consultation, where additional exclosure fences, cattleguards, and water gaps excluded the permitted livestock from over 10 miles Wet Beaver Creek's upper-reaches. This livestock exclosure restricts permitted livestock grazing from over 3,300 acres of Wet Beaver Wilderness, and an additional 1,000 acres of riparian habitat and its immediate uplands. Upper

Walker Creek, which forms the southern boundary of the Valley South (Bull) Pasture, is fenced to exclude livestock grazing except for a small (200 feet in stream length) water gap for livestock water during designated grazing periods.

Summary of the Beaver Creek Allotment:

Period of Proposed Action: 6 years (through December 31, 2006) (permit expires).

Allotment Acres: 60,600 total; 54,597 full and potential capacity.

Permitted Use: 550 cow/calf; 50 bulls on Lower and Upper White Mesa Pasture.

Major Vegetation Types: Ponderosa pine; grassland; desert scrub.

Major Drainages/Riparian Waterways: Wet Beaver Creek; Beaver Creek; Long Canyon; Walker Creek; Jacks Canyon; Brady Canyon; Red Tank Draw.

Type of Grazing System and Maximum Utilization: Year-round on allotment in three zones (winter, transition, summer); 26 pastures; intensive rotation system with use based on plant phenological growth criteria; 50% utilization (Jerry Bradley, Sedona Ranger District, pers. comm.).

5th Code Watersheds: Wet Beaver Creek; Dry Beaver Creek; West Clear Creek.

Perennial and Non-perennial Streams: 13 miles perennial; 23 miles non-perennial.

Range Condition and Trend: (1961 and 1977) Fair to poor range conditions with static trends. In 1992, Parker three-step clusters showed 73% of vegetation exhibiting static or upward trends.

<u>Buckhorn Allotment</u>

The current management for the Buckhorn Allotment was established in 1986 (Jerry Bradley, Sedona Ranger District, pers. comm.). A new 10-year permit was issued in 2000 which expires on December 31, 2009. This allotment extends for approximately 22 miles east and west along the Mogollon Rim. Buckhorn Allotment vegetation follows traditional elevation regimes, with ponderosa pine in the high elevations to grasslands and desert scrub at the low elevations. The allotment has three distinct management zones, the Winter Use Zone in the Verde Valley (3,800-5,400 foot elevation); the Transition Use Zone in the pinyon/juniper woodlands (5,400-6,500 foot elevation); and the Summer Use Zone in the ponderosa pine (6,500-6,900-foot elevation).

Bull Pen and Clear Creek pastures are within the West Clear Creek drainage and, when grazed, the livestock have direct access to the creek. These pastures were last grazed in 1994, and were both set aside from grazing until a new EA could be completed to officially address resource-use

conflicts for these two areas. Livestock cross the intermittent reach of Willow Valley, a tributary to West Clear Creek, twice each year during the late summer or fall season of use.

From the mid 1960s to 1990 this allotment was grazed under a conventional rest-rotation grazing system. The range conditions of the allotment following this 25 years of management strategy were determined to be 5% in very poor condition, 74% in poor condition, and 21% in fair condition with static trends. From 1990 to 1994 an intensive rest-deferred rotation grazing system (30 days of grazing when forage plants are dormant; 20 days or less during active growth periods) was initiated. This strategy of shorter grazing periods coupled with smaller pastures promoted improved grazing distribution and reduced overgrazing by domestic livestock.

Summary of the Buckhorn Allotment:

Period of Proposed Action: 9 years (through December 31, 2009 when permit expires).

Allotment Acres: 33,273 total; 25,176 full and potential capacity.

Permitted Use: 250 cow/calf; 22 bulls.

Major Vegetation Types: Ponderosa pine; grassland; desert scrub.

Major Drainages/Riparian Waterways: West Clear Creek; Willow Valley Draw; Long Valley Draw; Clover Creek; Hance Spring Exclosures.

Type of Grazing System and Maximum Utilization: year-round on allotment in three zones (winter, transition, summer); 22 pastures; itensive rotation system with use based on plant phenological growth criteria; 40% utilization (Jerry Bradley, Sedona Ranger District, pers. comm.).

5th Code Watersheds: West Clear Creek; Wet Beaver Creek.

Perennial and Non-perennial Streams: 4 miles perennial; 0.5 miles non-perennial.

Range Condition and Trend: (1960s-1990s) 74% poor, 21 % fair, 5% very poor, with static trends; (2000) 48% poor, 46% fair, 6% good, with upward trends.

<u>Hackberry/Pivot Rock Allotment</u>

The current management for the Hackberry/Pivot Rock Allotment was established in 1987, and in a subsequent amended 1989 AMP. This allotment ranges in elevation from 2,800 feet along the Verde River to over 7,600 feet along the Mogollon Rim. Livestock are managed under the principles of Holistic Resource Management, with livestock movement, control, and use directly tied to plant growth.

As an annual iteration of the AMP, the Annual Operating Instructions (AOI) specify pasture use and livestock numbers during a specific year. The AMP implements objectives for the allotment, which include improved watershed conditions through greater control of the livestock. The AMP, and thus the AOI, incorporate pasture rest from livestock grazing on an annual basis during the growing season in the winter/spring pastures, and within specified pastures in the summer/fall use areas.

The allotment is grazed as separate seasonal zones – the winter/spring area pastures (Sonoran desert scrub / pinyon-juniper) and the summer/fall area pastures (ponderosa pine). The AMP/AOI specify grazing all the winter/spring pastures (Hackberry portion of the allotment) from late October to late May. The summer/fall pastures (Pivot Rock portion of the allotment) are grazed from late May through late October. This grazing strategy, specified in the 2001 AOI, results in:

- complete rest from livestock grazing on three pastures in the summer/fall use areas (Baker, Huffer, and Potato);
- complete growing season rest or deferral in the winter/spring use area;
- pastures are grazed for short time periods (2 to 37 days), and most pastures are grazed once during the year, except when a lack of other access forces use of a previously grazed pasture as a pass-through to another pasture;
  growing season deferment on those summer/fall use pastures which are grazed by livestock during September and October.

Livestock management is tied directly to plant growth. When plants are in the dormant stage, grazing periods can be for as long as 2 months. During fast growth, most grazing periods are generally 20 days or less. These grazing periods reduce and/or eliminate the chance of overgrazing by domestic livestock.

In addition to the phenology-based management, in areas where there are two grazing ungulates in competition (cattle and elk), some pastures in the summer/fall area (Pivot Rock Management Unit) are rested every other year, while others are deferred through the growing season every year. This allows for livestock and rest to be used as tools to help manipulate elk grazing patterns. That is, elk move into areas grazed by livestock once plant regrowth starts attaining the highest plane of nutrition from the new plant growth. At the same time, the rested pastures contain enough old feed to discourage elk from grazing on the new plant growth in those pastures.

Fencing and topographic features prevent livestock from accessing the Verde River, which flows on the west side adjacent to the Hackberry management unit and is the allotment boundary. As a result of the fence construction along the Verde River, the allotment's permitted livestock are excluded from access to the Verde River, except for an emergency access for water. However,

the steep slopes on the allotment prevent an even distribution of grazing throughout individual pastures, resulting in disproportionate use of riparian areas and riparian pastures.

A short segment (1/4 mile) of fence was constructed in the Potato Pasture in 1999 that, with the exclosure constructed in 1997 and the existing watershed exclosure in Potato Draw, splits this Pasture into the North and South Potato pastures. This will simplify management and increase flexibility in the Pivot Rock Management Unit. A livestock exclosure was constructed around Potato Lake in 2000, tying in to the fence discussed above, and totally excluding livestock from Potato Lake. A livestock exclosure was constructed in the Potato pasture in 1997, which excludes livestock grazing in the headwaters of East Clear Creek. In addition, short sections of drift fence were constructed in 1997 in the Kehl and Clear Creek pastures, downstream from the Potato Pastures, which will prevent cattle access to East Clear Creek. A mile of fence separates the Kehl and Clear Creek pastures. This fence crosses East Clear Creek near the junction of Poverty Draw and East Clear Creek. Due to past improvements, cattle can now cross East Clear Creek in only one location.

Summary of the Hackberry/Pivot Rock Allotment:

Period of Proposed Action: 6 years (through December 31, 2006) (permit expires).

Allotment Acres: 80,314 total; 80,314 capable.

Permitted Use: 760 head.

Major Vegetation Types: Ponderosa pine; pinyon-juniper; desert scrub; pinyon-juniper/pine; pine/oak/juniper; pine/oak canyons; mixed conifer; mountain meadows; riparian.

Major Drainages/Riparian Waterways: Verde River; Towel Creek; Sycamore Creek; Deer Basin; Hackberry Creek.

Type of Grazing System and Maximum Utilization: Year-round on allotment in three zones (winter, transition, summer); 51 pastures; intensive rotation system with use based on plant phenological growth criteria; 50% utilization (Jerry Bradley, Sedona Ranger District, pers. comm.).

5th Code Watersheds: West Clear Creek; Horseshoe Reservoir; Fossil Creek.
Perennial and Non-perennial Streams: 18 miles perennial; 16 miles non-perennial.

Range Condition and Trend: Pivot Rock: (1962 to1983) 42% poor, 13% fair, <1% very poor; remainder rates as non-range and is closed to grazing; (1983) stable or upward trend in most transects; Hackberry: (1964 and 1967) majority of acres in poor and very poor condition; no range transect data to determine trend.

Fossil Creek Allotment

The current management for the Fossil Creek Allotment was established in 1991 and reviewed in 1995 to insure compliance with current standards. Extending above and below the Mogollon Rim, the allotment is 15 miles across from west to east. The Allotment's southern boundary is Fossil Creek proper, with the southern pastures extending to the banks of the Verde River. Elevations on the allotment range from 2,800 feet at the Verde River to 6,200 feet at the northeast corner near Salomon Lake.

The Fossil Creek Allotment's vegetation follows traditional elevation regimes, with ponderosa pine stringers in the high elevations to grasslands and desert scrub at the low elevations. The allotment has three distinct management zones, the Winter Use Zone in the Verde Valley (2,800-5,000 foot elevation); the Transition Use Zone in the pinyon/juniper woodlands (5,000-5,900 foot elevation) and the Summer Use Zone in the ponderosa pine (5,900-6,200-foot elevation). The allotment contains an estimated 340 acres of riparian habitat along several streamcourses.

The allotment's livestock are managed under the principles of Holistic Resource Management, with livestock movement, control, and use tied directly to plant growth. All pastures are grazed each year, with deferred rest. Pastures within the summer and winter ranges are rotated each year where each pasture is used at a different time of season when possible. This intensive management program, with its short-duration grazing periods, eliminates overgrazing and reduces the potential re-grazing of forage plants before full plant recovery occurs.

During the winter months of plant dormancy, the main herd grazes for approximately 35-40 days. There are 15-20-day grazing periods during active plant growth periods of the spring and summer months. Exceptions to these grazing periods do occur, particularly when dealing with small numbers of bulls and/or heifers during dormant growth periods (winter months), where grazing periods may extend from 60 to 90 days.

Livestock grazing occurs within riparian habitats during the dormant growing season within the Stehr Lake Pasture on a three-quarter mile portion of Fossil Creek and on the northeast side of Stehr Lake. To protect riparian habitat, sensitive stream conditions, and threatened, endangered, and sensitive species associated with the riparian area, grazing in the Stehr Lake Pasture occurs for only 15 days during January/February dormant growth periods. For the first time since the 15-day restriction has been imposed, cattle will rotate from Surge Tank to Boulder Pasture, trailing back through Stehr Lake Pasture. This trailing through Stehr Pasture is anticipated to occur over a 3- to 5-day period, with the majority of the herd moving within 1-2 days and the remnant numbers trailing over the next 2-3 days.

Following the 1998 Ongoing Grazing Consultation mitigation requirements, a Forest interdisciplinary team (including grazing permittee representatives) made an on-site evaluation of livestock access to Fossil Creek. The team found four access points for livestock entry to the creek. Two of the four access sites were fenced in December 1999 to protect the riparian habitat.

Summary of the Fossil Creek Allotment:

Period of Proposed Action: 5 years (through December 31, 2005); permit expires on December 31, 2001, but the Forest indicates they cannot complete the new AMP until sometime in 2005 (Jerry Bradley, Sedona Ranger District, pers. comm.).

Allotment Acres: 38,482 total.

Permitted Use: 477 cattle; 8 cattle and 5 horses under temporary permit.

Major Vegetation Types: Ponderosa pine; pinyon-juniper; desert scrub.

Major Drainages/Riparian Waterways: Verde River; Fossil Creek; Sally Mae Drainage; Boulder Creek; Sycamore Creek.

Type of Grazing System and Maximum Utilization: Year-round on allotment in three zones (winter, transition, summer); 18 pastures; intensive rotation system with use based on plant phenological growth criteria; 60-70% utilization (Jerry Bradley, Sedona Ranger District, pers. comm.).

5th Code Watersheds: Fossil Creek; Horseshoe Reservoir; West Clear Creek.

Perennial and Non-perennial Streams: 14 miles perennial; 38 miles non-perennial.

Range Condition and Trend: (1999) summer portion of allotment showed 78% of vegetation in good to fair conditions with upward trends. No data were provided on winter range.

<u>Walker Basin Allotment</u>

The current management for the Walker Basin Allotment was established in 1991. This allotment extends an estimated 30 miles east to west along the Mogollon Rim. The allotment's western boundary begins at the Town of Camp Verde and runs due east to Forest Highway 3, south of Happy Jack. Elevations range from to 3,100 feet in the Verde Valley to 7,352 feet at Hollingshead Butte located in the allotment's northeast corner.

Three riparian waterways are found adjacent to the allotment. The Verde River proper is only 1 to 2 miles east of the allotment's western boundaries. Wet Beaver Creek is adjacent to the allotment's northwestern pastures and it is not grazed, as all portions of the creek are excluded from permitted livestock. Upper Walker Creek forms the northern boundary of the Walker Basin Pasture. Upper Walker Creek is fenced to exclude livestock grazing, with the exception of a single small water gap for stock water.

Vegetation follows typical elevation regimes, with ponderosa pine in the high elevations to grasslands and desert scrub at the low elevations. The allotment has three distinct management zones, the Winter Use Zone in the Verde Valley (3,100-4,000 foot elevation); the Transition Use Zone in the pinyon/juniper woodlands (5,500-6,500 foot elevation); and the Summer Use Zone in the ponderosa pine (6,500-7,000-foot elevation).

Walker Basin was managed under a progressive rest-rotation grazing system from the mid 1960's to 1990. After 30 years of range resource management under this conventional grazing system, the range conditions of the allotment generally were classified as having static trends with poor to fair range conditions (1962 and 1970 data).

An intensive rest-deferred rotation grazing system (grazing periods are approximately 30 days when forage plants are dormant and 20 days or less during active growth periods) was initiated from 1990 through 1999. This strategy of shorter grazing periods coupled with smaller pastures promoted improved grazing distribution and reduced overgrazing by domestic livestock. In addition, one-half of the allotment's Summer and Transition Use zones were completely rested from livestock grazing to promote rested habitat for wildlife species.

The pastures that are grazed have an allowable grazing use of 50% or less on forage plants. The use half/rest half strategy was synchronized with the five adjacent allotments to further reduce livestock grazing conflicts. However, a concern of this management strategy was that the pastures grazed in September often received less than 30 days between first and second grazing periods as livestock rotated back through the same pastures, thus not allowing adequate times for forage regrowth and recovery from the first graze. Also, due to frost and cold temperatures, forage plants progressed into a slow plant growth or dormant condition. Even with a 2-year rest following this intensive use, these September pastures seemed to not recover well, particularly when drought conditions were prevalent. Consequently, the permittee requested that a 2-year (2000-01) trial period be given for a different grazing management strategy. The trial strategy entailed the same intensity and change to a total deferred pasture rotation system of management. Grazing utilization was set at 35 percent or less on all grazed pastures, and the phenological growth criteria were implemented. The Forest indicates that this trial strategy will continue to be used through 2005 (Jerry Bradley, Sedona Ranger District, pers. comm.)

A 1992 and 1999 range resource assessment of the Walker Basin Allotment found range conditions improved, as analysis of the Parker three-step clusters showed range conditions improving to fair to good with upward trends. The 1999 data summary found 67% of the clusters having good to fair range condition with upward trends, a significant improvement over previous cluster readings.

Summary of the Walker Basin Allotment:

Period of Proposed Action: 10 years (through December 31, 2010) (permit expires) **OR** when additional NEPA is completed on the allotment, whichever is sooner.

Allotment Acres: 86,785 total; 65,438 capable.

Permitted Use: 543 cow/calf (Jerry Bradley, Sedona Ranger District, pers. comm).

Major Vegetation Types: Ponderosa pine; pinyon-juniper; desert scrub.

Major Drainages/Riparian Waterways: Verde River; Wet Beaver Creek; Beaver Creek; Willow Valley; West Clear Creek.

Type of Grazing System and Maximum Utilization: Year round on allotment in three zones (winter, transition, summer); 32 pastures; intensive rotation system with use based on plant phenological growth criteria; 35% utilization through 2005 (Jerry Bradley, Sedona Ranger District, pers. comm.).

5th Code Watersheds: West Clear Creek; Wet Beaver Creek; Horseshoe Reservoir; Camp Verde.

Perennial and Non-perennial Streams: 4.3 miles perennial; 3 miles non-perennial.

Range Condition and Trend: (1999) 67% of Parker three-step 3-step clusters showed good to fair range condition.

Windmill Allotment

The current management for the southern portion of the Windmill Allotment was established in 1988. This allotment is located approximately 6 miles south and west of Flagstaff and angles southwest to the Verde River. It is adjacent to the communities of Munds Park, Village of Oak Creek, Sedona, Clarksdale, Cottonwood, Cornville, and associated communities.

The allotment is divided into three main herds with an additional winter bull herd. Each main herd will use a combination of winter and summer range areas. The Mill Park herd will use areas west of State Route 89A from Rodgers Lake to the Mogollon Rim in the summer and below the Mogollon Rim to the Verde River in the winter. The Munds-Pocket herd will use an area from the Munds Park area north along I-17 to James Canyon in the summer and southwest of Sedona and west of State Route 89A in the winter. The Foxboro herd will use an area south of Munds Park to the Woods Canyon area in the summer and an area southeast of Sedona and east of Oak Creek in the winter. The bull herd will use an area just north of Cornville. In addition, 160 head of cattle in the summer and 155 head in the winter are included from an Arizona State Land Department permit.

The allotment utilizes a rest-rotation and deferred rest-rotation system. The following paragraphs list the summer and winter grazing schedules for each herd unit. These grazing schedules are given as a guide to future use; however, these schedules may be adjusted to better meet the goals of this proposal because of monitoring, weather, etc. throughout the 10-year planned period. The

Annual Operating Plan is the document that may adjust livestock numbers, change season of use, and adjust pasture rest periods to respond to this new information.

The Mill Park summer herd would graze a maximum of 675 head of cattle from approximately June 9 to October 15. The cattle would run in a nine-pasture rest-rotation grazing system. Grazing periods would vary from four to 29 days. One or two pastures each year would receive year-long rest. Each large pasture would be rested at least once every five years.

The Munds-Pocket summer herd would graze a maximum of 250 head of cattle from approximately June10 to October 10. The cattle would run in a six-pasture rest-rotation grazing system. Grazing periods would vary from five to 45 days. One or two pastures each year would receive year-long rest. Each large pasture would be rested at least once every six years.

The Foxboro summer herd would graze a maximum of 250 head of cattle from approximately June12 to December 20. The cattle would run in a nine-pasture deferred-rotation grazing system. Grazing periods would vary from five to 60 days. The deferred grazing system would rotate the season of pasture use from year to year.

The Mill Park winter herd would graze a maximum of 675 head of cattle from approximately October15 to June 8. The cattle would run in a 13-pasture rest-rotation grazing system. Grazing periods would vary from three to 37 days. Three or four pastures each year would receive year-long rest. Each large pasture would be rested at least once every four years.

The Munds-Pocket winter herd would graze a maximum of 250 head of cattle from approximately October 9 to June 1. The cattle would run in a five-pasture rest-rotation grazing system. Grazing periods would vary from 12 to 81 days. One pasture each year would receive year-long rest. Each large pasture would be rested at least once every four years.

The Foxboro winter herd would graze a maximum of 250 head of cattle from approximately December 21 to June 11. The cattle would run in a six-pasture rest-rotation grazing system. Grazing periods would vary from two to 60 days. The deferred grazing system would rotate the season of pasture use from year to year.

Finally, a maximum of 100 bulls would graze with the cow herds except from October16 to March 1. Bull grazing would run in a two-pasture deferred-rotation grazing system. Grazing periods would vary from 56 to 60 days. The deferred grazing system would rotate the season of pasture use from year to year.

Wilderness areas will only be used as travel routes between summer and winter ranges. The Foxboro Herd uses the Jacks Canyon trail to travel through the Munds Mountain Wilderness. The Mill Park Herd uses the Mooney Mountain trail to travel through the Red Rock Secret Mountain Wilderness.

Utilization levels throughout the allotment will be up to 50% by cattle and/or elk, except in Mexican spotted owl protected activity centers (PACs). [Note: Effects to the Mexican spotted owl for the Windmill Allotment were addressed under consultation number 2-21-95-F-399; October 28, 1997.] Mexican spotted owl PAC utilization will be up to 40%. When pasture use in any area approaches 50% by cattle and/or elk, cattle will move to the next pasture in the rotation. If elk use exceeds 50% before cattle enter a pasture, cattle will skip that pasture and move to next pasture in the rotation. Adjustments in the AOPs would be made if grazing periods are adjusted more than one week.

The following range structural improvements have been completed or will be completed in 2002:

- A fence has been built at Mormon Crossing on Lower Oak Creek to limit cattle access (White Flat Pasture).
- In Fry Lake pasture, one-half mile of fence and one cattleguard have been built. This fence and cattleguard are designed to keep Windmill Allotment cattle from the majority of Fry Lake.
- Nine waterlot fences will be built around stock tanks in Barney East and Barney West pastures. These waterlots are designed to assist in cattle distribution and pasture gathering. At least two gates will be built on each waterlot. These gates will only be closed during short time periods when cattle are in these pastures, when needed for management.
- In the Rodgers Lake pasture the Forest Service will build one-quarter mile of fence and one cattleguard. This is designed to keep Windmill Allotment cattle from Rodgers Lake and the Fry Lake area.
- In the Jacks Point and Harding Point pastures, the Forest Service plans to build earthen roadside tanks which will improve cattle and wildlife distribution in these areas.
- The Forest Service plans to relocate an allotment boundary fence and a cattleguard near the Mogollon Rim on Schnebly Hill Road in the Schnebly pasture. One and one-half miles of fence will be removed. The cattleguard would be moved approximately ¼ mile west of its current location. One quarter of a mile of fence will be installed to tie into the new cattleguard location. This fence relocation will add approximately 202 acres of the old Sedona Allotment to the Schnebly Pasture of the Windmill Allotment.
- In the winter range between Skeleton Bone and Gyberg Pasture, the Forest Service will build one-quarter mile of pipeline and 1 drinker. The drinker will be in North Gyberg Pasture.
- In the Duff Flat Pasture, the Forest Service plans to build ¾ mile of pipeline with one drinker.

Summary of the Windmill Allotment:

Period of Proposed Action: 5 years (through December 31, 2005) **OR** when additional NEPA analysis is completed on the allotment, whichever is sooner.

Allotment Acres: 248,792 total; 54,300 capable.

Permitted Use: 1,097 cattle;160 cattle (summer) & 155 cattle (winter) (Arizona State Land Department); 3 herds plus winter bull herd.

Major Vegetation Types: Ponderosa pine; pinyon-juniper; desert scrub; desert grassland.

Major Drainages/Riparian Waterways: Verde River; Oak Creek; Spring Creek; Dry Beaver Creek.

Type of Grazing System and Maximum Utilization: Year-round on allotment with three herds; 44 pastures (Mike Hannemann, Peaks Ranger District, pers. comm); rest-rotation and deferred rest-rotation; 50% utilization cattle and/or elk; 40% utilization in MSO PACs.

5th Code Watersheds: Oak Creek; Dry Beaver Creek; Sycamore Canyon; Verde Valley.

Perennial and Non-perennial Streams: 5.5 miles perennial; 49 miles non-perennial.

Range Condition and Trend: Based on 2000 monitoring data, most areas are in poor to fair condition, with some in good condition. Trends are mostly static.

Best Management Practices/Monitoring: Grazing systems alternately rested and grazed in planned sequence; intensity that will protect soils and maintain or improve vegetation cover; stabilization and protection of streambanks; increased livestock distribution through providing watering facilities; fencing to control access to streams; monitoring and/or inventory of fish and stream habitat; utilization monitoring; permittee compliance monitoring and enforcement; pre-entry readiness inspections.

<u>Beaverhead/Grief Hill Driveway</u>

A 70-mile segment of the Beaverhead - Grief Hill Driveway is located on two National Forests (Coconino and Prescott). The Driveway starts at Badger Springs and crosses State and Bureau of Land Management lands before reaching the Prescott National Forest. The Driveway crosses onto the Coconino from the Prescott National Forest at the Verde River. The Driveway continues to the northeast to approximately the Coconino/Yavapai County boundary, and then heads north toward Flagstaff. Just south of Kachina Village, the Driveway heads northwest to the southwest corner of Camp Navajo, and then enters the Kaibab National Forest. The

Coconino and Prescott National Forest portion of the Driveway is long and averages one mile in width.

The Beaverhead - Grief Hill Driveway has been a sheep Driveway since 1884 when sheep were driven to and from summer range in the Flagstaff area in May and October/November, respectively. Each year from the 1920s until the early 1960s, more than 30,000 sheep traveled along this Driveway. The current term grazing permit for the Beaverhead - Grief Hill Driveway allows for grazing by 5,885 head of sheep in three bands from May 1 to May 31 as they are trailed across the Prescott and Coconino National Forests enroute to allotments on the Coconino and Kaibab National Forests. These three bands travel up the Driveway with an approximate one-day spacing between bands. The bands travel about three miles a day. Where possible, sheep are herded on the Driveway to one side or the other as they go up each year. Night bedding areas are specified along the entire length of the Driveway. Night bedding areas and midday rest stops are located away from water. Since 1995, sheep have not been allowed to bed or rest within one-quarter mile of riparian areas.

The Driveway passes through several existing grazing allotments of the Coconino National Forest. Wildlife grazing also occurs in this area.

Summary of the Beaverhead/Grief Hill Driveway:

Period of Proposed Action: 10 years (through December 31, 2010) **OR** when additional NEPA analysis is completed on the allotment, whichever is sooner.

Allotment Acres: Acres unknown; 70 miles long, 1 mile wide.

Permitted Use: 5,885 sheep in three bands.

Major Vegetation Types: Ponderosa pine; pinyon-juniper; desert scrub.

Major Drainages/Riparian Waterways: Verde River; Dry Beaver Creek; Pumphouse Wash; T-Six Canyon; Upper Volunteer Canyon; Bar M/Woods Canyon.

Type of Grazing System and Maximum Utilization: May 1 to May 31 trailing of sheep in three bands; permitted livestock carrying capacity on the Driveway is within current proper allowable forage use capabilities (BAE).

5th Code Watersheds: Sycamore Canyon; Oak Creek Canyon; Dry Beaver Creek; Camp Verde; Agua Fria.

Perennial and Non-perennial Streams: Not provided.

Range Condition and Trend: According to the 2001 ongoing grazing consultation, approximately 71 percent of this allotment is in fair condition, with the rest in good (11 percent), poor (11 percent) and very poor (7 percent). Trends are mostly static.

Best Management Practices/Monitoring: Permittee compliance monitoring and enforcement; range inspections; prohibition of sheep bedding in riparian areas and meadows; control of livestock activities with the objective to achieve soil cover.

Status of the Species

Loach minnow

The loach minnow was listed as a threatened species on October 28, 1986 (USFWS 1986a). Critical habitat was designated on April 25, 2000 (USFWS 2000). Critical habitat includes portions of the Verde, Black, middle Gila, San Pedro, San Francisco, Tularosa, Blue, and upper Gila rivers; and Eagle, Bonita, Tonto, and Aravaipa creeks and several tributaries of those streams. Most of the upper Verde River is designated critical habitat, and this critical habitat is located within and adjacent to the project area.

Constituent elements for both spikedace and loach minnow include such habitat components as permanent, flowing, unpolluted water; areas of slow to relatively swift flow velocities in shallow water; moderate to high instream cover; pool, riffle, run, and backwater components; low to moderate stream gradient; periodic flooding; abundant aquatic insect prey base; habitat devoid of nonnative fish; uncemented sand, gravel, and cobble substrates; low to moderate amounts of fine sediment and substrate embeddedness; a hydrograph that demonstrates an ability to support a native fish community; and water temperatures in the approximate range of 35-85° F (USFWS 2000).

The historical range of loach minnow included the basins of the Verde, Salt, San Pedro, San Francisco, and Gila rivers (Minckley 1973; Sublette et al. 1990). Habitat destruction plus competition and predation by nonnative species have reduced the range of the species by about 85 percent (Miller 1961; Williams et al. 1985; Marsh et al. 1989). The loach minnow remains in limited portions of the upper Gila, San Francisco, Blue, Black, Tularosa, and White rivers; and Aravaipa, Turkey, Deer, Eagle, Campbell Blue, Pace, Frieborn, Negrito, Whitewater, and Dry Blue creeks in Arizona and New Mexico (Barber and Minckley 1966; Silvey and Thompson 1978; Propst et al. 1985; Propst et al. 1988; Marsh et al. 1990; USFWS 1994a; Bagley et al. 1995; Bagley et al. 1996; Miller 1998). Loach minnows were last detected in the main stem of the Verde River in 1938 (Minckley 1973). Surveys for loach minnow in tributaries of the Verde River are ongoing, but none have been detected (USFWS unpubl. data).

The loach minnow is a bottom-dwelling inhabitant of shallow, swift water over gravel, cobble, and rubble substrates (Rinne 1989; Propst and Bestgen 1991). Loach minnows use the spaces between, and in 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).

The life span of the loach minnow is about two years (Britt 1982; Propst and Bestgen 1991). Loach minnows feed exclusively on aquatic insects (Schreiber 1978; Abarca 1987). Spawning occurs in March through May (Britt 1982; Propst et al. 1988); however, under certain circumstances loach minnows also spawn in the autumn (Vives and Minckley 1990). The eggs of loach minnows are attached to the underside of rocks that form the roof of a small cavity in the substrate on the downstream side. Limited data indicate that the male loach minnows may guard the nest during incubation (Propst et al. 1988; Vives and Minckley 1990).

Biochemical genetic studies indicate that there are substantial differences in genetic makeup between remnant loach minnow populations (Tibbets 1993). Remnant populations occupy disjunct fragments of the Gila River basin and are isolated from each other. Based upon her work, Tibbets (1992, 1993) recommended that the genetically distinctive units of loach minnows should be managed as separate units to preserve the existing genetic variation.

The status of the loach minnow is declining range-wide. Although it is currently listed as threatened, we have found that the species warrants endangered status. A reclassification proposal is pending; however, work on it is precluded by work on other higher-priority listing actions (USFWS 1994b).

Spikedace

The spikedace was listed as a threatened species on July 1, 1986 (USFWS 1986b). Critical habitat was designated on April 25, 2000 (USFWS 2000). Critical habitat includes portions of the Verde, middle Gila, San Pedro, San Francisco, Blue, and upper Gila rivers; and Eagle, Bonita, Tonto, and Aravaipa creeks and several tributaries of those streams. Most of the upper Verde River is designated critical habitat.

Spikedace historically occurred throughout the mid-elevations of the Gila River drainage, but are currently known only from the middle and upper Gila 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). It is possible that spikedace persist in the Verde River (see discussion under Environmental Baseline, below). Habitat destruction, along with competition and predation from introduced nonnative species, are the primary causes of the species' decline (Miller 1961; Williams et al. 1985; Douglas et al. 1994).

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 that eggs are laid over gravel and cobble where they adhere to the substrate. Spikedace live about two years with reproduction occurring primarily in one-year-old fish (Barber et al. 1970; Anderson 1978; Propst et al. 1986). They feed primarily on aquatic and terrestrial insects (Schreiber 1978; Barber and Minckley 1983; Marsh et al. 1989).

Recent taxonomic and genetic work indicate there are substantial differences in morphology and genetic makeup between remnant spikedace populations. Remnant populations occupy disjunct fragments of the Gila basin and are isolated from each other. Anderson and Hendrickson (1994) found that spikedace from Aravaipa Creek are morphologically distinguishable from spikedace from the Verde River, while spikedace from the upper Gila River and Eagle Creek have intermediate measurements and partially overlap the Aravaipa and Verde populations. Mitochondrial DNA and allozyme analyses have found similar patterns of geographic variation within the species (Tibbets 1992, 1993).

The status of the spikedace is declining range-wide. Although it is currently listed as threatened, we have found that endangered status is warranted. A reclassification proposal is pending; however, work on it is precluded due to work on other, higher-priority listing actions (USFWS 1994b).

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 and its habitat to provide a platform from which to assess the effects of the action now under consultation.

Verde River Watershed

The Verde River is vital to the recovery of spikedace and loach minnow. Because of their spring originations, the Verde River and many of its tributaries have an unusual watershed configuration and an unusual hydrograph. About 30% of the watershed of the Verde River lies upstream from the point where perennial flow begins. Although perennial flow occurs in headwater tributaries, perennial flow in the Verde River itself originates from mildly thermal, relatively constant spring flows near the mouth of Granite Creek. These springs provide an unusually flat base-flow hydrograph over which are superimposed flood events originating from surface runoff due to precipitation and reflecting in volume the large watershed area. The flood events are highly variable in volume and timing.

In most Southwestern river systems, the headwaters, or beginning of perennial flow, are located in the uppermost parts of the watershed, generally in hill or mountain areas that have little upstream human development. Because of its spring origin, the headwaters of the Verde River are well downstream from the upper reaches of the watershed and are also downstream from major human activity. The Big and Little Chino Valleys and Williamson Wash are located upstream from the headwaters of the Verde River and support substantial urban and suburban areas as well as agricultural activity including irrigated croplands. These upstream activities have a wide variety of direct, indirect, and cumulative adverse effects on the Verde River and its native fish community.

The human population in and around the Verde River watershed has grown substantially in recent years. Eight incorporated cities (Camp Verde, Chino Valley, Clarkdale, Cottonwood, Jerome, Prescott, Prescott Valley, and Sedona) exist within Yavapai County. The population has increased over the last 50 years, especially since the 1970s. The human population grew from 24,991 in 1950 to 107, 714 in 1990. In 1998, the population of Yavapai County was 148, 500 people. Since 1998, the county has continued to grow in population. All of the incorporated communities in Yavapai County and some other adjacent counties and communities use the Verde River and/or it's watershed for water, recreation, housing, industry, agriculture, and commercial purposes.

The quality and quantity of suitable aquatic habitat for threatened and endangered fish in the Verde Valley has been affected through numerous past actions resulting in reduction of riparian habitat, altered species composition, increased presence of exotic fish, decreased surface water availability, changes in stream morphology, and other deviations from historical conditions. A significant portion of the adverse impacts to the Verde River and its aquatic and riparian ecosystem come from the additive effect of small actions that individually may not threaten the system, but cumulatively result in continuing deterioration of the ecosystem.

Substantial areas of the watershed have been subject to vegetation reduction or removal; soil disturbance or compaction; or covering with impermeable surfaces (e.g., pavement), which alter runoff, infiltration, and groundwater recharge patterns (Esposito *et al*. 1979; Platts 1990; Naiman 1992; Ewing *et al.* 1994). Under these types of watershed alterations, flood volume generally increases while flood duration, infiltration, and groundwater recharge decrease (Leopold 1994). Erosion is increased and results in larger sediment input into the Verde River. Unquantified, elevated fine sediment levels or substrate embeddedness in the upper Verde River have been noted by several workers (Schuhardt 1989; Kuntz 1992; USFWS unpublished data). Depletion of beaver populations throughout the Verde River system has also played an important role in the loss of cienega-type habitats and alteration of the hydrologic regime of the river.

The volume and pattern of flow in the river, particularly within the Verde Valley, has been modified by water diversion, groundwater pumping, and watershed alteration. The river channel has been modified by removal or use of riparian vegetation, flood control, construction of diversion dams, roads and bridges, gravel mining, and agricultural/suburban development of the floodplain. Although groundwater pumping in the upper Verde basin has decreased since 1970

due to declines in irrigated agriculture in the Big Chino Valley, it is again increasing (Tellman *et al.* 1997). The entire flow in the Verde River can be diverted between the Town of Cottonwood and Oak Creek for agricultural purposes, then returned to the riverbed downstream. It is likely that groundwater pumping will continue to increase because of the significant population growth in the Verde Valley in the last 10 years (Arizona Department of Water Resources, pers. com). Towns such as Prescott have nearly eliminated the flow of Granite Creek into the Verde River (Tellman *et al.* 1997).

Developments in areas such as Chino Valley use groundwater, which appears to be affecting surface water supplies downstream (Tellman *et al.* 1997). Rapidly growing urban and suburban development in the Chino Valley and Paulden areas are dependent upon groundwater use, and the city of Prescott is acquiring groundwater wells in the Big Chino/Williamson Valley area for use as city water supply (Prescott Daily Courier, 1994). Groundwater use in the Verde Valley is also increasing, with 293 wells in the six contiguous sections in and near Cottonwood, and 821 wells in the six contiguous sections in and near Camp Verde (Arizona Department of Water Resources Wells Registration files). Groundwater pumping in the upper watershed of the Verde River is expected to adversely affect the spring flow which forms the Verde River (Owen-Joyce and Bell 1983; Ewing *et al.* 1994). The extent of water overdraft in this area and the remaining central and southern parts of Arizona is considered critical (Leopold 1997).

In addition to the adverse effects detailed above, the rapidly growing population in the Prescott, Chino Valley, and Cottonwood areas places increasing demands on the Verde River for recreation. In the warm area of the Verde Valley, recreation is often concentrated in riparian areas of the Verde River resulting in reduced riparian vegetation due to trampling, clearing, wood cutting, and soil compaction. Recreation is presently causing adverse impacts to the Verde River in the form of bank degradation and erosion, primarily from roads and off-road vehicles (Schuhardt 1989; Sullivan and Richardson 1993). Areas of the Verde River on the Windmill Allotment, Thirteen-Mile Rock Allotment, and Beaver Creek Allotment are particularly impacted by recreational uses.

The Verde River is one of the few rivers in the United States where sand and gravel is mined from a live stream (Tellman *et al.* 1997). Gravel mining destroys riparian vegetation and also erodes the river channel and causes instability, migration of the stream channel, lowering of water tables, loss of sand and gravel to the river, increased siltation, and lowered water quality (Tellman *et al.* 1997). Mining for sand and gravel is an important industry in the Verde Valley from Tapco to Camp Verde. Demand for these materials has grown as the population and development increase. Growth in the Verde Valley and Flagstaff depends largely on Verde Valley sand and gravel. For every 1,000 new Arizonans, 7,000 additional tons of sand and gravel are required (Tellman *et al.* 1997).

It is extremely difficult to quantify the changes to the Verde River resulting from past and ongoing activities on the watershed and in the river itself. Sufficient information for a pre-effect analysis is lacking. The large size of the watershed area also means that there are many on-the-ground actions taking place, and while the effects of one may not appear to be significant, the

combined effects often are. Segregating out one effect, in one area, from the background of combined effects is not possible within the scope of this biological opinion. That should not be construed to say that the effects of any individual action are not important, merely that it is difficult to isolate the specific effects.

In addition to habitat alterations, various nonnative aquatic species have been introduced by humans into the Verde River system and have adversely affected native fishes through predation and competition (Marsh and Brooks 1989; Marsh *et al.* 1989; Rinne and Minckley 1991; Douglas *et al*. 1994). Nonnative species currently reported to exist within the upper Verde River include mosquitofish (Gambusia affinis), yellow bullhead (Ameiurus natalis), channel catfish (Ictalurus punctatus), flathead catfish (Pylodictis olivaris), red shiner (Cyprinella lutrensis), carp (Cyprinus carpio), smallmouth bass (Micropterus dolomeiui), green sunfish (Lepomis cyanellus), fathead minnow (Pimephales promelas), and crayfish (Oronectes virilis) (Hendrickson 1989; USFWS 1988; USFWS 1989; AGFD 1993; Stefferud 1995; Rinne 1999; AGFD unpublished data; J. Rinne and J. Stefferud, USFS unpublished data). While native species form the majority of the fish community in the Verde River above Sycamore Creek (upstream of the proposed action), nonnative fish now predominate downstream from Sycamore Creek, including the action area. The long-term trend in the native/nonnative species balance appears to be toward more nonnatives and less natives (J. Rinne, In press).

Although the upper Verde River supports one of the best remaining native fish communities in the Gila River basin, the past and present adverse impacts to the river and fish are substantial. This past and ongoing degradation along with the increasing presence of detrimental nonnative species results in a tenuous status for the Verde River native fish community and has already resulted in the extirpation of several native fish species (Minckley 1973).

The proposed action (excluding Beaverhead/Grief Hill Driveway) includes a total of 75 miles of perennial streams and 155 miles of non-perennial streams. Four of the eight allotments report poor to fair range conditions with static and upward trends. The Forest Service provides no range conditions for the Apache Maid Allotment, but only reported that the trend is undesirable and downward. No range condition or trends were reported for the Windmill Allotment. The remaining two allotments report good to fair range conditions. No information regarding range condition or trend was provided for the Beaverhead/Grief Hill Driveway.

Formal consultation has documented various effects from Federal actions to spikedace and loach minnow which contributed to the environmental baseline (Administrative Record). Some of these actions contained components that lessened adverse effects of ongoing actions or were aimed at improving watershed conditions (livestock grazing management changes, etc.). While incidental taking of spikedace and loach minnow was authorized in many instances, actions to reduce and minimize take through reasonable and prudent measures provided protection so that no take of a threatened or endangered species likely occurred.

Loach minnow in the action area

Despite the lack of documentation of the presence of loach minnow in the Verde River for several decades, the designation of the Verde River, Fossil Creek, West Clear Creek, Beaver/Wet Beaver Creek and Oak Creek as critical habitat for loach minnow emphasizes the importance of these areas for eventual re-introduction and recovery of the species. It is likely that loach minnow were historically common throughout the Verde River basin but were extirpated as a result of human activities discussed above. Surveys for the species continue (USFWS, unpublished data). Thus, a primary concern with loach minnow in the action area is to ensure the protection and improvement of its historical habitat.

Spikedace in the action area

In the final critical habitat rule we stated that the Verde River is considered occupied by spikedace for 72 miles from the confluence with West Clear Creek to Sullivan Dam. However, despite annual surveys by both the AGFD and the Rocky Mountain Research Station, only a single specimen has been recorded (in 1999) since 1996 (AGFD unpublished data; Rinne, in press).

Surveys in 2000 and 2001 by AGFD failed to locate spikedace (AGFD unpublished data), and surveys conducted every year by the U.S. Forest Service-Rocky Mountain Research Station (Rinne, in press) have failed to locate spikedace since 1996. Concurrent with the absence of spikedace, the Rocky Mountain Research Station survey efforts have yielded increasing numbers of non-native species, including smallmouth bass. It is likely that the presence of non-natives, particularly aggressive predators such as smallmouth bass, have significantly reduced the likelihood that spikedace persist in the Verde River (J. Rinne, U.S. Forest Service Rocky Mountain Research Station, pers. comm.). If the species is present, it is likely reduced to extremely low numbers.

Despite the lack of documentation of spikedace in the Verde River in the last few years, the designation of the Verde River, Fossil Creek, West Clear Creek, Beaver/Wet Beaver Creek and Oak Creek as critical habitat emphasizes the importance of these areas for eventual recovery of the species. It is likely that spikedace were historically common throughout much of the Verde River basin but are now either absent or present in extremely low numbers as a result of the human activities discussed above. Surveys for the species continue (USFWS, unpublished data). Thus, a primary concern with spikedace is to ensure the protection and improvement of the action area since it is critical and historical habitat for the species.

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. 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.

As the effects of livestock grazing on spikedace and loach minnow are interconnected with the effects of the proposed action on critical habitat for these species, we analyze the effects on the fish and their critical habitat contemporaneously. The constituent elements of critical habitat are generalized descriptions and ranges of selected habitat factors that are essential for the survival and recovery of spikedace and 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 must 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.

Analysis of the effects of livestock grazing on fish and fish habitat requires examination of subtle, long-term, incremental changes in watershed functions, riparian and aquatic communities, and stream channel morphology. Limited data available on range condition, fish, and fish habitat make an empirical analysis of the effects of grazing and grazing management difficult and often misleading, particularly on an allotment-by-allotment basis. However, extrapolations of general hydrologic and biologic principles and site-specific research data 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; Leopold 1951; York and Dick-Peddie 1969; Hastings and Turner 1980; Dobyns 1981; Kauffman and Krueger 1984; Skovlin 1984; Kinch 1989; Chaney *et al.* 1990; Platts 1990; Armour *et al.* 1991; Bahre 1991; Meehan 1991; Fleischner 1994).

The effects of livestock grazing within the project area on spikedace and loach minnow survival and recovery, as well as their critical habitat, from the proposed ongoing livestock grazing and its management would occur through four mechanisms: 1) watershed alteration; 2) physical destruction and alteration of streambanks, stream channels, water column, and the riparian vegetation community; 3) alteration of the faunal community; and 4) effects of grazing-related structural elements. These mechanisms have varying effects on spikedace, loach minnow, and their critical habitat.

1) Watershed Alteration

Unsatisfactory range and watershed conditions due to past heavy livestock grazing, roads, and other human uses contribute to changes in overland flows and sediment transport to the river. Soil compaction, changes to root structures in overused plants, changes in plant species composition and overall biomass, and loss of soil from erosion can result from overuse by

livestock. In some cases, restoration of the historical condition may not be possible.

Watershed changes due to grazing are difficult to document due to their long-term, incremental nature; the time lag and geographic distance between cause and effect; and the numerous confounding variables. Despite this, the relationship between livestock grazing in a watershed and effects to river systems is widely recognized and documented (Leopold 1946; Blackburn 1984; Skovlin 1984; Chaney *et al.* 1990; Platts 1990; Bahre 1991; Meehan 1991; Fleischner 1994; Myers and Swanson 1995). Although watershed effects vary depending upon the number and type of livestock, the length and season of use, and the type of grazing management, the mechanisms remain the same and the effects vary only in extent of area and severity (Blackburn 1984; Johnson 1992).

Livestock grazing may alter the vegetative composition of the watershed (Martin 1975; Savory 1988; Vallentine 1990; Popolizio *et al.* 1994). It may cause soil compaction and erosion, alter soil chemistry, and cause loss of cryptobiotic soil crusts (Harper and Marble 1988; Marrs *et al.* 1989; Orodho *et al.* 1990; Schlesinger *et al.* 1990; Bahre 1991). Cumulatively, these alterations contribute to increased erosion and sediment input into streams (Johnson 1992; Weltz and Wood 1994). They also contribute to changes in infiltration and runoff patterns, thus increasing the volume of flood flows while decreasing their duration, and decreasing the volume of low flows while increasing their duration (Brown *et al.* 1974; Gifford and Hawkins 1978; Johnson 1992). Groundwater levels may decline and surface flows may decrease or cease (Chaney *et al.* 1990; Elmore 1992). Development of livestock waters may alter surface flows by impoundment, spring capture, or runoff capture.

With the information available, it is not possible to differentiate watershed alteration effects caused by current livestock grazing on the allotments under consultation from those caused by past grazing, current grazing on upslope allotments, upslope urban and suburban development, agriculture, roads, or other watershed effects. Information presented by the Forest Service for this consultation indicates that the watershed conditions in many of the pastures nearest to the river have significant areas in unsatisfactory condition. We recognize the limitations in the applicability of these soil condition data, but directly applicable data are not available. Additionally, the range conditions for many of the allotments are mostly in poor to fair condition, with some reaching good condition; the majority of the poorest conditions are located in the desert grassland and desert shrub vegetation types that make up most of the winter use pastures.

While the Forest Service indicates that most of these allotments have static or upward trends, much of the existing range is of such poor condition that these improving trends do little to mitigate the present adverse effects. In addition, the rate of upward trend appears to be very slow and is unlikely to result in improvement in the stream conditions for many decades. Improvement is needed immediately to provide for sufficient stream improvement to benefit spikedace and loach minnow recovery.

Overland flows off the pinyon-juniper pastures above designated critical habitat carry sediments through the lower-elevation vegetation types and, if the conditions there are less than satisfactory,

amelioration of the flow rate or the sediment load will be reduced. Additionally, very erosive soils (unsatisfactory and inherently unstable soils) are found adjacent to designated critical habitat in large portions of the Thirteen-mile Rock, Apache Maid, Beaver Creek, Hackberry Management Unit, Fossil Creek, and Windmill allotments. Without proper vegetative conditions, these erosive soils are less stable and contribute fine sediment downstream during rain events. Winter use of the range removes vegetation and thus reduces litter. Winter rains may then wash sediment loads into the tributaries of the Verde River and eventually to the Verde River itself. Overland flows and the subsequent timing and stage of riverine flows are also influenced.

Proposed utilization rates are generally high for the allotments under consultation. While most allotments have proposed maximum utilization rates of 40% - 50%, the Fossil Creek Allotment has an upper utilization rate of 60%-70%. The exception in the proposed action is the Walker Basin Allotment, where a trial period of 35% utilization will be extended through 2005. Monitoring information for many of the allotments for the years 1998-2000, conducted after livestock were removed from the pasture (but before the end of the growing season), indicate that pastures are at "moderate use" levels (26-50%). However, some pastures occasionally showed "high use" levels (51-70%). This was evident in 2000 at six pastures within the Hackberry/Pivot Rock Allotment.

Moderate to heavy grazing levels for herbaceous and woody species in riparian and upland areas are proposed. "Heavy" is defined as a degree of herbage utilization that does not permit desirable forage species maintenance. "Moderate" is defined as a degree of herbage utilization that allows palatable species to maintain themselves, but usually does not permit improvement in herbage production. Holochek *et al.* (1999) explained that conventional wisdom has held that moderate stocking involves 50% use of forage; the basic approach which is applied to these allotments. While that level is appropriate for southern pine forest and humid and annual grasslands, it results in rangeland deterioration in the semi-arid grasslands, desert, and coniferous forest rangelands. Holochek *et al.* (1999) explained that the research for desert rangelands was remarkably consistent. Moderate grazing in the desert involved about 35% to 45% use. Vallentine (1990) suggested that 25% to 35 % is the proper utilization rate for southern desert shrublands. Galt *et al.* (2000) recommended a 25% harvest coefficient (the percentage of total forage produced that is assigned to grazing animals for consumption) for most western rangelands. Based upon the analyses completed by Holochek *et al.* (1999) and Vallentine (1990), the proposed moderate to heavy stocking should lead to a downward trend and/or no improvement of current conditions.

The generally poor range and soil conditions described in the Forest Service's assessment demonstrates that heavy grazing has resulted in rangeland deterioration, which will hinder the ability of the designated critical habitat within, adjacent to, and downstream of, the allotments to assist in the recovery of the spikedace and loach minnow.

2) Physical Destruction and Alteration of Streambanks, Stream Channels, Water Column, and Riparian Vegetation Community

Cattle will occur in limited areas of streambanks within and outside of critical habitat, on several of the allotments. The potential effects of grazing on streambanks include the shearing or sloughing of streambank soils by either hoof or head action; elimination of streambank vegetation; erosion of streambanks following exposure to water, ice, or wind due to loss of vegetative cover; and an increased streambank angle which increases water distribution horizontally while decreasing its depth. Damage can begin to occur almost immediately upon entry of the cattle onto the streambanks, and use of riparian zones may be highest immediately following entry of cattle into a pasture (Platts and Nelson 1985; Goodman *et al*. 1989). Vegetation and streambank recovery from long rest periods may be lost within a short period following grazing reentry (Duff 1979). Bank configuration, soil type, and soil moisture content influence the amount of damage, with moist soil being more vulnerable (Marlow and Pogacnik 1985; Platts 1990).

Following streambank alteration, potential effects to the channel itself can include changes in channel morphology and altered sediment transport processes (Platts 1990). Within the stream itself, there can be changes to pools, riffles, runs, and the distribution of backwater areas, a reduction in cover for fishes, elevated water temperatures, changes in nutrient levels, and increased sedimentation (Platts 1990; Belsky *et al*. 1999).

Livestock will continue to directly alter streamside vegetation in several areas by trampling, rubbing, and feeding on herbaceous plants and shrubs. Use and removal of herbaceous vegetation leads to changes in species composition, species diversity, and biomass, while use and removal of woody vegetation can lead to changes in foliage cover, structural height diversity, and stand reproduction. Livestock may also have indirect effects on riparian vegetation by compacting the soils and causing increased runoff and decreased water availability to plants, and by increasing soil temperatures which can lead to increased evaporation due to the removal of vegetation (Kauffman and Krueger 1984).

Changes to the water column within the stream can be many and varied. Water-column alterations can be caused by changes in the magnitude and timing of organic and inorganic energy inputs to the stream; increases in fecal contamination; changes in water temperatures due to removal of vegetation; changes in water-column morphology, including increases in stream width and decreases in stream depth, as well as reduction of stream shore water depth; changes in timing and magnitude of streamflow events from changes in watershed vegetative cover; and increases in stream temperature (Platts 1990; Fleischner 1994).

The effects of grazing in the uplands on riparian systems have been discussed above. To generate and maintain riparian habitat, a healthy watershed (uplands, tributaries, ranges, etc.) is a key component (Elmore and Kauffman 1994; Briggs 1996). Elmore and Kauffman (1994) note that "simply excluding the riparian area (from grazing) does not address the needs of upland vegetation or the overall condition of the watershed. Unless a landscape-level approach is taken, important ecological linkages between the uplands and aquatic systems can not be restored and riparian recovery will be limited." Continuing to graze in uplands where the soil conditions and riparian habitat in upland tributaries are unsatisfactory will continue to impact spikedace and

loach minnow habitat and result in unnatural flooding, delaying recovery of the habitat.

Cattle grazing in and on riparian vegetation may cause changes in the structure, function, and composition of the riparian community (Szaro and Pase 1983; Warren and Anderson 1987; Platts 1990; Schulz and Leininger 1990; Schulz and Leininger 1991; Stromberg 1993). Species diversity and structural diversity may be substantially reduced and nonnative species may be introduced through spread in cattle feces. Reduction in riparian vegetation quantity and health, plus shifts from deep-rooted to shallow-rooted vegetation, contribute to bank destabilization and collapse and production of fine sediment (Meehan 1991). Loss of riparian shade results in increased fluctuation in water temperatures with higher summer and lower winter temperatures (Karr and Schlosser 1977, Platts and Nelson 1989). Litter is reduced by trampling and churning into the soil thus reducing cover for soil, plants, and wildlife (Schulz and Leininger 1990). The capacity of the riparian vegetation to filter sediment and pollutants to prevent their entry into the river and to build streambanks is reduced (Lowrance *et al*. 1984; Elmore 1992). Channel erosion in the form of downcutting or lateral expansion may result (Heede and Rinne 1990; USBLM 1990).

Although the majority of the riparian areas on the Verde River and Fossil, West Clear, Beaver/Wet Beaver, and Oak creeks within and adjacent to the allotments are excluded from livestock use through fencing and topographic features, some areas remain accessible to livestock. In addition, where fencing exists there will inevitably be some use of the riparian area due to cows getting through broken fences. This problem has been identified specifically in the BA for the Thirteen-mile Rock, Beaver Creek, and Windmill allotments. Fence maintenance is imperative to improving the watershed and reducing direct impacts to the habitat for both species.

Riparian alteration would not be limited to the Verde River, but would also occur on tributary streams. The condition of those streambanks and riparian vegetation contributes to the condition of the Verde River. The tributary riparian vegetation and streambank condition, including intermittent and ephemeral channels, form important buffers between upland impacts and the mainstem (Erman *et al*., 1977; Mahoney and Erman, 1981; Osborne and Kovacic, 1993). Deteriorated riparian and streambank conditions cannot adequately perform this buffering function.

Within the allotments included in this consultation, many of the tributaries to critical habitat exhibit many aspects of degradation caused by livestock on the streambanks and grazing in the riparian zone. Although no quantitative data exist on trends in streambank and channel condition, observational data reported in the BA for some allotments indicate that livestock access to some of these areas is impacting riparian vegetation and not allowing for regeneration of woody riparian species, and is inhibiting a multiple age-class distribution of woody riparian species. This can lead to riparian vegetation in densities inadequate to dissipate energy during high flows, absence of mature vegetation, lack of a floodplain, inadequate deposition of fine sediments, and linear channel configurations.

Livestock will continue to directly alter streamside vegetation on five of the nine allotments included in this consultation. Direct access to critical habitat will occur in the following allotments: Thirteen-mile Rock Allotment – 0.6 mile of West Clear Creek; Beaver Creek Allotment – 0.5 mile on Wet Beaver Creek; Hackberry Management Unit – one "emergency access point" on the Verde River; Windmill Allotment – three access points on Oak Creek; Beaverhead/Grief Hill Driveway – sheep crossing the Verde River.

In addition to direct access to critical habitat by livestock, these allotments also provide access to perennial and intermittent riparian reaches that flow into critical habitat. This will occur in the following allotments and locations: Thirteen-mile Rock – Toms Creek, upper reaches of Fossil Creek, and Cottonwood and Mesquite Springs; Apache Maid – 13 miles of Dry Beaver Creek, Wet Beaver Creek above critical habitat, and other ephemeral drainages including Rarick Canyon/Red Tank Draw; Beaver Creek – Jacks Canyon, Brady Canyon, Walker Creek, Red Tank Draw, Beaver Creek, Wet Beaver Creek, and six springs; Buckhorn – headwaters of Willow Valley crossed by livestock; Hackberry/Pivot Rock – Hackberry Creek, Sycamore Creek, Towel Creek, Toms Creek, and Clover Creek; Fossil Creek – Fossil Creek above critical habitat, Sally Mae Drainage, Sycamore Creek, and Deer Basin; Walker Basin – perennial reaches of Wet Beaver Creek, Willow Valley, and upper West Clear Creek.

Many of the riparian areas in the proposed action area have been rated, using Proper Functioning Condition (PFC) methods, as "functional," but some areas of "non-functioning" and "functional at-risk" are present within the allotments. Large portions of the riparian areas have not been rated. Although PFC is a useful classification for stream conditions, the relationship between such ratings and spikedace and loach minnow habitat is unknown. Although a PFC rating as "less than functional" most likely indicates poor conditions of both species' habitat, the converse is not necessarily true; i.e., the fact that the stream is "functioning" in a general sense does not mean that conditions are good for spikedace or loach minnow. In fact, a stream can be properly functioning and still be unsuitable for one or both of these species due to one or more missing factors or the presence of one or more undesirable factors.

3) Alteration of the Faunal Community

Livestock use of the riparian corridor can cause changes in species composition and community structure of the aquatic and riparian fauna, in addition to floral changes already addressed. The aquatic invertebrate community may change because of altered stream channel characteristics, sediment deposition, or nutrient enrichment (Rinne 1988; Meehan 1991; Li *et al*. 1994). This change in the food base may then contribute to change in the vertebrate community. In addition, the structure and diversity of the fish community may shift due to changes in availability and suitability of habitat types (Storch 1979; Van Velson 1979). Livestock grazing may lead to loss of aquatic habitat complexity, thus reducing diversity of habitat types available and altering fish communities (Li *et al.* 1987).

In the southwestern U.S., loss of habitat complexity has been a major factor in the displacement of native fish species by nonnatives (Bestgen 1986; Rinne and Minckley 1991; Baltz and Moyle

1993). Rinne (2001) states that in the upper Verde River, removal of livestock grazing from the stream and riparian corridor has been adverse to spikedace through improvement of habitat for some nonnative fish species. However, because of the lack of significant flooding in the upper Verde River during the period in question, the ongoing steady increase in nonnative fish species prior to grazing changes, and several other factors, interpretation of fish community changes in the past several years is difficult.

4) Effects from Grazing-related Structural Elements

Continued livestock use on the allotments requires that roads and fences be maintained. Roads are of concern since they can contribute sediment to stream courses. Fences are of concern because where they are near streams and/or in floodplains, they assist in the creation of erosion channels and can negatively affect the channel banks. The continued use and maintenance of existing waterlots and stocktanks within the allotments can increase the potential for both authorized and unauthorized stocking of non-native fish. Flood events may then cause breaches in these water developments and allow non-native fish to enter tributaries and major waterways.

Summary of Effects

With the information available, it is not possible to differentiate adverse watershed alteration and water quality effects caused by current livestock grazing on the allotments included in this consultation from those caused by past grazing, private lands use, agriculture, roads, or other human activities. However, the following should be noted:

1) The overall conditions of the 5th code watersheds in which these allotments are located are generally poor to fair, with some in good condition. Soil condition and trend includes many areas of impaired, unsatisfactory, and inherently unstable soil conditions. These soil conditions are most often found on steep slopes and in winter range and are most often proximate to designated critical habitat.

2) Riparian condition data, while somewhat limited and often outdated, indicate areas of functional-at risk perennial and non-perennial streams and decreasing trends on significant portions of many of the allotments.

3) Livestock grazing will likely be the most pervasive land use on the allotments and surrounding area.

4) Livestock are known to adversely impact vegetation condition, erosion levels, soil compaction, streambank stability, and stream channel characteristics (see preceding and following discussions). Livestock and livestock grazing are likely to continue contributing to these adverse ecological conditions on grazing allotments adjacent to spikedace and loach minnow critical habitat in the future.

<u>Spikedace and its Critical Habitat</u>

As previously noted, it is unclear whether spikedace are present in the Verde River. Critical habitat for spikedace has been designated along portions of the Verde River and along Fossil, West Clear, Beaver/Wet Beaver, Oak, and Granite creeks. All of these except Granite Creek flow completely through or adjacent to the allotments. Livestock from the Thirteen-mile Rock, Beaver Creek, Hackberry Management Unit, and Windmill allotments, as well as the Beaverhead/Grief Hill Driveway, will be permitted to access spikedace critical habitat. In addition, as noted in the discussion above, indirect effects from livestock to critical habitat may result from impacts on upland soils, vegetation, and watershed conditions. Direct access by livestock will occur at one point on the Verde River for emergency water access. Six-tenths of a mile of critical habitat in West Clear Creek will be accessible at three water gaps in Thirteen-mile Rock Allotment. One-half mile of Wet Beaver Creek critical habitat will be accessible in the Beaver Creek Allotment. An unknown amount of critical habitat on Oak Creek will be accessible at three points in the Windmill Allotment.

Critical habitat includes over 174 stream miles on the Verde River and designated creeks. According to our estimates, there are approximately 65 miles of critical habitat along the Verde River adjacent to the allotments included in this consultation, which accounts for approximately 61 percent of all the critical habitat in on the Verde River. Indirect effects to critical habitat on the Verde River would occur downstream of the allotments as well, increasing the amount of critical habitat on the Verde River affected by the proposed action. All 7.2 miles of critical habitat along West Clear Creek are within or adjacent to the Thirteen-mile Rock Allotment. All of Beaver/Wet Beaver Creek critical habitat is within or adjacent to the Walker, Apache Maid Allotments, and Beaver Creek allotments. Nearly 100 percent of Oak Creek critical habitat (excluding approximately 1.5 miles) flows through private lands that lie between the Windmill Allotment and Oak Creek.

The primary constituent elements of critical habitat for spikedace are listed in the Status of the Species section (above). The proposed action is likely to adversely affect, both directly and indirectly, the overall habitat quality that the primary constituent elements create by degrading bank conditions through trampling and removal of vegetation in areas where livestock have direct access, increasing soil compaction and thereby decreasing infiltration at the stream and within the uplands, decreasing the ability of the stream system to handle high energy flows by removing essential vegetation, and increasing the instability of the river system.

Because of the degraded range and soil conditions, and because of the proposed continuation of high utilization levels on the majority of these allotments, degradation of the watershed and the Verde River will continue. The affected portions of the Verde River (61%), Fossil Creek (100%), West Clear Creek (100%), Beaver/Wet Beaver Creeks (100%), and Oak Creek (99%) represent 75 percent of the designated critical habitat for this species in the Verde Basin critical habitat area, and 20 percent of all designated critical habitat for the species. In addition, the proposed grazing on the allotments included in this consultation will affect critical habitat downstream, and potentially upstream, of the allotments.

In summary, the Forest Service acknowledges that guidance criteria developed specifically to

determine if adverse effects may occur on both spikedace and its critical habitat will not be met. Because of the degraded range conditions and the proposed high utilization levels, adverse effects to critical habitat will likely result from the proposed action.

Loach Minnow and its Critical Habitat

Critical habitat for loach minnow includes the same number of miles of the Verde River and Fossil Creek, West Clear Creek, Beaver/Wet Beaver Creek and Oak Creek as discussed above for the spikedace. The same miles of habitat will be affected by grazing allotments as discussed above.

The constituent elements of critical habitat for loach minnow are listed in the Status of the Species section (above). The proposed action is likely to adversely affect critical habitat, both directly and indirectly, by degrading bank conditions through trampling and removal of vegetation in limited areas, increasing soil compaction and thereby decreasing infiltration at the stream and within the uplands, decreasing the ability of the stream system to handle high energy flows by removing essential vegetation, and increasing the instability of the river system.

In summary, the Forest Service acknowledges that guidance criteria developed specifically to determine if adverse effects may occur on both loach minnow and its critical habitat will not be met. Because of the degraded range conditions and the proposed utilization levels, degradation of the watershed, and ultimately the Verde River, will continue.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Most of the ongoing activities that are cumulative to the proposed action are discussed in the environmental baseline section of this opinion. Most of the Verde River in the Verde Valley through the towns of Clarkdale, Cottonwood, and Camp Verde is privately owned. Ongoing activities on these private lands that would be cumulative to the proposed action include residential use and development, commercial development, gravel mining, road development, surface water diversion, stocking of non-native aquatic species, groundwater extraction, livestock grazing, and irrigated agriculture. These activities contributed significantly to the listing of the spikedace and loach minnow and continue to contribute to the degraded condition of the stream channel and fish habitat in Verde River.

Conclusion

After reviewing the current threatened status of the spikedace and loach minnow, the environmental baseline for the action area, the effects of the proposed action on the species and

their critical habitat, and the cumulative effects, it is our biological opinion that the on-going grazing on the eight allotments and one sheep driveway included in this consultation, as proposed, is not likely to jeopardize the continued existence of spikedace or loach minnow. It is also our biological opinion that the proposed action is not likely to destroy or adversely modify critical habitat of loach minnow and spikedace. We present these conclusions for the following reasons:

According to regulations at 50 CFR 402.02, actions likely to "jeopardize the continued existence" of a species are those that reasonably would be expected, directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution of that species. Actions likely to "destroy or adversely modify" critical habitat are those that would appreciably reduce the value of critical habitat for the survival and recovery of the species. Common to these definitions is the appreciable detrimental effect on both the survival and recovery of the listed species.

Livestock have direct access to critical habitat at water gaps on five of the allotments and at the sheep crossing of the Verde River, but the majority of habitat is excluded from livestock access and, therefore, impacts which would effect the reproduction, numbers, or distribution of the species in such a way as to appreciably reduce the likelihood of the species' survival and recovery are not expected. We do expect that this stream access, as well as effects to uplands described in this BO, will continue to impede, and possibly prevent, complete recovery of the spikedace and loach minnow in the Verde River. However, we do not believe that ongoing grazing will result in a significant reduction in the likelihood of the species' survival, nor an appreciable reduction in the value of critical habitat for the species' survival.

INCIDENTAL TAKE STATEMENT (no incidental take authorized)

An Incidental Take Statement functions to immunize persons from liability and penalties under section 9 off the Act for takings that occur during activities that are otherwise lawful and in compliance with its terms and conditions. 16 U.S.C. 1536(o). This biological opinion does not exempt the Forest Service from incidental take provisions. (see discussion under Amount or Extent of Take, below).

Regulations pursuant to section 4(d) of the Act (50 CFR 17.31) prohibit the take of threatened species without special exemption. "Take" is defined under the Act as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. The terms "harm" and "harass", both of which may involve habitat modification, are further defined under regulations at 50 CFR 17.3. "Harm" is defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined as intentional or negligent actions that create the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

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

Amount or Extent of Take

Loach Minnow

Because no loach minnow have been detected in the Verde River since 1938 (Minckley 1973), we conclude that no take of loach minnow is expected to occur. No Incidental Take Statement is therefore included in this biological opinion.

Spikedace

In our draft of this biological opinion supplied to the Forest Service in November, 2001, we included a draft Incidental Take Statement that contemplated incidental taking of spikedace as a result of the proposed action. In developing that draft Incidental Take Statement we stated our belief that spikedace may remain, albeit in very low numbers, in the Verde River. However, in a December, 2001 ruling by the 9th Circuit Court of Appeals (Arizona Cattle Growers' Association vs. U.S. Fish and Wildlife Service Appeal 9th Cir. Nos. 99-16102, 16103, 00-15322, 00-15511) , the court held that "absent rare circumstances such as those involving migratory species, it is arbitrary and capricious to issue an Incidental Take Statement when the Fish and Wildlife service has no rational basis to conclude that a take will occur incident to the otherwise lawful activity." In essence, the court ruled that an Incidental Take Statement may only be included in a biological opinion when it can be shown with "reasonable certainty" that taking will result from the action under consultation. In order to meet this standard, the Fish and Wildlife Service would have to show--(a) reasonable certainty that the species is present on the property in question, and (b) reasonable certainty that the action under consultation would result in actual injury and/or death to the species (under the definition of "harm"), or create a likelihood of injury (under the definition of "harass").

As discussed in the Environmental Baseline section of this biological opinion, only one spikedace has been collected in the Verde River since 1996, and fairly extensive annual surveys since that 1999 record have failed to yield a single spikedace. Given that the spikedace may be extirpated from the Verde River or that, if some individuals are present, they exist in extremely low number, it is difficult to attain the 9th Circuit standard that take of the spikedace is reasonably certain to result from the proposed action. Thus, in this final biological opinion we do not anticipate that taking of spikedace will occur. No Incidental Take Statement is therefore included in this biological opinion.

Disposition of Dead or Injured Listed Animals

Upon finding a dead or injured threatened or endangered animal, initial notification must be made to the Fish and Wildlife Service's Division of Law Enforcement, Federal Building, Room 8, 26 North McDonald, Mesa, Arizona (480/835-8289) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph, and any other pertinent information. Care must be taken in handling injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible condition. If feasible, the remains of intact specimens of listed animal species shall be submitted as soon as possible to this office or the nearest Arizona Game and Fish Department office, or to educational or research institutions holding appropriate State and Federal permits.

CONSERVATION RECOMMENDATIONS

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

1. We recommend the following to protect riverine and riparian habitat from significant grazing effects within the eight livestock grazing allotments included in this consultation:

    - Construct exclosure fencing and water gapping at appropriate watering sites within the Winter Pasture of the Thirteen-mile Rock Allotment such that livestock do not impact soils and riparian plants at the Black Mountain Canyon confluence.

    - In the Thirteen-mile Rock Allotment, Heifer Pasture, explore options for providing water sources other than the three water gaps currently located within critical habitat on West Clear Creek. If earthen tanks are used, they should be located outside of the 100-year floodplain.

    - Construct fences to exclude livestock access to one of the two access points (water gaps) on Fossil Creek within the Stehr Lake Pasture of the Fossil Creek Allotment.

    - Fence livestock from intermittent creeks within the Apache Maid Allotment. Specifically, consider fencing reaches on Dry Beaver Creek, Rarick Canyon, and Wet Beaver Creek, where livestock have access.

    - Fence livestock from intermittent creeks within the Pivot Rock Management Unit of the Hackberry/Pivot Rock Allotment. Specifically, consider fencing livestock- accessible reaches of Clover Creek, Clover Spring, Bed Bug West, and Toms Creek.

    - Because vandalism of fences and livestock trespass are known to occur, conduct thorough inspections of fences along West Clear Creek within the Wingfield Pastures of the

Thirteen-mile Rock Allotment; along Wet Beaver Creek in the Miss Cindy, Wet Beaver Wilderness, Valley North, and Valley (Bull) South pastures of the Beaver Creek Allotment; and at Cottonwood and Mesquite Washes within the Hackberry Management Unit of the Hackberry/Pivot Rock Allotment. These inspections should be conducted immediately prior to livestock being moved into these pastures, and every week thereafter while livestock access these pastures. If the fences are found to have been vandalized they should be immediately repaired. If any livestock are found within these exclosures they should be immediately removed.

- Closely monitor utilization and physical damage levels within the following allotments and pastures: Thirteen-mile Rock Allotment – Winter, Heifer, Wingfield Mesa (all four), and Cactus Pastures; Apache Maid Allotment – Middle Verde and White Hills Pastures; Beaver Creek Allotment – Miss Cindy, Wet Beaver Wilderness, Valley North, and Valley South (Bull) Pastures; Hackberry/Pivot Rock Allotment – Dogleg, Ladder, Jims 1, Bull Run, and Lower Towel Pastures; Fossil Creek Allotment – Stehr Lake, Chalk Springs West, and Surge Tank Pastures; Walker Basin Allotment – North Montezuma, West Russell, and South Montezuma Pastures; and, Windmill Allotment – White Flats Pasture.

2. We recommend promoting continued improvement of range, soil, watershed, and riparian conditions by establishing appropriate utilization levels, for the following allotments.

   - For the Fossil Creek Allotment, which currently has a maximum utilization level of 60-70 percent, establish a utilization level of 35-40 percent in key areas When utilization levels are met in any pasture, cattle should be removed from that pasture. The Forest Service should identify key areas which may include riparian areas, tributary channels, source areas of sediment.

   - For the Apache Maid, Beaver Creek, Hackberry/Pivot Rock, and Windmill allotments, which currently have maximum utilization levels of 50 percent, the Forest Service should establish utilization levels of 35 - 40 percent in key areas. When utilization levels are met in any pasture, cattle should be removed from that pasture.

   - For the Walker Basin Allotment, continue the planned experimental utilization levels of 35 percent through the life of the permit (2010).

3. We recommend increasing available data on aquatic and riparian conditions by monitoring, including monitoring of the constituent elements of critical habitat, as follows:

   - Monitoring of aquatic and riparian conditions, including constituent elements of critical habitat, should be conducted every 3 years and be in adherence with an established monitoring protocol. The following criteria should be met:

--A journey-level fishery biologist should conduct inspections.
--The biologist should survey stream habitats for suitability, occupancy, and overall condition with respect to bank stability, stream morphology, and embeddedness.
--The biologist should evaluate riparian vegetation and upland watershed and soil conditions, and provide a report of any measurable on-going effect on critical habitat.
--Key areas for completing this assessment should be those that are ecologically most relevant to the species.

- Monitor forage utilization on all pastures within all allotments at least twice during grazing periods and within three weeks after livestock exit each pasture. Monitoring should be conducted in key areas which should include the most ecologically sensitive areas for the spikedace (e.g., riparian areas, tributary channels, source areas of sediment).

4. Explore the option of removing the Miss Cindy Pasture on the Beaver Creek Allotment from permitted livestock grazing.

5. Consider removing the Hackberry Management Unit of the Hackberry/Pivot Rock Allotment from permitted livestock grazing.

In order that we be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in the consultation request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. An example of new information would be the location or identification of spikedace and/or loach minnow within the boundaries of any of these allotments during survey efforts.

We appreciate your efforts and interest in conserving endangered and threatened species. If you have any questions regarding this consultation, please contact please contact Shaula Hedwall (928) 226-1811 of our Flagstaff Suboffice.

Sincerely,

/s/ Steven L. Spangle
Field Supervisor

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (Attn: ARD-ES)
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LITERATURE CITED

Abarca, F.J. 1987. Seasonal and diet patterns of feeding in loach minnow (Tiaroga cobitis Girard). Proceedings of the Desert Fishes Council 20:20.

Anderson, R.M. 1978. The distribution and aspects of the life history of *Meda fulgida* in New Mexico. New Mexico State University, Las Cruces, New Mexico. 62 pp.

Arizona Game and Fish Department. 1993. Upper Verde River survey, April 1993. Arizona Game and Fish Department, Phoenix, AZ. 8 pp.

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

Bagley, B.E., G.W. Knowles, and T.C. Inman. 1995. Fisheries surveys of the Apache-Sitgreaves National Forests, trip reports 1-9. May 1994 to September 1995. Arizona State University, Tempe, Arizona. 50 pp.

Bagley, B.E., G.H. Schiffmiller, P.A. Sowka, and P.C. Marsh. 1996. A new locality for loach minnow, *Tiaroga cobitis*. Proceedings of the Desert Fishes Council 28:8.

Bahre, C.J. 1991. A legacy of change. Historic human impact on vegetation in the Arizona borderlands. University of Arizona Press, Tucson, AZ.

Baltz, D.M. and P.B. Moyle. 1993. Invasion resistance to introduced species by a native assemblage of California stream fishes. Ecological Applications 246-255.

Barber, W.E. and W.L. Minckley. 1966. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. The Southwestern Naturalist 11(3):313-324.

Barber, W.E. and W.L. Minckley. 1983. Feeding ecology of a southwestern Cyprinid fish, the spikedace, *Meda fulgida* Girard. The Southwestern Naturalist 28(1):33-40.

Barber, W.E., D.C. Williams, and W.L. Minckley. 1970. Biology of the Gila spikedace, *Meda fulgida*, in Arizona. Copeia 1970(1):9-18.

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

Bestgen, K.R. 1986. Red shiner vs. native fishes: replacement or displacement? Proceedings of the Desert Fishes Council 18:209.

Blackburn, W.H. 1984. Impacts of grazing intensity and specialized grazing systems on watershed characteristics and responses. Pp. 927-983. In: Developing strategies for rangeland management. National Research Council/National Academy of Sciences. Westview Press. Boulder, CO.

Briggs, M. 1996. Riparian Ecosystem Recovery in Arid Lands: Strategies and References. University of Arizona Press, Tucson, Arizona.

Britt, K.D. 1982. The reproductive biology and aspects of the life history of *Tiaroga cobitis* in southwestern New Mexico. New Mexico State University, Las Cruces. 56 pp.

Brown, H.E., M.B. Baker,Jr., J.J. Rogers, W.P. Clary, J.L. Kovner, F.R. Larson, C.C. Avery, and R.E. Campbell. 1974. Opportunities for increasing water yields and other multiple use values on ponderosa pine forest lands. US Forest Service Rocky Mountain Forest and Range Experiment Station, Research Paper RM-129, Ft. Collins, CO. 1-36 pp.

Chaney, E., W. Elmore, and W.D. Platts. 1990. Livestock grazing on western riparian areas. U.S. Environmental Protection Agency, Eagle, ID. 44 pp.

Dobyns, H.F. 1981. From fire to flood: historic human destruction of Sonoran Desert riverine oasis. Ballena Press Anthropological Papers No. 20, 222 pp.

Douglas, M.E., P.C. Marsh, and W.L. Minckley. 1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: *Meda fulgida* (Cyprinidae) as a case study. Copeia 1994(1):9-19.

Duff, D.A. 1979. Riparian habitat recovery on Big Creek, Rich County, Utah. A method for analyzing livestock impacts on stream and riparian habitat in O.B. Cope (ed.) Forum -- Grazing and riparian/stream ecosystems. Trout Unlimited, Denver, Colorado.

Elmore, W. 1992. Riparian responses to grazing practices. Pp. 442-457 In: Watershed management; balancing sustainability and environmental change. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Elmore, W. and B. Kauffman. 1994. Riparian and watershed systems: degradation and restoration. Pages 212 - 231 *In* M. Vavra, W.A. Laycock, and R.D. Pieper (eds.) Ecological implications of livestock herbivory in the West. Society for Range Management, Denver, Colorado.

Erman, D.C., J.D. Newbold, and K.B. Roby. 1977. Evaluation of streamside bufferstrips for protecting aquatic organisms. California Water Resources Center, Univ. of California, Davis, CA. 48 pp.

Esposito, D.M., M.M. Milne, A.H. Simpson, and A. Gallardo. 1979. Verde Valley water pollution source analysis. Northern Arizona Council of Governments. 148 pp.

Ewing, D.B., J.C. Osterberg, and W.R. Talbot. 1994. Groundwater study of the Big Chino Valley, Technical Report. U.S. Bureau of Reclamation, Denver, CO.

Fleischner, T.L. 1994. Ecological costs of livestock grazing in western North America. Conservation Biology 8(3):629-644.

Galt, D., F. Molinar, J. Navarro, J. Joseph, and J. Holechek. 2000. Grazing Capacity and Stocking Rate. Rangelands 22(6):7 - 11.

Gifford, G.F., and R.H. Hawkins. 1978. Hydrologic impact of grazing on infiltration: a critical review. Water Resources Research. 14:305-313.

Goodman, T., G.B. Donart, H.E. Kiesling, J.L. Holechek, J.P. Neel, D. Manzanares, and K.E. Severson. 1989. Cattle behavior with emphasis on time and activity allocations between upland and riparian habitats. Pages 95 - 102 in R.E. Gresswell, B.A. Barton, and J.L. Kershner (eds.) Practical approaches to riparian resource management, an educational workshop. U.S. Bureau of Land Management, Billings, Montana.

Harper, K.T. and J.R. Marble. 1988. A role for nonvascular plants in management of arid and semiarid rangelands. Pp. 137-169 In: Vegetation science applications for rangeland analysis and management. Tueller, P.T., Ed. Kluwer Academic Publishers, Boston, MA.

Hastings, J.R. and R.M. Turner. 1980. The changing mile. University of Arizona Press, Tucson, AZ. 327 pp.

Heede, B.H. and J.N. Rinne. 1990. Hydrodynamic and fluvial morphologic processes: implications for fisheries management and research. North American Journal of Fisheries Management 10(3):249-268.

Hendrickson, D.A. 1989. Memorandum - Verde River fish sampling. Arizona Game and Fish Department, Phoenix, AZ. 2 pp.

Jakle, M. 1992. Memo Feb. 26, 1992 - Summary of fish and water quality sampling along the San Pedro River from Dudleyville to Hughes Ranch near Cascabel, Oct. 24 and 25, 1992, and the Gila River from Coolidge Dam to Ashurst/Hayden Diversion Dam, Oct. 28-31, 1991. U.S. Bureau of Reclamation, Phoenix, Az. 11 pp.

Johnson, K.L. 1992. Management for water quality on rangelands through best management practices: the Idaho approach. Pp. 415-441 In: Watershed management; balancing sustainability and environmental change. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Karr, J.R. and I.J. Schlosser. 1977. Impact of nearstream vegetation and stream morphology on water quality and stream biota. U.S. Environmental Protection Agency, Ecological Research Series 600/3-77-097. Athens, GA. 90 pp.

Kauffman, J.B. and W.C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management. . .a review. Journal of Range Management 37(5):430-438.

Kinch, G. 1989. Riparian area management: grazing management in riparian areas. U.S. Bureau of Land Management, Denver, CO. 44 pp.

Knowles, G.W. 1994. Fisheries survey of the Apache-Sitgreaves National Forests, third trip report: Eagle Creek, June 05-07 and August 02, 1994. Arizona State University, Tempe, AZ. 6 pp.

Kuntz, J. 1992. Upper Verde River riparian survey 1992. U.S. Forest Service, Prescott, AZ. 134 + figs pp.

Leopold, A. 1924. Grass, brush, timber, and fire in southern Arizona. Journal of Forestry 22(6):1-10.

Leopold, A. 1946. Erosion as a menace to the social and economic future of the southwest. A paper read to the New Mexico Association for Science, 1922. Journal of Forestry 44:627-633.

Leopold, L.B. 1951. Vegetation of southwestern watersheds in the nineteenth century. The Geographical Review 41:295-316.

Leopold, L.B. 1994. A view of the river. Harvard University Press, London, England. 298 pp.

Leopold, L.B. 1997. Water, rivers and creeks. University Science Books, Sausalito, CA. 185 pp.

Li, H.W., G.A. Lamberti, R.N. Pearsons, C.K. Tait, J.L. Li, and J.C. Buckhouse. 1994. Cumulative effects of riparian disturbances along high desert trout streams of the John Day Basin, Oregon. Transactions of the American Fisheries Society 123:627-640.

Li, H.W., C.B. Schreck, C.E. Bond, and E. Rexstad. 1987. Factors influencing changes in fish assemblages of Pacific Northwest streams. Pp. 193-202 In: Community and evolutionary ecology of North American stream fishes. Matthews, W.J. and D.C. Heins, Eds. University of Oklahoma Press, Norman, OK.

Lowrance, R., R. Todd, J. Fail,Jr., O. Hendrickson,Jr., R. Leonard, and L. Asmussen. 1984. Riparian forests as nutrient filters in agricultural watersheds. BioScience 34(6):374-377.

Mahoney, D.L. and D.C. Erman. 1981. The role of streamside bufferstrips in the ecology of aquatic biota. California Riparian Systems Conference, Sept. 17-19, 1981.

Marlow, C.B. and T.M. Pogacnik. 1985. Time of grazing and cattle-induced damage to streambanks. Pages 279-284 in R.R. Johnson, C.D. Zeibell, D.R. Patton, P.F. Ffolliot, and R.H. Hamre (Technical Coordinators) Riparian ecosystems and their management: reconciling conflicting uses. GTR RM-120, USDA Forest Service, Rocky Mountain Forest and Range Experimental Station, Fort Collins, Colorado. 523 pp.

Marrs, R.H., A. Rizand, and A.F. Harrison. 1989. The effects of removing sheep grazing on soil chemistry, above-ground nutrient distribution, and selected aspects of soil fertility in long-term experiments at Moor House National Nature Preserve. Journal of Applied Ecology 26:647-661.

Marsh, P.C. and J.E. Brooks. 1989. Predation by ictalurid catfishes as a deterrent to re-establishment of hatchery-reared razorback suckers. The Southwestern Naturalist 34(2):188-195.

Marsh, P.C., F.J. Abarca, M.E. Douglas, and W.L. Minckley. 1989. Spikedace *(Meda fulgida)* and loach minnow *(Tiaroga cobitis)* relative to introduced red shiner *(Cyprinella lutrensis)*. Report to Arizona Game and Fish Department. Phoenix, Arizona. 116 pp.

Marsh, P.C., J.E. Brooks, D.A. Hendrickson, and W.L. Minckley. 1990. Fishes of Eagle Creek, Arizona, with records for threatened spikedace and loach minnow (Cyprinidae). Journal of the Arizona-Nevada Academy of Sciences 23(2):107-116.

Martin, S.C. 1975. Ecology and management of southwestern semidesert grass-shrub ranges. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station, Research Paper RM-156, Ft. Collins, CO. 39 pp.

Meehan, W.R. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19, Bethesda, Maryland. 751 pp.

Miller, D. 1998. Fishery survey report. Negrito Creek within the Gila National Forest, New Mexico. 29 and 30 June 1998. Gila National Forest, Silver City, New Mexico. July 14, 1998. 7 pp.

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

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

Myers, T.J. and S. Swanson. 1995. Impact of deferred rotation grazing on stream characteristics in central Nevada: a case study. North American Journal of Fisheries Management 15:428-439.

Naiman, R.J. 1992. Watershed management. Springer-Verlag, New York, NY. 542 pp.

Orodho, A.B., M.J. Trlica, and C.D. Bonham. 1990. Long-term heavy-grazing effects on soil and vegetation in the four corners region. The Southwestern Naturalist 35(1):9-15.

Osborne, L.L. and D.A. Kovacic. 1993. Riparian vegetated buffer strips in water-quality restoration and stream management. Freshwater Biology 29:243-258.

Platts, W.S. 1990. Managing fisheries and wildlife on rangelands grazed by livestock. Nevada Department of Wildlife, Reno, NV. 462 pp.

Platts, W.S. and R.L. Nelson. 1985. Stream habitat and fisheries response to livestock grazing and instream improvement structures, Big Creek, Utah. Journal of Soil and Water Conservation 49(4):374-379.

Platts, W.S. and R.L. Nelson. 1989. Stream canopy and its relationship to salmonid biomass in the intermountain west. North American Journal of Fisheries Management 9:446-457.

Popolizio, C.A., H. Goetz, and P.L. Chapman. 1994. Short-term response of riparian vegetation to four grazing treatments. Journal of Range Management 47(1):48-53.

Prescott Daily Courier. 1994. City council ok's purchase of well. December 22, 1994. 112(305):1.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1986. Distribution, status, biology, and conservation of the spikedace (*Meda fulgida*) in New Mexico. Ed. 15. U.S. Fish and Wildlife Service, Endangered Species Reports, 93 pp.

Propst, D.L. and K.R. Bestgen. 1991. Habitat and biology of the loach minnow, *Tiaroga cobitis*, in New Mexico. Copeia 1991(1):29-38.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1988. Distribution, status, biology, and conservation of the loach minnow (*Tiaroga cobitis*) Girard in New Mexico. U.S. Fish and Wildlife Service Endangered Species Report 17, Albuquerque, NM. 75 pp.

Propst, D.L., P.C. Marsh, and W.L. Minckley. 1985. Arizona survey for spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*): Fort Apache and San Carlos Apache Indian Reservations and Eagle Creek, 1985. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 8pp. plus maps.

Rinne, J.N. 1988. Effects of livestock grazing exclosure on aquatic macroinvertebrates in a montane stream, New Mexico. Great Basin Naturalist 48:146-153.

Rinne, J.N. 1989. Physical habitat use by loach minnow, *Tiaroga cobitis* (Pisces: Cyprinidae), in southwestern desert streams. The Southwestern Naturalist 34(1):109-117.

Rinne, J.N. and W.L. Minckley. 1991. Native fishes of arid lands: a dwindling resource of the desert southwest. USFS Rocky Mtn. Forest and Range Exp. Station, General Tech. Rpt. RM-206, Ft. Collins, CO. 45 pp.

Rinne, J.N. 1999. The status of spikedace (*Meda fulgida*) in the Verde river, 1999: implications for management and research. Hydrology and Water Resources of Arizona and the Southwest. Proceedings of the 1999 meetings of the hydrology section, Arizona-Nevada Academy of Science Vol. 29.

Rinne, J.N. 2001. In press. Relationship of fine sediment and two native southwestern fish species. Hydrology and Water Resources of Arizona and the Southwest. Proceedings of the 2001 meetings of the hydrology section, Arizona-Nevada Academy of Science. Vol. 31.

Rinne, J.N. In press. Changes in fish assemblages, Verde River, Arizona, 1994-2002: Management implications. IN, J.N. Rinne, R. Hughes, and B. Calamusso (eds) Changes in Large River Fish Assemblages in North America: Implications for management and sustainability of native species. Amer. Fish Soc. Spec. Publ.

Rinne, J.N., and E. Kroeger. 1988. Physical habitat use by spikedace, *Meda fulgida*, in Aravaipa Creek, Arizona. Proceedings of the Western Assocation of Fish and Wildlife Agencies Agenda 68:1-10.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology. Pagosa Springs, CO.

Savory, A. 1988. Holistic resource management. Island Press, Covelo, CA. 563 pp.

Schlesinger, W.H., J.F. Reynolds, G.L. Cunningham, L.F. Huenneke, W.M. Jarrell, R.A. Virginia, and W.G. Whitford. 1990. Biological feedbacks in global desertification. Science 246:1043-1048.

Schreiber, D.C. 1978. Feeding interrelationships of fishes of Aravaipa Creek, Arizona. Arizona State University, Tempe, Arizona. 312 pp.

Schuhardt, S. 1989. Stream survey report, 1989, Verde River, Oak Creek, and tributaries and Verde River literature review. U.S. Forest Service, Flagstaff, AZ. 40 pp.

Schulz, T.T. and W.C. Leininger. 1990. Differences in riparian vegetation structure between grazed areas and exclosures. Journal of Range Management 43(4):295-299.

Schulz, T.T. and W.C. Leininger. 1991. Nongame wildlife communities in grazed and ungrazed montane riparian areas. The Great Basin Naturalist 51(3):286-292.

Silvey, W. and M.S. Thompson. 1978. The distribution of fishes in selected streams on the Apache-Sitgreaves National Forest. Completion Report to USDA Forest Service. Arizona Game and Fish Department, Phoenix, Arizona. 49 pp.

Skovlin, J.M. 1984. Impacts of grazing on wetlands and riparian habitat: a review of our knowledge. Pp. 1001-1103. In: Developing strategies for rangeland management. National Research Council/National Academy of Sciences. Westview Press. Boulder, CO.

Stefferud, S.E. 1995. Memo on crayfish species in Arizona. U.S. Fish and Wildlife Service, Phoenix, AZ. 1 pp.

Stromberg, J.C. 1993. Fremont cottonwood-Goodding willow riparian forests: a review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 26(3):97-110.

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 393 pp.

Sullivan, M.E., and M.E. Richardson. 1993. Functions and values of the Verde River riparian ecosystem and an assessment of the adverse impacts to these resources. U.S. Fish and Wildlife Service, Phoenix, AZ. 364 pp.

Szaro, R.C. and C.P. Pase. 1983. Short-term changes in a cottonwood-ash-willow association on a grazed and ungrazed portion of Little Ash Creek in central Arizona. Journal of Range Management 36(3):382-384.

Tellman, B., R. Yarde, and M.G. Wallace. 1997. Arizona's Changing Rivers: How people have affected the rivers. Water Resources Research Center, College of Agriculture, University of Arizona, Tucson.

Tibbets, C.A. 1992. Allozyme variation in populations of the spikedace (*Meda fulgida*) and the loach minnow Tiaroga cobitis. Proceedings of the Desert Fishes Council 24:37.

Tibbets, C.A. 1993. Patterns of genetic variation in three cyprinid fishes native to the American southwest. MS Thesis. Arizona State University, Tempe, Arizona. 127 pp.

U.S. Bureau of Land Management. 1990. Riparian management and channel evolution. Phoenix Training Center Course Number SS 1737-2. Phoenix, AZ. 26 pp.

U.S. Fish and Wildlife Service (USFWS). 1986a. Endangered and threatened wildlife and plants; determination of threatened status for the loach minnow. 51 FR 39478; October 28, 1996.

U.S. Fish and Wildlife Service (USFWS). 1986b. Endangered and threatened wildlife and plants; determination of threatened status for the spikedace. 51 FR 23781. July 1, 1986.

U.S. Fish and Wildlife Service. 1988. Upper Verde River fish sampling data, 1986-1987 IFIM study. US Fish and Wildlife Service, Phoenix, AZ. 51 pp.

U.S. Fish and Wildlife Service. 1989. Fish and Wildlife Coordination Act substantiating report, Central Arizona Project, Verde and East Verde River water diversions, Yavapai and Gila Counties, Arizona. U.S. Fish and Wildlife Service, Phoenix, AZ. 132 pp.

U.S. Fish and Wildlife Service (USFWS). 1994a. Endangered and threatened wildlife and plants; designation of critical habitat for the threatened loach minnow (*Tiaroga cobitis*). 59 FR10898. March 8, 1994.

U.S. Fish and Wildlife Service (USFWS). 1994b. Endangered and threatened wildlife and plants; Notice of 90-day and 12-month findings on a petition to reclassify the spikedace and loach minnow. 59 FR 35303. July 11, 1994.

U.S. Fish and Wildlife Service. 2000. Endangered and threatened wildlife and plants; final designation of critical habitat for the spikedace and loach minnow. 65 FR 24328.

Vallentine, J.F. 1990. Grazing management. Academic Press, Inc., San Diego, CA. 533 pp.

Vives, S.P. and W.L. Minckley. 1990. Autumn spawning and other reproductive notes on loach minnow, a threatened cyprinid fish of the American southwest. The Southwestern Naturalist 35(4):451-454.

Warren, P.L. and L.S. Anderson. 1987. Vegetation recovery following livestock removal near Quitobaquito spring, Organ Pipe Cactus National Monument. Technical Report No. 20. National Park Service, Cooperative National Park Resources Studies Unit, Tucson, AZ. 40 pp.

Weltz, M. and M.K. Wood. 1994. Short-duration grazing in central New Mexico: effects on sediment production. Journal of Soil and Water Conservation 41:262-266.

Williams, J.E., D.B. Bowman, J.E. Brooks, A.A. Echelle, R.J. Edwards, D.A. Hendrickson, and J.J. Landye. 1985. Endangered aquatic ecosystems in North American deserts with a list of vanishing fishes of the region. Journal of the Arizona-Nevada Academy of Science 20(1):1-62.

York, J.C. and W.A. Dick-Peddie. 1969. Vegetation changes in southern New Mexico during the past hundred years. Pp. 157-166 In: Arid lands in perspective.