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AESO/SE
2-21-95-F-020R
2-21-01-F-308
2-21-01-F-105
2-21-01-F-309
2-21-01-F-310 February 26, 2002

Mr. John C. Bedell
Forest Supervisor
Apache-Sitgreaves National Forests
P.O. Box 640
Springerville, Arizona 85938-0640

Dear Mr. Bedell:

This biological opinion responds to your request for consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act). Your February 26, 2001, request for formal consultation was received on February 27, 2001. At issue are impacts that may result from the proposed reissuance of the Term Grazing permit for the Tule Allotment (expired 2001), Mud Springs Allotment (expires 2004), and the ongoing grazing activity on the Double Circles, East Eagle, Baseline/Horsesprings, and Dark Canyon allotments in Greenlee County, Arizona. Your request for consultation and accompanying biological assessments found that the proposed action may affect the threatened loach minnow (*Tiaroga cobitis*), spikedace (*Meda fulgida*) and their respective critical habitat, and Southwestern willow flycatcher (*Empidonax traillii extimus*).

This biological opinion pertains to allotments contained in the Apache-Sitgreaves National Forests (Forest) within the Eagle Creek watershed, which comprises six of the twenty-eight allotments for which formal consultation was initially requested. In addition to initiating consultation for loach minnow, spikedace, their respective critical habitat, and the Southwestern willow flycatcher, the Forest requested formal conferencing for the proposed Chiricahua leopard frog (*Rana chiricahuensis*) on some allotments. The six allotments contained in this biological opinion and the effects determinations made by the Forest are outlined in Table 1.

TABLE 1: GRAZING ALLOTMENTS WITHIN EAGLE CREEK WATERSHED BIOLOGICAL OPINION

Allotment	Consultation Number	Forest's Effects Determination	Included in this Biological Opinion
East Eagle	2-21-01-F-309	• LAA Spikedace, Loach Minnow and Critical Habitat	• Yes
Mud Springs	2-21-01-F-105	• LAA Spikedace, Loach Minnow and Critical Habitat • MA/NLAA Razorback Sucker • MA/LAA Southwestern Willow Flycatcher • MA/NLAA Mexican Spotted Owl • NE Bald Eagle • MA/NLAA Lesser Long-nosed Bat • MA/NLJ Mexican Gray Wolf • MA/NLAA Jaguar • MA/NLAA Arizona hedgehog cactus	• Yes • No • Yes • No • No • No • No • No • No
Baseline Horsespring	2-21-95-F-020R	• LAA Spikedace, Loach Minnow and Critical Habitat • NLAA/NLJ Chiricahua leopard frog	• Yes • No
Double Circles	2-21-01-F-105	• LAA Spikedace, Loach Minnow and Critical Habitat • MA/NLAA Razorback Sucker • MA/LAA Southwestern Willow Flycatcher • MA/NLAA Mexican Spotted Owl • NE Bald Eagle • MA/NLAA Lesser Long-nosed Bat • MA/NLJ Mexican Gray Wolf • MA/NLAA Jaguar • MA/NLAA Arizona hedgehog cactus	• Yes • No • Yes • No • No • No • No • No • No
Tule	2-21-01-F-310	• LAA Spikedace, Loach Minnow and Critical Habitat • NLAA/NLJ Chiricahua leopard frog	• Yes • No
Dark Canyon	2-21-01-F-308	• LAA Spikedace, Loach Minnow and Critical Habitat • NLAA/NLJ Chiricahua leopard frog	• Yes • No

This biological opinion is based on information provided in the Forest's Biological Assessments, Environmental Assessments, addendums to the Biological Assessments, maps, and other documents associated with the above allotments; telephone conversations and/or electronic mail transmissions with Frank Hayes and Bill Wall of the Clifton Ranger District; a November 20, 2001, site visit to the allotments accompanied by Frank Hayes and Bill Wall; and other sources of information. A complete administrative record of this consultation is on file at this office. Table 2 provides a detailed list of primary documentation used in this biological opinion.

TABLE 2: PRIMARY DOCUMENTATION USED IN BIOLOGICAL OPINION

ALLOTMENT	PRIMARY DOCUMENTATION USED IN BIOLOGICAL OPINION
East Eagle	• 2000 Chiricahua leopard frog; Western Yellow-billed Cuckoo Addendum, East Eagle Allotment Ongoing Grazing
	• 2001 Allotment Summary Sheets for East Eagle
	• 2001 Addendum to the Biological Assessment and Evaluation In Regards To the East Eagle On-Grazing
Mud Springs	• December 2000, USDA Forest Service Southwestern Region Biological Assessment for Ongoing Grazing
	• November 2000 Grazing Consultation forms for Mud Springs Allotment
Baseline/ Horsprings	• May 2001, Addendum to the Biological Assessment and Evaluation In Regards to Baseline/Horsesprings Grazing Allotment
	• May 2001, Chiricahua leopard frog; Western Yellow-billed Cuckoo Addendum, Baseline/Horsesprings Allotment
	• December 1997, Final Environmental Analysis Baseline/Horsesprings Allotment Management Plan
	• December 1994, Biological Evaluation for Baseline/Horsesprings Allotment
Double Circles	• December 2000, USDA Forest Service Southwestern Region Biological Assessment for Ongoing Grazing
	• November 2000, Grazing Consultation Forms Double Circles Allotment
Tule Allotment	•May 2001 Addendum to the Biological Assessment and Evaluation In Regards to Tule Ongoing Grazing
	•May 2001 Chiricahua leopard frog Addendum, Tule Allotment
	•March 1998, Allotment Summary Sheets, Tule Allotment
Dark Canyon	•September 2001 Allotment Summary Sheets for the Dark Canyon Allotment
	•May 2001 Addendum to the Consultation Forms in Regards to Dark Canyon Ongoing Grazing
	•September 1999, Chiricahua leopard frog, Wester Yellow-billed Cuckoo Addendum, Dark Canyon Allotment
	•October 1998, Biological Assessment for Reauthorizing Livestock Grazing in the Southwest Region

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Consultation History

To address the designation of critical habitat for spikedace and loach minnow, on May 15, 2001, we received the Forest's May 14, 2001, letter requesting initiation and reinitiation of formal section 7 consultation. In addition to initiating consultation for loach minnow and spikedace critical habitat, the Forest requested formal conferencing for the proposed Chiricahua leopard frog. The Forest's consultation initiation package contained the basic information required to begin formal consultation and conferencing. On May 30, 2001, the Service entered into formal section 7 consultation with the Apache-Sitgreaves National Forest after we received all the necessary information.

On July 12, 2001, the Service requested to batch consultations by watershed (Blue/San Francisco, Eagle Creek, and Black River), a 60-day extension, and to do separate conferences on the allotments throughout the Forest which contained only leopard frog. On July 23, 2001, the Apache concurred with the requests of the Service. In a letter dated July 12, 2001, the Service explained that due to workload constraints we expected to begin work on two of the three watershed consultation batches (Black River Watershed and Blue/San Francisco Watersheds), with the third (Eagle Creek Watershed) postponed until a later date. A subsequent phone call from the Regional Forester's office indicated that the Forest Service would like all three watershed consultations to be completed at the same time. On September 25, 2001, we requested a 60-day time extension for the third watershed (Eagle Creek), which would result in a completion date of November 26, 2001. A letter from the Forest on October 5, 2001, granted an extension.

The Forest Service notified the Service on October 24, 2001, that the East Eagle allottees, Gary and Dary Ely, had been granted applicant status for purposes of this section 7 consultation and that Delbert Motes had been granted applicant status for the Mud Springs Allotment. On February 6, 2002, the Forest notified the Service that John Anderson had been granted applicant status for Double Circles Allotment, the Winkle Brothers had been granted applicant status for the Tule Allotment, and that Jim and Clarice Holder had been granted applicant status for the Baseline/Horsesprings Allotment.

An additional 60-day extension was requested by the Service on November 8, 2001. The Forest, in coordination with the applicants, granted this extension on November 15, 2001, making the due date for the biological opinion January 27, 2002. On November 19, 2001, the Service met with Clifton Ranger District staff to view the allotments contained in this Biological Opinion. In addition, numerous email and telephone communications have occurred regarding these allotments.

On December 26, 2001, a draft Biological Opinion was sent to the Forest. We received extensive comments from the Forest, comments from the applicants, and significant new information from the Forest on January 29, 2002. The Tule applicant's letter addressed concerns regarding the statement in the BAE and Biological Opinion that "100% of the Tule allotment is in unsatisfactory condition." In addition, the applicant was concerned that the Service was not

using the latest data available concerning the Tule Allotment. Permittees for the Baseline/Horsespring Allotment wanted it clearly outlined that loach minnow and spikedace could not inhabit Eagle Creek on their allotment because there is surface water only 2-3 months per year. Applicants for the East Eagle Allotment voiced concerns over the presence of loach minnow in Eagle Creek on the East Eagle Allotment. In addition, the applicants for the East Eagle Allotment wanted the BO to clearly state that there were factors outside of Forest Service land that was contributing to the environmental conditions on the allotment. Applicants for the Double Circle Allotment made comments about the number and names of summer and winter pastures on the allotment.

A letter dated September 25, 2001, from the Service issued concurrences for the Mexican gray wolf (*Canis lupus baileyi*), razorback sucker (*Xyrauchen texanus*), lesser-long nosed bat (*Leptonycteris curasoae yerbabuenae*), jaguar (*Panthera onca*), and Arizona hedgehog cactus (*Echinocereus triglochidiatus arizonicus*) for the Mud Springs and Double Circles allotments. The same letter issued a concurrence of "may effect, not likely to adversely affect" for the Mexican spotted owl (*Strix occidentalis lucida*) on the Double Circles Allotment. After the Service received additional information concerning the Mexican spotted owl on the Mud Springs Allotment from the Forest, the Service issued a concurrence of "may affect, not likely to adversely affect" on October 9, 2001 for that allotment. The Chiricahua leopard frog was also addressed in the September 25, 2001, letter to the Forest. The Service was unclear as to what guidance criteria the Forest was using to make an effects determination. Subsequent letters and discussions with the Forest indicated that a conference concerning the Chiricahua leopard frog was not warranted for these allotments. Therefore, a conference report for the Chiricahua leopard frog is not included in this biological opinion.

BIOLOGICAL OPINION

Description of Proposed Action

The six allotments described in this Biological Opinion are located in the Eagle Creek Watershed. Appendix A, Map 1 shows the location and relationship of the allotments on the Apache-Sitgreaves National Forest. In this biological opinion the allotments will be described in a north to south order. East Eagle, the northern-most allotment, will be described first followed by Mud Springs, Baseline/Horsesprings, Double Circles, Tule, and finally Dark Canyon, the southern-most allotment contained in this opinion.

The action area for the proposed action in this biological opinion consists of all covered allotment areas and the Forest Service and private land areas of the watersheds contained therein as shown in Appendix A, Map 8. Therefore, effects are not restricted to the allotments themselves, but extend for miles downstream or upstream of allotment boundaries, depending on the specific effect. The Forest uses a 25-mile guideline in the grazing consultation forms when examining downstream effects of an action. With streams, the action area is often much larger than the area of the proposed project because impacts may be carried downstream with the flow.

Watersheds and sub-watersheds are comprised of numerous inter-connected upland and riparian areas that function together as an ecological unit. As a result, activities in one part of the watershed can affect adjacent areas and activities in the uplands can affect riparian areas. Impacts to and from Reservation lands are not addressed.

Specifics of the proposed action for each allotment as provided by the Forest Service are discussed below:

East Eagle Allotment

The current Term Grazing permit for the East Eagle Allotment authorizes 410 cattle (cow/calf) and 10 horses from March 1 to February 28 each year. The East Eagle Allotment consists of nine pastures/unit which include (1) South East Eagle, (2) Dry Prong and Maylay, (3)North East Eagle, (4) McBride, (5) Sawmill, (6) Shorty and Triangle, (7) Steer, (8) Horse, and (9) Holding Pasture. Appendix A, Map 2 of this document provides a layout of the pastures on this allotment.

<u>The following provides details on the use and acreage of the East Eagle Allotment</u>:
Forest: Apache-Sitgreaves
Ranger District: Clifton
4th Code Basin: Gila
5th Code Sub-Watershed: Eagle Creek
Period of Proposed Action: Time remaining on a 10 year permit issued in 2001 or until NEPA for a new AMP is completed.
Season of Use: March 1 - February 28
Allotment Acres:
- Total acres = 37,259

Projected Stocking Density:
- Animal Unit Months 4,137

Proposed Use:
- 410 cow/calf
- 10 horses

Type of Grazing System:
- Deferred rotation grazing system

This allotment is grazed under a deferred rotation grazing system. Two winter pastures are used, with one grazed each winter while the other is rested for 18 months. Summer grazing occurs through a four pasture deferred system. Currently the allotment is under a Memorandum of Understanding (MOU) that only allows grazing up to 300 head until the completion of assigned range improvements and approval by the District Ranger. The MOU is in force until February 28, 2002. For the past five years the actual use on the allotment has been at 57% of the permitted number (410 cow/calf). Pastures with perennial streams are either excluded from grazing (Robinson grazing), used only for trailing livestock during limited periods in the spring and fall

(East Eagle and Eagle Creek), or are included within rest rotation winter grazing (Chitty Creek) where 6 months of grazing is followed by 18 months of rest. Trailing of livestock occurs through Eagle Creek twice a year.

Mud Springs Allotment

This allotment consists of ten pastures, only six of which are proposed for grazing. The ten pastures are Bear Canyon Trap, Gust Trap, Eagle Creek, Johnson (Strayhorse), P-Bar Pasture, PD Pasture and Holding, North, Big Pasture, Southwest, and Pipeline, the last six which are scheduled for grazing. Appendix A, Map 3 of this document provides a layout of the pastures on this allotment. The proposed season of use is from January 1 to February 28 the following year with 274 cattle (5,855 AUM's). Grazing will occur in a two-year cycle, with each grazing season lasting 6 weeks. For example, cattle are scheduled to enter the East Pasture on July 15 and exit the pasture on September 1 of the first year, and then will re-enter the pasture on September 1 and exit the pasture on October 15 of the second year. Once grazed, the pasture will receive complete rest during the next spring growing season (April to mid-July). According to the grazing consultation forms for the Mud Springs Allotment, maximum allowable use in key areas will be 35%.

<u>The following provides details on the use and acreage of the Mud Springs Allotment</u>:
Forest: Apache-Sitgreaves
Ranger District: Clifton
4th Code Basin: Gila
5th Code Sub-Watershed: Eagle Creek
Period of Proposed Action: Time remaining on a 10 year permit issued in 1994 or until NEPA for a new AMP is completed.
Allotment Acres:
- Total 25,182
- Full Capacity Range 4,549

Projected Stocking Density:
- Animal Months 5,855
- Acres Per Animal Month: 4

Proposed Use:
- 220 cow/calf
- 5 horses

Type of Grazing System:
- Deferred Rotation - Year-long

Prior to permit transfer to the present permittee in 1994, an MOU was developed with several private land owners along Eagle Creek which has resulted in exclusion of livestock along Eagle Creek since that date. In addition, the allotment is under an MOU for resource protection. This MOU is in place with range improvement maintenance and construction that would support an estimated capacity for the allotment of 274 cattle (5855 AUM's), or until the AMP environmental assessment is complete, scheduled to start within the next 3 years. Current levels

commensurate with the MOU, are a maximum of 220 cattle, depending on results of forage use monitoring. It is expected that this level of stocking is sustainable for the duration of the period until AMP analysis is complete (3-5 years).

Baseline/Horsesprings

The ongoing management for the Baseline/Horsesprings Allotment authorizes up to 100 cows with calves or between 190-405 yearlings in combination (total 3,019 AUM's) for a season of use between September 1 and May 30. Average actual use for the last 5 years has been 210 AUM's per year, with summer rest since 1996, and complete non-use in 2000-2001. The allotment is managed under a seven pasture, seasonal, deferred rotation schedule. The seven pastures of use are (1)North Water Loop, (2)South Water Loop, (3)North Bear Canyon, (4)Black Mountain, (5)East Eagle, (6)South Bear Canyon, and (7) Cemetery Pastures. Appendix A, Map 4 of this document provides a layout of the pastures on this allotment.

<u>The following provides details on the use and acreage of the Baseline/Horsesprings Allotment</u>:
Forest: Apache-Sitgreaves
Ranger District: Clifton
4th Code Basin: Gila
5th Code Sub-Watershed: Eagle Creek
Period of Proposed Action: Time remaining on a 10-year permit issued in 1998.
Season of Use: September 1 - May 30
Allotment Acres:

- Total 9,494
- Full Capacity Range 5,981

Projected Stocking Density:

- Animal Months 3,019

Proposed Use:

- Not to exceed 3,000 AUM's, in combination with either cows and/or yearlins, per Term Permit as described above.

Type of Grazing System:

- Deferred Rotation - Seasonal

Under this grazing schedule maximum livestock use duration within each of the seven main pastures is 40 days during the growing season, followed by growing season rest (USFS 1997). A minimum of 123 days of growing season rest for all grazing areas is prescribed. Under the proposed action livestock are not allowed into the ephemeral stream channel of Eagle Creek.

Double Circles Allotment

The allotment contains 4 winter pastures (Tabletop, Grey Peak, Main, and Four Bar Mesa) and 7 larger summer pastures (Cottonwood, Open Draw, NO Bar, Big Dry, Big Dry East, Bee Spring, and Pruner Flat). There are numerous smaller traps throughout the allotment used for holding, shipping, bulls and weaning livestock. PD pasture is about 75% private lands, used primarily for horses and weaning. About 100 acres of the Eagle Creek riparian corridor south of the

headquarters has been removed from the allotment acreage by fencing in 1999, and the remainder of the Eagle Creek corridor has been isolated through fencing in 1994. There are 13 very small pastures within the historic Double Circles ranch irrigated fields which are presently used in a limited, intensively rotated program, only when forage is available thereby maximizing rest and recovery only when forage is available. Based on the original Ongoing Grazing Biological Opinion issued in 1998, these fields are no longer cultivated, have been reseeded, and have been buffered with additional fencing from Eagle Creek to remove both direct and indirect effects. The following describes the allotment. Appendix A, Map 5 of this document provides a layout of the pastures on this allotment.

The following provides details on the use and acreage of the Double Circles Allotment:
Forest: Apache-Sitgreaves
Ranger District: Clifton
4th Code Basin: Gila
5th Code Sub-Watershed: Eagle Creek and Lower Blue River
Period of Proposed Action: Time remaining on a 10 year permit issued in 2001 or until NEPA for a new AMP is completed.
Season of Use: March 1 - February 28
Allotment Acres:
- Total acres 36,272
- Full Capacity Range 8,395

Projected Stocking Density:
- Animal Unit Months 6,424
- Acres Per Animal Month 6

Proposed Use:
- 400 cow/calf

Type of Grazing System:
- Year-long

Tule Allotment

The current Term Permit is 14 head of livestock, grazed year-long, and it expired in December, 2001. A new Term Permit will be issued for 5 years, for 14 livestock year-long season. As part of this permit, a 5 year MOU for management and capacity determination will be issued that will provide for staged stocking, commensurate with the results of forage and soils/watershed monitoring. Proposed stocking during the 2002 grazing period will be 30 cattle, 45 in 2003, and 60 in 2004-2006, pending results of monitoring. Monitoring will determine stocking rates for the duration of the Term Permit, to expire December 31, 2006. Results of the 5 years of stocking and monitoring will determine capacity to be provided in a new Term Permit. The Tule Allotment consists of 8 pastures, two of which are privately owned. The pastures are West, East, Tule Trap, Tule Springs (private land), Horse Trap, Tule, Tule Field (private land), and Cistern. Appendix A, Map 6 of this document provides a layout of the pastures on this allotment. The following describes the general conditions of the allotment.

The following provides details on the use and acreage of the Tule Allotment:
Forest: Apache-Sitgreaves
Ranger District: Clifton
4th Code Basin: Gila
5th Code Sub-Watershed: Eagle Creek
Period of Proposed Action: Time remaining on a 5 year permit to be issued in 2002 or until NEPA for a new AMP is completed (scheduled for 2006).
Season of Use: March 1 - February 28
Allotment Acres:
- Total acres 14,194

Projected Stocking Density:
- Animal Unit Months 216

Proposed Use By Year:
- 2001: 14 cow/calf
- 2002: 30 cow/calf
- 2003: 45 cow/calf
- 2004 - 2006: 60 cow/calf

Type of Grazing System:
- 3 primary pastures with 8-10 grazing areas delineated, maximizing rest for recovery.

Dark Canyon Allotment

The allotment management plan for livestock on the Dark Canyon Allotment prescribes a term grazing permit for 33 cattle (cow/calf) and 25 horses, year-long. There are currently six livestock pastures on the Dark Canyon Allotment: Spur Cross, Knight, Eagle Creek, Painted Bluff, Coronado, and Zorilla. Appendix A, Map 7 of this document provides a layout of the pastures on this allotment.

The following provides details on the use and acreage of the Dark Canyon Allotment:
Forest: Apache-Sitgreaves
Ranger District: Clifton
4th Code Basin: Gila
5th Code Sub-Watershed: Eagle Creek
Period of Proposed Action: Remaining time on a 10 year permit issued in 2001.
Season of Use: March 1 - February 28
Allotment Acres:
- Total 18,266 acres of National Forest land and 26 acres of private land

Projected Stocking Density:
- Maximum of 833 AUM's

Proposed Use:
- 25 horses, 33 cattle (cow/calf)

Type of Grazing System:
- Three pasture rest rotation - Year-long
- Primary use pastures - Spur Cross, Knight, and Painted Bluff

Trailing of livestock occurs through Eagle Creek twice a year.

Monitoring measures are part of the proposed action to evaluate changes over time in overall landscape conditions on the Dark Canyon Allotment. A record will be maintained of 1) changes in the planned annual livestock operation, 2) numbers of livestock stocked annually, 3) duration of use per grazing pasture, 4) general observations of utilization levels of available forage, 5) forage use patterns for livestock, 6) overall riparian condition, 7) regeneration of riparian species, 8) livestock use levels and patterns within riparian areas, and 9) any observations on wildlife, soil movement, or changes in the land area in order to improve future management. Point photographs will be used to document changes or observations. Production/utilization surveys will be conducted annually during the first three years and on a periodic basis thereafter to verify estimated capacity, allowable forage use levels, and use patterns.

Status of the Species/Critical Habitat

Spikedace

Spikedace was listed as a threatened species on July 1, 1986 (USFWS 1986a). Critical habitat was designated for spikedace on April 25, 2000 (USFWS 2000a). 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.

Spikedace is a small silvery fish whose common name alludes to the well-developed spine in the dorsal fin (Minckley 1973). Spikedace historically occurred throughout the mid-elevations of the Gila River drainage, but is currently known only from the Verde, middle Gila, 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). 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 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). It feeds primarily on aquatic and terrestrial insects (Schreiber 1978, Barber and Minckley 1983, Marsh *et al*. 1989).

When critical habitat was designated, the Service determined the primary constituent elements for spikedace. Constituent elements include those habitat features required for the physiological, behavioral, and ecological needs of the species. For spikedace, these include permanent, flowing, unpolluted water; living areas for adult spikedace with slow to swift flow velocities in shallow water with 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 downstream riffle edges; living areas for juvenile spikedace with slow to moderate flow velocities in shallow water with moderate amounts of instream cover; living areas for larval spikedace with slow to moderate flow velocities in shallow water with abundant instream cover; sand, gravel, and cobble substrates with low to moderate amounts of fine sediment and substrate embeddedness; pool, riffle, run, and backwater components present in the aquatic habitat; low stream gradient; water temperatures in the approximate range of 35 to 65 degrees Fahrenheit; abundant aquatic insect food base; periodic natural flooding; a natural, unregulated hydrograph or, if the flows are modified or regulated, then a hydrograph that demonstrates an ability to support a native fish community; and habitat devoid of nonnative aquatic species detrimental to spikedace or habitat in which detrimental nonnative species are at levels that allow the persistence of spikedace.

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

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

The status of spikedace is declining rangewide. Although it is currently listed as threatened, the Service has found that a petition to uplist the species to 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 1994a).

Loach Minnow

Loach minnow was listed as a threatened species on October 28, 1986 (USFWS 1986b). Critical habitat was designated for loach minnow on April 25, 2000 (USFWS 2000a). 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.

Loach minnow is a small, slender, elongate fish with markedly upwardly-directed eyes (Minckley 1973). Historic 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). 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, Dry Blue, Pace, Frieborn, Negrito, Whitewater and Coyote 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, Bagley *et al*. 1995, USBLM 1995, Bagley *et al*. 1996, Miller 1998).

Loach minnow is a bottom-dwelling inhabitant of shallow, swift water over gravel, cobble, and rubble substrates (Rinne 1989, Propst and Bestgen 1991). Loach minnow uses the spaces between, and in the lee of, larger substrate for resting and spawning (Propst *et al*. 1988; Rinne 1989). It is rare or absent from habitats where fine sediments fill the interstitial spaces (Propst and Bestgen 1991). Some studies have indicated that the presence of filamentous algae may be an important component of loach minnow habitat (Barber and Minckley 1966). Loach minnow feeds exclusively on aquatic insects (Schrieber 1978, Abarca 1987). Spawning occurs in March through May (Britt 1982, Propst *et al*. 1988); however, under certain circumstances loach minnow also spawn in the autumn (Vives and Minckley 1990). The eggs of loach minnow are attached to the underside of a rock that forms the roof of a small cavity in the substrate on the downstream side. Limited data indicate that the male loach minnow may guard the nest during incubation (Propst *et al*. 1988, Vives and Minckley 1990).

When critical habitat was designated for loach minnow, the Service determined the primary constituent elements for loach minnow. These elements include permanent, flowing, unpolluted water; living areas for loach minnow adults, juveniles, and larvae with appropriate flow regimes and substrates; spawning areas; low amounts of fine sediment and substrate embeddedness; riffle, run, and backwater components; low to moderate stream gradients; appropriate water temperatures; periodic natural flooding; an unregulated hydrograph, or, if flows are modified, a hydrograph that demonstrates an ability to support a native fish community; and habitat devoid of nonnative aquatic species detrimental to loach minnow, or habitat where such nonnative species are at levels which allow persistence of loach minnow. These constituent elements are general descriptions and ranges of selected habitat factors that are critical for the survival and recovery of loach minnow.

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

Recent biochemical genetic work on loach minnow indicate that there are substantial differences in genetic makeup between remnant loach minnow populations (Tibbets 1993). Remnant populations occupy isolated 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 minnow should be managed as separate units to preserve the existing genetic variation.

The status of loach minnow is declining rangewide. Although it is currently listed as threatened, the Service has found that a petition to uplist the species to 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 1994c).

Southwestern Willow Flycatcher

The southwestern willow flycatcher is a small grayish-green passerine bird (Family Tyrannidae) measuring approximately 5.75 inches. It has a grayish-green back and wings, whitish throat, light gray-olive breast, and pale yellowish belly. Two white wingbars are visible (juveniles have buffy wingbars). The eye ring is faint or absent. The upper mandible is dark, and the lower is light yellow grading to black at the tip. The song is a sneezy fitz-bew or a fit-a-bew, the call is a repeated whitt.

The southwestern willow flycatcher is one of four currently recognized willow flycatcher subspecies (Phillips 1948, Unitt 1987, Browning 1993). It is a neotropical migrant that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). The historic breeding range of the southwestern willow flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja) (Unitt 1987).

The southwestern willow flycatcher was listed as endangered, without critical habitat on February 27, 1995 (USFWS 1995). Critical habitat was later designated on July 22, 1997 (USFWS 1997a). A correction notice was published in the Federal Register on August 20, 1997

to clarify the lateral extent of the designation (USFWS 1997b). On May 11, 2001, the 10th circuit court of appeals set aside designated critical habitat in those states under the 10th circuit's jurisdiction. The Service decided to set aside critical habitat designated for the southwestern willow flycatcher in all states (California, Arizona, and New Mexico) until it can re-assess the economic analysis.

Declining southwestern willow flycatcher numbers have been attributed to loss, modification, and fragmentation of riparian breeding habitat, loss of wintering habitat, and brood parasitism by the brown-headed cowbird (Sogge *et al.* 1997, McCarthey *et al.* 1998). Habitat loss and degradation are caused by a variety of factors, including urban, recreational, and agricultural development, water diversion and groundwater pumping, channelization, dams, and livestock grazing. Fire is an increasing threat to willow flycatcher habitat (Paxton *et al.* 1996), especially in monotypic saltcedar vegetation (DeLoach 1991) and where water diversions and/or groundwater pumping desiccates riparian vegetation (Sogge *et al.* 1997). Willow flycatcher nests are parasitized by brown-headed cowbirds (*Molothrus ater*) which lay their eggs in the host's nest. Feeding sites for cowbirds are enhanced by the presence of livestock and range improvements such as waters and corrals; agriculture; urban areas; golf courses; bird feeders; and trash areas. When these feeding areas are in close proximity to flycatcher breeding habitat, especially coupled with habitat fragmentation, cowbird parasitism of flycatcher nests may increase (Hanna 1928, Mayfield 1977a,b, Tibbitts *et al.* 1994).

Habitat

The southwestern willow flycatcher breeds in dense riparian habitats from sea level in California to approximately 8000 feet in Arizona and southwestern Colorado. Historic egg/nest collections and species' descriptions throughout its range, describe the southwestern willow flycatcher's widespread use of willow (*Salix* spp.) for nesting (Phillips 1948, Phillips *et al.* 1964, Hubbard 1987, Unitt 1987, T. Huels *in litt.* 1993, San Diego Natural History Museum 1995). Currently, southwestern willow flycatchers primarily use Geyer willow, Goodding's willow, boxelder (*Acer negundo*), saltcedar (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolio*) and live oak (*Quercus agrifolia*) for nesting. Tamarisk is an important component of the flycatchers's nesting and foraging habitat in Arizona. In 2000, 270 of the 303 known nests built were placed in a tamarisk tree (Paradzick *et al.* 2001). Other plant species less commonly used for nesting include: buttonbush (*Cephalanthus* sp.), black twinberry (*Lonicera involucrata*), cottonwood (*Populus* spp.), white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* spp.). Based on the diversity of plant species composition and complexity of habitat structure, four basic habitat types can be described for the southwestern willow flycatcher: monotypic willow, monotypic exotic, native broadleaf dominated, and mixed native/exotic (Sogge *et al.*1997).

Open water, cienegas, marshy seeps, or saturated soil are typically in the vicinity of flycatcher territories and nests; flycatchers sometimes nest in areas where nesting substrates were in standing water (Maynard 1995, Sferra *et al.* 1995, 1997). However, hydrological conditions at a particular site can vary remarkably in the arid Southwest within a season and among years. At some locations, particularly during drier years, water or saturated soil is only present early in the

breeding season (i.e., May and part of June). However, the total absence of water or visibly saturated soil has been documented at several sites where the river channel has been modified (e.g. creation of pilot channels), where modification of subsurface flows has occurred (e.g. agricultural runoff), or as a result of changes in river channel configuration after flood events (Spencer *et al.* 1996).

Breeding Biology

Throughout its range the southwestern willow flycatcher arrives on breeding grounds in late April and May (Sogge and Tibbitts 1992, Sogge *et al.* 1993, Sogge and Tibbitts 1994, Muiznieks *et al.* 1994, Maynard 1995, Sferra *et al.* 1995, 1997). Nesting begins in late May and early June and young fledge from late June through mid-August (Willard 1912, Ligon 1961, Brown 1988a,b, Whitfield 1990, Sogge and Tibbitts 1992, Sogge *et al.* 1993, Muiznieks *et al.* 1994, Whitfield 1994, Maynard 1995). Southwestern willow flycatchers typically lay three to four eggs per clutch (range = 2 to 5). Eggs are laid at one-day intervals and are incubated by the female for approximately 12 days (Bent 1960, Walkinshaw 1966, McCabe 1991). Young fledge approximately 12 to 13 days after hatching (King 1955, Harrison 1979). Typically one brood is raised per year, but birds have been documented raising two broods during one season and renesting after a failure (Whitfield 1990, Sogge and Tibbitts 1992, Sogge *et al.* 1993, Sogge and Tibbitts 1994, Muiznieks *et al.* 1994, Whitfield 1994, Whitfield and Strong 1995). The entire breeding cycle, from egg laying to fledging, is approximately 28 days.

Southwestern willow flycatcher nests are fairly small (3.2 inches tall and 3.2 inches wide) and its placement in a shrub or tree is highly variable (2.0 to 59.1 feet off the ground). Nests are open cup structures, and are typically placed in the fork of a branch. Nests have been found against the trunk of a shrub or tree (in monotypic saltcedar and mixed native broadleaf/saltcedar habitats) and on limbs as far away from the trunk as 10.8 feet (Spencer *et al.* 1996). Flycatchers using predominantly native cottonwood/willow riparian habitats nest low to the ground (5.9 to 6.9 feet on average), whereas birds using mixed native/exotic and monotypic exotic riparian habitats nest higher (14.1 to 24.3 feet on average). Birds nesting in habitat dominated by box elder nest the highest (to almost 60 feet).

The southwestern willow flycatcher is an insectivore, foraging in dense shrub and tree vegetation along rivers, streams, and other wetlands. The bird typically perches on a branch and makes short direct flights, or sallies to capture flying insects. Drost *et al.* (1998) found that the major prey items of the southwestern willow flycatcher (in Arizona and Colorado), consisted of true flies (Diptera); ants, bees, and wasps (Hymenoptera); and true bugs (Hemiptera). Other insect prey taxa included leafhoppers (Homoptera: Cicadellidae); dragonflies and damselflies (Odonata); and caterpillars (Lepidoptera larvae). Non-insect prey included spiders (Araneae), sowbugs (Isopoda), and fragments of plant material.

Brown-headed cowbird parasitism of southwestern willow flycatcher broods has been documented throughout its range (Brown 1988a,b, Whitfield 1990, Muiznieks *et al.* 1994, Whitfield 1994, Hull and Parker 1995, Maynard 1995, Sferra *et al.* 1995, Sogge 1995b). Where studied, high rates of cowbird parasitism have coincided with southwestern willow flycatcher

population declines (Whitfield 1994, Sogge 1995a,c, Whitfield and Strong 1995) or, at a minimum, resulted in reduced or complete nesting failure at a site for a particular year (Muiznieks *et al.* 1994, Whitfield 1994, Maynard 1995, Sferra *et al.* 1995, Sogge 1995a,c, Whitfield and Strong 1995). Cowbird eggs hatch earlier than those of many passerine hosts, thus giving cowbird nestlings a competitive advantage (Bent 1960, McGeen 1972, Mayfield 1977a,b, Brittingham and Temple 1983). Flycatchers can attempt to renest, but it often results in reduced clutch sizes, delayed fledging, and reduced nest success (Whitfield 1994). Whitfield and Strong (1995) found that flycatcher nestlings fledged after July 20th had a significantly lower return rate and cowbird parasitism was often the cause of delayed fledging.

Territory size

Southwestern willow flycatcher territory size likely fluctuates with population density, habitat quality, and nesting stage. Estimated territory sizes are 0.59 to 3.21 acres for monogamous males and 2.72 to 5.68 acres for polygynous males at the Kern River (Whitfield and Enos 1996), 0.15 to 0.49 acres for birds in a 1.48 to 2.22 acre patch on the Colorado River (Sogge 1995c), and 0.49 to 1.24 acres in a 3.71 acre patch on the Verde River (Sogge 1995a). Territories are established within a larger patch of appropriate habitat sufficient to contain several nesting pairs of flycatchers. These birds appear to be semi-colonial nesters.

Rangewide Distribution and Abundance

Unitt (1987) documented the loss of more than 70 southwestern willow flycatcher breeding locations rangewide (peripheral and core drainages within its range) estimating the rangewide population at 500 to 1000 pairs. There are currently 182 known southwestern willow flycatcher breeding sites in California, Nevada, Arizona, Utah, New Mexico, and Colorado (all sites from 1993 to 1999 where a resident flycatcher has been detected) holding approximately 915 territories (Appendix B, Table 1). Sampling errors may bias population estimates positively or negatively (e.g., incomplete survey effort, double-counting males/females, composite tabulation methodology, natural population fluctuation, and random events) and it is likely that the total breeding population of southwestern willow flycatchers fluctuates. Numbers have increased over the last few years, and some habitat remains unsurveyed; however, they are consistent with the 1987 estimate that 500 to 1000 pairs probably exist. About 50 percent of the 915 territories are currently found throughout the subspecies range are located at three locations (U-Bar Ranch - NM, Roosevelt Lake - AZ, San Pedro/Gila confluence - AZ).

Rangewide, the population is comprised of extremely small, widely-separated breeding groups including unmated individuals. For example, in Arizona, 57 percent (27/47) of the sites where flycatchers were found in 2000 (Paradzick *et al.* 2001) were comprised of five or fewer territories. In Arizona during the 2000 season, all but the "Salt River Inflow Site" at Roosevelt Lake had 20 pairs or less (Paradzick *et al.* 2001). Rangewide, 81 percent of all sites from 1993 to 1999 had 5 or less flycatcher territories present at the site (Sogge *et al.* 2000).

The distribution of breeding groups is highly fragmented, often separated by considerable distance. In Arizona, about a 55 mile straight-line distance exists between breeding flycatchers at Roosevelt Lake, Gila County, and the next closest pairs on the San Pedro River, Pinal County or Verde River, Yavapai County.

The large distances between breeding groups and small size of those populations reduces meta-population stability and increases the risks of local extirpation due to stochastic events, predation, cowbird parasitism, and other factors. Willow flycatchers no longer occur at 40 of the 182 sites located and/or tracked rangewide since 1993 (USFWS 2001). All but two of these sites had less than 5 flycatcher territories present. The two exceptions (PZ Ranch on San Pedro River and Colorado River Delta at Lake Mead) were destroyed by fire and lake inundation, respectively; however, many more than 5 territories will be lost at Roosevelt Lake in the near future.

Unlike many other endangered bird species, the flycatcher's habitat is dynamic and can change rapidly: nesting willow habitat can grow out of suitability; saltcedar habitat can develop from seeds to suitability in five years; heavy runoff can remove all habitat in a day; or river channels, floodplain width, location, and vegetation density may change over time. Because of those changes, flycatcher "habitat" is often defined in three categories: potential, suitable, or occupied. This demonstrates that areas other than existing occupied locations can be considered flycatcher "habitat." The development of flycatcher habitat is a dynamic process involving, maintenance, recycling, and regeneration of habitat. Flycatcher habitat can quickly change and vary in suitability, location, and occupancy over time (Finch and Stoleson 2000).

Arizona Distribution and Abundance

As reported by Paradzick *et al.* (2001), the largest concentrations or general locations of willow flycatchers in Arizona in 2000 were near the confluence of the Gila and San Pedro rivers (219 flycatchers, 119 territories); at the inflows of Roosevelt Lake (207 flycatchers, 115 territories); Gila River, Safford area (30 flycatchers, 15 territories); Topock Marsh on the Lower Colorado River (25 flycatchers, 15 territories); Verde River at Camp Verde (9 flycatchers, 5 territories); Alpine/Greer on the San Francisco River/Little Colorado River (7 flycatchers, 5 territories); Alamo Lake on the Bill Williams River (includes lower Santa Maria and Big Sandy river sites) (44 flycatchers, 24 territories); Big Sandy River, Wikieup (23 flycatchers, 16 territories) and Lower Grand Canyon on the Colorado River (14 flycatchers, 8 territories). The greatest number of flycatchers are found at two general locations. Roosevelt Lake and the San Pedro/Gila confluence make up 234 (71%) of the 328 territories known in the state.

Unitt (1987) concluded that "...probably the steepest decline in the population level of *E.t. extimus* has occurred in Arizona..." Historic records for Arizona indicate the former range of the southwestern willow flycatcher included portions of all major river systems (Colorado, Salt, Verde, Gila, Santa Cruz, and San Pedro) and major tributaries, such as the Little Colorado River and headwaters, and White River.

Just after listing in 1996, 145 territories were known to exist in Arizona. In 2000, 328 territories were detected. However, the increase of 153 territories at Roosevelt and at San Pedro/Gila River confluence since 1995 represent almost 85 percent of statewide growth. Discovery as a result of survey effort was a large factor in detecting more birds at San Pedro/Gila confluence, but the Roosevelt population grew as a result of increased habitat development in the conservation pool of the reservoir.

While numbers have increased in Arizona and significantly at a few specific areas, distribution throughout the state has not changed much. Recovery and survival of the flycatcher depends not only on numbers of birds, but territories that are well distributed (USFWS 2001). As a result, the population stability in Arizona has been largely dependent on the presence of two large populations (Roosevelt Lake and San Pedro/Gila River confluence). Therefore, the result of catastrophic events or losses of significant populations either in size or location would greatly change the status and survival of the bird. Conversely, expansion into new habitats with increases in number of birds would also improve the stability and status of the flycatcher.

Some areas of Arizona have recently declined in known flycatcher abundance, specifically northern Arizona and the White Mountains in central/eastern Arizona. Populations in northern Arizona and the White Mountains have existed along the Colorado River in the Grand Canyon and upper Lake Mead, Little Colorado River, San Francisco River, and Verde River. The known populations at these sites declined from a high of 35 territories in 1996 to 19 territories in 2000 (Paradzick *et al.* 2001).

Because of the bird's low numbers, the effects of management and research activities are a concern. Survey and nest monitoring activities, and handling and banding procedures are regulated by Federal and State permitting processes to remove and reduce effects to the bird. Trapping, handling, banding, determining the nest's status, and removing cowbird eggs can, even with the most careful biologist, result in injury or death to a bird. Specific training in standardized survey and monitoring procedures (Sogge *et al*. 1997) are required throughout its range.

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 actions now under consultation.

General Eagle Creek Watershed Baseline

Eagle Creek is an 83 mile tributary of the Gila River in Greenlee County, Arizona. It is an intermittent stream, with perennial flow above and below the proposed project area. From Mud Springs Canyon to Big Dry Canyon, Eagle Creek has surface water only about 2 to 3 months per year. Approximately 31 miles (75%) of the perennial flow reaches are on non-National Forest lands, including Tribal and private lands.

Human influences to Eagle Creek have come primarily from livestock grazing, water development, mining, irrigated agriculture, roads, recreation, beaver removal, and flood control/channelization. Although the area is remote and sparsely settled, these human activities have caused changes to the watershed and the stream channel. Altered hydrologic conditions within the Eagle Creek watershed have resulted in a braided stream channel throughout much of

the upper, non-canyon reach of Eagle Creek. Surface flow in substantial areas of the creek ceases during parts of the year, where anecdotal information from local residents indicates the stream may have flowed perennially throughout the year in the early 1900's. These changes were occurring as early as 1921, when Leopold noted that significant erosion of the floodplain was underway (Leopold 1921, 1946).

Grazing by livestock has been the primary pervasive use of the Eagle Creek watershed for the past 150 years with substantial alteration of watershed vegetation, soil, erosion, and hydrologic characteristics (Leopold 1946, USFS 2001a-g). Livestock grazing within the watershed has been reduced from historic levels and the Forest Service and private landowners are working cooperatively to improve the management of livestock in the riparian corridor of Eagle Creek (pers comm. Frank Hayes, November 6, 2001). These cooperative efforts have facilitated improvement of riparian vegetation. Almost all livestock grazing on the main stream channel has been removed on Forest lands, although it continues on some private land. Table 4 details the actual stocking densities on the Eagle Creek watershed since 1998, indicating a decrease in stocking density in some allotments over the four years.

TABLE 4: Eagle Creek Watershed Actual Stocking Density
(All numbers based on year-long grazing unless otherwise noted)

	1998	1999	2000	2001
East Eagle Allotment	12 horses 221 cow/calf	12 horses 223 cow/calf	12 horses 148 cow/calf	12 horses 222 cow/calf
Mud Springs Allotment	173 cow/calf 5 horses	178 cow/calf 5 horses	182 cow/calf	181 cow/calf pairs 5 horses
Baseline/ Horsespring Allotment	190 yearlings for six months	250 yearlings for six months	None Stocked	None Stocked
Double Circles Allotment	247 head of cattle 1/1/98-5/30/98 347 head of cattle 6/1/98 - 10/30/98	349 cattle	326 cattle	281 cattle
Tule Allotment	14 cow/calf	14 cow/calf	14 cow/calf	14 cow/calf
Dark Canyon Allotment	15 horses	12 horses	8 horses	20 horses
Mesa Allotment*	75 cattle	75 cattle	75 cattle 50 yearlings	125 cattle 3/1 - 6/15
AD/ Hogtrail Bar Allotment*	58 cattle 8 horses	105 cattle 8 horses	60 cattle	20 cattle 7 horses

* These allotments are not on Eagle Creek, but remote uplands only.

Water development and interbasin water transfers have altered the volume and timing of flow in the creek. In 1945, Phelps Dodge Corporation constructed a diversion from the Black River (Gila River basin) into Willow Creek, a tributary of middle Eagle Creek. This diversion augments flow in Eagle Creek below Willow Creek by about 27 percent (Minckley and Sommerfeld 1979). That water, plus an additional 9 percent, is removed about 15 miles downstream at a diversion dam and pumping station. That diversion has been in place since before 1919 (Olmstead 1919) and the water is piped to the Phelps Dodge copper mine at Morenci, where mining started in 1872 (Bahre 1991). Furthermore, local residents pump groundwater from the basin for domestic and agricultural use and Phelps Dodge pumps groundwater and places it into the stream channel for transport to the diversion dam for subsequent removal (USGS 1994).

While no major mining occurs in the Eagle Creek drainage, the massive copper mine in the adjacent San Francisco drainage at Clifton/Morenci has impacted Eagle Creek. Augmentation and diversion of water by Phelps Dodge is primarily for supporting mining operations. Also affecting the Eagle Creek watershed was the historic cutting of timber for mine construction and fuel. According to Olmstead (1919) "the watershed [of Eagle Creek] has been badly torn up for the past nine years, largely on account of changes in the ground cover conditions, due to extensive mining operations." Extensive harvest of wood from watersheds surrounding the Clifton/Morenci mines decimated both upland and riparian woodlands and its depletion made it necessary to bring additional wood for the mines from as far away as Wilcox (Bahre 1991). In addition, it is likely that some of the wood from the Eagle Creek watershed was moved down the creek in tie-drives (Coor 1992). To facilitate this on small streams without sufficient flow to carry logs, cut logs were stockpiled behind small trees on a slope near the stream and when flood flows rose, the small trees were knocked down with small charges of dynamite allowing the logs to roll into the flood waters and be carried downstream (B. Marks, Blue, Arizona, pers. com. 1994). Water transportation of logs is highly destructive of stream channels and fish habitat (Meehan 1991) with long-term consequences.

Road construction, reconstruction, and maintenance has resulted in substantial alterations in the hydrologic regime of Eagle Creek, and associated tributaries of East Eagle and Dry Prong above Honeymoon campground. Approximately 8 miles of the 22 miles of Forest Road 217 which connects Highway 191 to Honeymoon campground, follows closely along upper Eagle Creek to the campground destination, including 3 crossings (all on private or Tribal lands) and substantial amount of private lands. Following floods of 1973 and 1984 significant reconstruction occurred of portions of the upper roadway in this 8 mile corridor. Travelways and roads above Honeymoon campground into perennial reaches of East Eagle and Dry Prong forks of upper Eagle Creek were historically dozier access roads to ranch cabins or sawmill locations. Prior to 1991, both prongs had roadways that were traveled the entire length, but were closed to vehicle traffic following the 1993 winter flood events. Previous management of these travelways included both dozing open roadways and clearing/burning of large log jams. These practices were completed in both drainages following the flood of 1983, but have been discontinued since

that time. According to Clifton District Ranger, Frank Hayes, in cooperation with Greenlee County, has taken a proactive road maintenance approach along the 22 mile Forest Road 217, and especially in the 8 mile corridor since about 1993, with hardening of Eagle Creek crossings to reduce siltation, improved hardening of road surfaces to reduce maintenance and siltation from runoff, and eliminating direct stream alternations for road reconstruction if required (pers comm. Frank Hayes, January 24, 2002). Very limited maintenance has been performed on Forest Road 8369 (upper Eagle Creek above Honeymoon campground), with a seasonal closure (Feb 1-June 30) implemented in February of 2000 to enhance riparian recovery.

In addition to habitat alterations, various nonnative aquatic species have been introduced by humans into Eagle Creek and have adversely affected spikedace, loach minnow, and other native fishes through predation and competition (Marsh *et al.* 1990). Nonnative species that have been reported from Eagle Creek include black bullhead (*Ameiurus melas*), yellow bullhead (*Ameriurus natalis*), common carp (*Cyprinus carpio*), red shiner (*Cyprinella lutrensis*), mosquitofish (*Gambusia affinis*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieui*), largemouth bass (*Micropterus salmoides*), rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), flathead catfish (*Pylodictis olivaris*), and crayfish (probably *Oronectes virilis*) (Kynard 1976; Minckley and Sommerfeld 1979; Propst *et al.* 1985; Hendrickson 1987; Papoulias *et al.* 1989; Brown 1990; Marsh *et al.* 1990; Knowles 1994). Native species still form the majority of the fish community in Eagle Creek above the Phelps Dodge diversion dam, but nonnatives dominate below the dam. The long-term trend in the native/nonnative species balance is toward more nonnatives and less natives. However, the presence of the diversion dam has deterred the upstream movement of many nonnatives and available data are too limited to determine the present rate of the trend in upper Eagle Creek.

Changes in streamflow and hydrologic cycles have caused reduction in the presence of large riparian trees and loss of recruitment along Eagle Creek overall. Aquatic habitat diversity in Eagle Creek is low with few pools and a dominant habitat of shallow runs and riffles over unstable cobble-gravel-boulder substrate (Marsh *et al.*1990, Arizona Game and Fish Department 1994, Knowles 1994). Although Eagle Creek supports a relatively intact native fish community, the past and present impacts to the stream and its fish are substantial. Aquatic habitats in Eagle Creek have also been impacted by crayfish and roads. Both spikedace and loach minnow are rare in Eagle Creek.

Within the Eagle Creek drainage, but excluding the San Carlos Apache Reservation[1], there have been 9 formal consultations involving effects to spikedace and/or loach minnow. There have also been 3 emergency consultations and 5 informal concurrences with "is not likely to adversely affect." These consultations are summarized in Table 5.

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[1]Section 7 consultations on the Reservation are conducted by the Service's Arizona Fisheries Resources Office, and information on those consultations is not available to the Arizona Ecological Service's Office, in compliance with Service policy regarding the San Carlos and White Mountain Apache Tribes.

TABLE 5. SPIKEDACE AND LOACH MINNOW SECTION 7 CONSULTATIONS ON EAGLE CREEK				
Project	Date of Opinion or Concurrence	Consultation Number	Species[2]	Finding
FORMAL CONSULTATIONS				
Apache-Sitgreaves NF Land and Resource Management Plan	May 6, 1986	2-21-83-F-16	spikedace	net benefit
Channel stabilization and flood repair at Fillman Ranch	January 28, 1994	2-21-94-F-002	spikedace	Nonjeopardy
Livestock grazing on the Baseline/Horse Springs Allotment	July 20, 1995	2-21-95-F-020	spikedace loach minnow	Nonjeopardy
Spillway repair on Phelps-Dodge diversion dam	July 22, 1996	2-21-96-F-335	spikedace	Nonjeopardy
Land and resource management plans, as amended for 1 Nat. Forest and grasslands	December 19, 1997	2-21-97-F-416	loach minnow spikedace	Nonjeopardy
Livestock grazing on East Eagle Allotment - ongoing grazing	February 2, 1999	000089RO	loach minnow spikedace	Nonjeopardy
Livestock grazing on Dark Canyon Allotment-grazing permits	June 30, 1999	2-22-99-F-016	loach minnow spikedace	Nonjeopardy
Robinson Mesa prescribed burn	October 8, 1999	2-21-99-F-317	loach minnow	Nonjeopardy
Eagle Creek Bank Stabilization Project	October 31, 2000	2-21-00-F-298	loach minnow spikedace	Nonjeopardy
EMERGENCY CONSULTATIONS				
Road repairs on FR 217	January 27, 1995	2-21-95-I-165	loach minnow spikedace	incomplete

[2]Only species also in this biological opinion are included here and only if the analysis was for that species in Eagle Creek

Road repairs on FR 217	February 14, 1995	2-21-95-I-165	loach minnow spikedace	incomplete
Road repairs on FR 217	March 10, 1995	2-21-95-I-165	loach minnow spikedace	incomplete
INFORMAL CONSULTATIONS - IS NOT LIKELY TO ADVERSELY AFFECT CONCURRENCES				
Programmatic on Forest Service grazing permits - unknown allotments	May 1995 (FWS programmatic concurrence)		loach minnow spikedace	blanket concurrence based on "guidance criteria"
Spillway repair on Phelps-Dodge diversion dam	July 22, 1996	2-21-96-F-335	loach minnow	concurrence
East Eagle Addition prescribed burn	May 2, 1997	2-21-97-I-077	loach minnow	concurrence
Ongoing grazing activities on Forest Lands - Bee Springs, Big Dry, Dark Canyon, and Mud Springs allotments	May 1, 1998 (FWS programmatic concurrence)	000089RO	loach minnow spikedace	blanket concurrence based on "guidance criteria"
Robinson Mesa prescribed burn	October 8, 1999	2-21-99-F-317	spikedace	concurrence

The combined effects of livestock management activities associated with the Eagle Creek Watershed allotments confounded with unsatisfactory watersheds and impaired soil conditions may be impeding survival and recovery of these fish species. There have been recent efforts by the National Forest to ameliorate some of the erosion and sedimentation problems aggravated by ongoing livestock grazing activities on these allotments. For example, the National Forest has implemented exclusion of livestock from most riparian areas. Actions like this are a proactive approach and have the potential to measurably benefit the ecosystem; but monitoring data are required to determine their effectiveness.

Status of the Species Within the Action Area

Loach minnow and spikedace

The historic fish fauna of Eagle Creek is incompletely documented. There are no early records of the fish, except at the confluence with the Gila River. However, using the few records available, in conjunction with records from the nearby Gila, San Francisco and Blue rivers and Bonita Creek, and based on information of earlier conditions of the stream and its habitat, it can be concluded that 12 species of native fish were probably found in the Eagle Creek system. Of

those 8[3] (66%) are still present; a much higher proportion than in the adjacent San Francisco and Blue river systems, where only 35 and 40% of the native species remain, respectively. Eagle Creek retains more native fish species than any other stream in the Gila River basin. Aravaipa Creek and the upper Gila River in New Mexico both retain 7 species. In addition, razorback suckers have been reintroduced into Eagle Creek (Hendrickson 1993), although it is unknown if any remain.

In 1934, Madsen (1935) and Gorsutch (University of Michigan Museum of Zoology Catalogue) sampled upper Eagle Creek and East Eagle Creek, respectively, looking for sport fish opportunities. Madsen (1935) recorded it to be full of "suckers", "bonytails", and Gorsutch found longfin dace, chub, speckled dace, and desert sucker. The first extensive survey was in 1950, when Miller recorded 7 native species, including loach minnow but not spikedace (Marsh et al. 1990). He found no nonnative fish species. In 1978, Minckley and Sommerfeld (1979) recorded 4 native species and 9 nonnatives, primarily in the lower creek, downstream from the Forest. Beginning in the mid-1980's, sampling of Eagle Creek fishes became more frequent and thorough. In 1985 larval samples from Eagle Creek revealed the presence of spikedace and 6 other natives, plus 3 nonnatives (Bestgen 1985, Propst *et al.* 1985).

Spikedace was first reported from Eagle Creek in 1985 when it was collected as larval fish from lower Eagle Creek (Bestgen 1985). In 1987 an intensive survey of Eagle Creek found spikedace common in the stretch from near Sheep Wash (on the Double Circles Allotment) downstream to the Phelps Dodge diversion dam (Marsh *et al.* 1990). No spikedace have been found in several sampling efforts in Eagle Creek since 1987 (Marsh *et al.* 1990, March 1993, Arizona Game and Fish Department 1994, Knowles 1994). Large fluctuations in numbers and distribution is a common pattern in short-lived, highly fecund fish species, particularly in marginal or deteriorated habitat and may be indicative of increased vulnerability to extinction (Minckley *et al*. 1991, Goodman 1987). The failure of the spikedace population in Eagle Creek to rebound to the levels seen in 1987 may indicate habitat deterioration or may reflect sampling limitations. Eagle Creek from Sheep Wash confluence downstream to the PD diversion dam is considered occupied by the Forest (USFS 1998a) because of the abundance of suitable habitat. Similarly, fish biologists believe that this area provides an abundance of suitable habitat and is occupied (USFS 1998a, USFWS 1994b).

Both distribution and abundance of spikedace have become dramatically reduced in the past century. Past changes in range and density undoubtedly occurred in response to natural and spatial and temporal variations in the environment, but the current threatened status of spikedace appears to be a direct or indirect result of human's activities. Within the upper Gila watershed in Arizona, spikedace are known only to occur within Eagle Creek, tributary to the Gila River in Graham and Greenlee counties.

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[3]Longfin dace (*Agosia chrysogaster*), speckled dace (*Rhinichthys osculus*), spikedace (*Meda fulgida*), loach minnow (*Tiaroga cobitis*), Gila chub (*Gila intermedia*), roundtail chub (*Gila robusta*), desert sucker (*Pantosteus clarki*), and Sonora sucker (*Catostomus insignis*)

In 1994, loach minnow were documented for the first time since 1950 (Knowles *et al.* 1995). Loach minnow continue to be found in the area from the first road crossing below the Honeymoon Campground (Smelley Crossing on the Mud Springs Allotment) to the campground (Knowles 1995, Marsh 1996, Bagley and Marsh 1997). Additionally, in March of 2000, loach minnow were identified at Honeymoon Campground indicating that they are further upstream (on the East Eagle Allotment) than previously documented (USFWS 2000b). This documentation was a visual sighting in which the fish were observed displaying behavior specific to loach minnow (pers. comm. Sally Stefferud, USFWS 2000b). The observation was discussed with other fish experts and placed in the required permit documentation requirements.

On Eagle Creek, critical habitat for both species extends from the Phelps-Dodge diversion dam, upstream to the confluence of Dry Prong and East Eagle creeks (Appendix A, Map 8). The project area and the entire action area (see Environmental Baseline section for definition) contain critical habitat of both the spikedace and loach minnow.

Southwestern Willow Flycatcher

The grazing consultation forms for the Double Circles and Mud Springs allotments note that surveys were conducted for flycatchers during 1995 within the Eagle Creek riparian corridor (USFS 2001d, 2001e). No flycatchers were detected, and it was determined that no suitable habitat existed within the allotment. The grazing consultation forms also note that improvements in riparian habitat may result in different determinations for this habitat. Grazing currently exists on both of these allotments outside of the riparian areas and on non-Forest Service lands within five miles of potential habitat. Nevertheless, the action area could become future habitat for the Southwestern willow flycatcher. Currently, all Forest Service riparian habitat along Eagle Creek has been protected from direct impacts due to livestock grazing. In addition, several private land parcels contiguous with upper Eagle Creek, about 200 acres, are managed with MOU's with the Apache-Sitgreaves National Forest in place to preclude livestock grazing.

Flycatchers are known to occur on the Apache-Sitgreaves National Forest at two locations, one each on the Little Colorado and San Francisco rivers. The nearest known nesting flycatchers on the Apache-Sitgreaves National Forest are those located northeast of the action area along the San Francisco River (approximately 32 air miles from the action area), with multiple territories documented each year as follows: five each in 1993 and 1994, four in 1995, three in 1996, two in 1997, three each in 1998 and 1999, and two in 2000. Flycatchers also inhabit lower elevation riparian habitats along the middle Gila river southeast of the project area about 25 air miles away.

Field inspections in the summer of 2000 indicated recovery of riparian vegetation along portions of Eagle Creek in Double Circles and Mud Springs allotments. All potential habitat for this species falling within these allotments has improved since the 1995 surveys and no changes to livestock management are expected which would preclude future riparian habitat improvement. Livestock grazing will not be permitted within the Eagle Creek riparian corridors as part of the

proposed action; therefore, cattle will not be permitted to graze in potential habitat. However, the BAE notes that cattle will be permitted to graze other portions of the allotment during the critical (i.e., growing) season.

Allotment by Allotment Baseline Conditions

East Eagle Allotment

The East Eagle Allotment has primarily been grazed on a year-long basis. According to the East Eagle addendum upland vegetation overstory is primarily mountain brush (34%), pinon/juniper woodland (24%), juniper/beargrass (18%), ponderosa pine (13%), mixed conifer (10%), and riparian hardwood (2%). Elevation ranges from 5,000 to 8,500 feet.

The East Eagle Allotment is managed under a Term Grazing Permit that includes a Memorandum of Understanding for resource protection, non-use of a portion of the permitted livestock numbers, and resting of Eagle Creek from Sawmill to the southern allotment boundary. With the exception of crossing and trailing of Eagle Creek during pasture moves, Eagle Creek on the allotment has been excluded from grazing. Livestock are to be excluded from Robinson Canyon riparian area. According to the 1998 Biological Opinion for Southwest Region U.S. Forest Service ongoing livestock grazing activities, the number of permitted livestock is correlated with range improvement construction and maintenance, livestock management, and improvement in range conditions on the East Eagle Allotment. Proactive livestock management, including riparian fencing and development of off-stream watering sites, have resulted in improved ecological conditions of both uplands and riparian corridors, especially where perennial flows occur within the allotment.

Riparian areas with perennial water on the East Eagle Allotment include about ½ mile of East Eagle Creek, about 1 mile of Eagle Creek below the confluence of Dry Prong and East Eagle, ¼ mile of Robinson Canyon that enters Eagle Creek below the East Eagle-Dry Prong confluence, and about 1 mile of Chitty Creek. The hydrologic assessment of Dry Prong Creek, from the Reservation boundary to its confluence with East Eagle Creek (within the Forest Service boundary), is that it is in very poor condition (USFS 2001b). In the past, it was likely a riparian gallery forest dominated by sycamores. Excessive flows from impaired upland conditions have almost eliminated riparian vegetation, with little recovery evident. Near Honeymoon, the riparian vegetation is generally connected and there are at least three age-classes of riparian vegetation. Although the riparian systems within the allotment are not likely to disintegrate, improvement may not be evident though until these woody species regain their foothold and demonstrate improved vigor and reproduction (USFS 2001b).

Using the Proper Functioning Condition method of riparian assessment, the Eagle Creek drainage, generally speaking, is functioning at risk with an upward trend. Timeframes associated with full recovery are estimated to be in excess of 50 to 100 years, in part dependent on regrowth and incorporation of sufficient amounts of woody vegetation and coarse woody debris.

However, due to the apparently unstable flow regimes of some major tributaries, along with flow augmentation and removal through pumping, the potential configuration of a stable Eagle Creek system will be different from what it was, and may take centuries to equilibrate (USFS 2001b).

Loach minnow were documented in 1997 near the first crossing downstream of Honeymoon Campground (USFS 2001c), approximately 3 miles downstream of the southern most portion of the allotment. Additionally, loach minnow were found at the Honeymoon campground on the allotment in 2000 (USFWS 2000b). This second documentation was a visual sighting in which the fish were observed displaying behavior specific to loach minnow. The observation was discussed with other fish experts and placed in the necessary permit documentation requirements. Conversely, spikedace have never been found on the allotment. The closest known spikedace was collected at Sheep Wash in 1989 (approximately nine miles downstream from the southern border of the allotment). Critical habitat for both species occurs on this allotment for about three river miles in Upper Eagle Creek. Channel alterations, down cutting, water diversions, and removed riparian vegetation characterize critical habitat on this allotment. Although the baseline conditions are anticipated to remain stable or improve, watershed and riparian conditions of designated critical habitat on the East Eagle Allotment may have effects to the species regarding the constituent elements of embeddedness, sedimentation, and changes in stream morphology that already exist. Embeddedness was considered moderate in Eagle Creek on the East Eagle Allotment (USFS 2001b). There is a lack of backwater habitat in the critical habitat. Bank cutting was rated as moderate and riparian conditions were rated at risk but improving for critical habitat.

Mud Springs Allotment

The Mud Springs Allotment is located at the northwest corner of the Clifton Ranger District. The allotment is primarily bordered by Eagle Creek on the western side and ranges in elevation from 5,000 to 8,500 feet (Map 3).

Approximately 31% (7,698 acres) of the allotment consists of pinyon juniper cover. The pinyon-juniper cover is sparse to moderate herbaceous cover and the overstory increases in density to the north. Eight percent (2,076 acres) of the allotment is grasslands which the allotment summary sheets describe as in fair to good condition. Browse constitutes 32% (8,146 acres) of the allotment. The allotment summary sheets mention that there has been some historical overuse of these areas. Chaparral and ponderosa pine constitute 12% (3,020 acres) and 14% (3,521 acres) respectively. Riparian areas constitute the remaining 3% (717 acres) of the allotment. According to the allotment summary sheets, Eagle Creek is improving. The other two riparian areas on the allotment, Mud Springs Canyon and Bear Canyon, are ephemeral streams. Half of the watershed (12,228 acres) was rated as in satisfactory condition, while the other half was thought to be in unsatisfactory condition (USFS 2001f).

Range condition on the allotment was described in the allotment summary sheets. Twenty-four percent (6,128 acres) of the allotment was rated as fair. Twenty-seven percent (7,007 acres) of the allotment was rated as having good range condition. The remaining 48% (12,047 acres) of the allotment was not rated due to being “No Capacity” or areas such as Eagle Creek and several traps that are not utilized by livestock (USFS 2001f).

There are approximately six miles of critical habitat for the spikedace and loach minnow in Eagle Creek on the Mud Springs Allotment, with some of this located on private lands. Critical habitat also occurs five miles downstream of the allotment (including some private land) and immediately upstream on the East Eagle Allotment for approximately 2.5 miles (including some private land). Two primary constituent elements are lacking in the critical habitat on this allotment: habitat devoid of nonnative species and low amounts of fine sediment and substrate embeddedness. Loach minnow have been captured near the first crossing downstream of the Honeymoon campground (USFS 1998c) which is on the allotment, but within a riparian corridor pasture that has received planned rest from authorized livestock grazing since at least 1991. According to the Clifton District Ranger this occupancy was immediately adjacent to one crossing that has been enhanced through cooperation with the county road maintenance crew with specific objectives to improve native fish habitat (reduced sedimentation and even flows over a riffle-type substrate) (pers comm. Frank Hayes, January 24, 2002). Additionally, loach minnow were found at the Honeymoon campground above the allotment in 2000 (USFWS 2000b). Conversely, spikedace have never been documented on the allotment. The closest known spikedace was collected at Sheep Wash in 1989 (approximately eight miles downstream from the southern border of the allotment).

The Mud Springs Allotment, contains 25,251 acres and comprises 14% of the Eagle Creek 5th Code Watershed. A surface water hydrologic connection exists between the Gila River and all the tributaries of the Eagle Creek Watershed via Eagle Creek. Existing watershed and riparian conditions on this allotment are primarily a result of current and previous livestock grazing and have resulted in reduced ground cover, stream channel down cutting and widening, alteration of hydrologic processes; and degradation of aquatic, fisheries and riparian conditions according to the grazing consultation forms for this allotment (USFS 2000e).

Southwestern willow flycatchers have not been observed on the Mud Springs Allotment during surveys by the AGFD in 1995 (USFS 1998c). In addition, in 1995 AGFD determined that suitable habitat for Southwestern willow flycatchers does not exist on the Mud Springs Allotment. Potential suitable habitat for this species has improved since the 1995 surveys and proposed livestock management is expected to continue the trend of riparian habitat improvement.

Baseline/Horsesprings Allotment

The Baseline-Horsesprings Allotment is located within the Upper and Lower Eagle Creek 5th code watersheds (Map 4). Its small size, however, limits its contributions to less than 2% of the acreage to either watershed. Eagle Creek is only an intermittent stream from Mud Springs Canyon to Big Dry Canyon (which includes the entire Baseline/Horsespring Allotment) with surface water only about 2-3 months per year, generally December to February. Portions of Bee Canyon, Bear Canyon, and Eagle Creek are within the allotment boundaries, and provide drainages in the Eagle Creek system. In the major drainages, the most critical factor precluding

riparian gallery development may be the poor watershed conditions (49% of the allotment currently has poor to very poor vegetative conditions and 57% of the soil conditions are currently impaired to unsatisfactory, which result in high peak flows which periodically scour the drainages (USFS 1997).

The Baseline-Horsesprings Allotment was grazed on a year-long basis up until 1996. The allotment was not grazed by livestock from 1996-1998. The allotment was again grazed in 1998 and 1999. However, during the past two years (2000 and 2001) the allotment did not receive livestock use. The Forest is planning for the Baseline-Horsesprings Allotment to be grazed by cattle in 2002.

Elevation ranges from 4,800 to 6,400 feet. Upland vegetation overstory is primarily alligator juniper woodland (51%), pinon/juniper/oak/beargrass (18%), grassland (17%), oneseed juniper woodland (11%), and riparian hardwood (1%) (USFS 2001a). Table 5 provides a comparison of the allotment conditions from 1995 to 1997.

Table 5: Vegetation and Soil Conditions - Baseline/Horsesprings Allotment

	1995	1997
Upland Vegetation Trend	Upward	50% upward 21% Stable 29% Downward
Upland Vegetation Condition	Generally Stable	0% Excellent 51% Good to Fair 49% Poor to Very Poor
Riparian Vegetation Condition	Degraded, Regeneration is low	10% Satisfactory 90% Unsatisfactory
Soil Condition	Generally Stable 20-30% vertisol soils	41% Satisfactory 37% Impaired 22% Unsatisfactory

Riparian vegetation is found along Eagle Creek, Bear Canyon, and Bee Canyon. Riparian vegetation on Eagle Creek includes Arizona sycamore (*Platanus wrightii*) and narrowleaf cottonwood (*Populus angustifolia*) with an understory of Arizona walnut (*Juglans major*), boxelder (*Acer negundo*), and alder (*Alnus oblongifolia*). Little regeneration of woody vegetation is occurring (USFS 2001a). On Bear and Bee canyons, riparian vegetation consists of Arizona walnut, willow (*Salix* sp.) boxelder, ash (*Fraxinus* sp.), gray oak, rabbitbrush, and widely scattered Arizona sycamore. Regeneration of riparian vegetation is low. Terrace vegetation along the streams includes juniper, pinyon, gray oak, desert ceanothus, and other species.

Current poor range conditions, in some areas of the allotment, may partially be the cumulative result of past overgrazing and the resulting degraded soil conditions. Baseline/Horseprings Allotment has been grazed since the mid to late 1800's; the first grazing permit was issued in the

early 1920's and the first management system was implemented in 1972. That management system was a three pasture rest rotation grazing schedule with a preference for 100 head of cattle on the Baseline Allotment and a two pasture rest rotation schedule with a preference for 146 cattle on the Horsespring Allotment. Current conditions in Eagle Creek are variable with the creek being dry most of the year during years with average precipitation. Although spikedace and loach minnow have not been documented on this allotment critical habitat consists of entire length of Eagle Creek on this allotment although it is ephemeral to seasonally intermittent.

On July 20, 1995, the Service provided the Forest with biological opinion regarding the allotment management plan for livestock grazing on the Baseline/Horsesprings Allotment (Table 5). The biological opinion issued incidental take for three listed species, loach minnow, spikedace, and razorback sucker, and was based on indirect effects to habitat (now considered critical habitat for loach minnow and spikedace), particularly from flows originating in drainages of Bear Canyon and Bee Springs which enter perennial aquatic reaches of Eagle Creek below the allotment boundary on the Double Circles allotment. Four objectives for minimizing and documenting incidental take were given. Terms and conditions given to implement the reasonable and prudent measures included minimization of activities, pollutant control, restriction of heavy equipment use in wetted channel, minimization of channel and floodplain alterations, monitoring for fish loss when activities occur in wetted channel, and two photopoints and one cross channel transect on Eagle Creek. These annual monitoring reports have not been received by the Service. These monitoring reports help to establish the baseline conditions of the allotment and identify where improved ecological conditions on the allotment have occurred.

Double Circles

The Double Circles Allotment contains 36,272 acres on the Clifton Ranger District. The allotment is bordered by Eagle Creek along its western border (Map 5). The allotment comprises 17% of the Eagle Creek 5th Code Watershed and 6% of the Lower Blue River 5th Code Watershed. The elevation on the allotment ranges from 5,000 to 7,000 feet (USFS 1998b).

The cover type on the allotment was described in the 1998 allotment summary sheets. Approximately 47% (17,129 acres) of the allotment consists of pinyon-juniper cover. This cover is sparse to moderate herbaceous cover and ranges from open to closed canopies. Thirty percent (10,930 acres) of the allotment consists of grasslands which are in poor to fair condition. Browse constitutes 13% (4,909 acres) of the allotment. There has been some overuse of browse cover on the allotment. Ponderosa pine comprises 6% (2,095 acres) of the allotment, while 0.5% (210 acres) of the allotment consist of chaparral cover. Approximately 3% (996 acres) of the allotment consist of riparian vegetation. According to the summary sheets, riparian vegetation on both Eagle Creek and Sheep Wash is improving (USFS 1998b).

Much of the allotment is considered to be in poor condition due to pinyon and juniper encroachment according to the grazing consultation forms. Range conditions from 1970 indicate that 55% of the allotment is in fair condition while the remaining 45% is in poor condition. The

allotment summary sheets indicate that in 1998, 29% (10,535 acres) of the allotment were in poor condition, 33% (12,154 acres) were in fair condition, and the remaining 37% (13,583 acres) not calculated due to No Capacity or areas such as Eagle Creek and several traps that are not utilized (USFS 1998b).

Approximately three miles of Eagle Creek on the Double Circles Allotment is designated critical habitat for loach minnow and spikedace near the northern boundary of the allotment. Critical habitat also occurs for eleven miles downstream of the allotment where Eagle Creek re-enters the Apache-Sitgreaves National Forests, and immediately upstream for approximately 13 miles (Map 5). Sporadic surveys in the past have failed to discover loach minnow on this allotment (USFS 2000d); therefore, current occupancy cannot be verified; however the fish historically occupied Eagle Creek and its tributaries.

Spikedace were last documented along the northern allotment border in 1989 near Sheep Wash confluence. Eagle Creek on the Double Circles Allotment is likely occupied by spikedace since fish movement downstream is unimpeded. The allotment summary sheets mention that Dr. Paul Marsh (ASU) strongly believes that they still persist in Eagle Creek, especially between Sheep Wash and the PD diversion dam, which has an abundance of suitable critical habitat. This area provides an abundance of suitable habitat (USFS 1998b); however, Eagle Creek may be in some state of impairment, both hydrologically and biologically (USFS 1998b).

Southwestern willow flycatchers have not been observed on the Double Circles Allotment during surveys by the AGFD in 1995 (USFS 1998b). In addition, in 1995 AGFD determined that suitable habitat for Southwestern willow flycatchers does not exist on the Double Circles Allotment. Potential suitable habitat for this species has improved since the 1995 surveys and proposed livestock management is expected to continue the trend of riparian habitat improvement.

Tule Allotment

According to the Tule Ongoing Grazing addendum, the Tule Allotment is located within the Eagle Creek and San Francisco 5th code watersheds. Tule encompasses 9% of the total Eagle Creek Watershed and less than 1% of the Lower San Francisco River watershed. A general watershed condition assessment was made for the Forest in the Environmental Impact Statement for the A-S National Forests. Based on this broadscale assessment completed in the early 1980's, about 60% of the Tule Allotment was considered in satisfactory/untreatable watershed condition, while 40% was considered unsatisfactory. Recent field reviews and documentation of riparian and watershed conditions show substantial improvement (Martinez 2001a and 2001b, pers comm. Frank Hayes, January 24, 2002) since the last range analysis was completed. An extensive re-analysis of soil and watershed conditions has not been completed.

According to District Ranger, Frank Hayes, the Tule Allotment Term Grazing permit to Arthur Wright was reduced through administrative decision in the late 1970's from 228 head to 125 head over a period of years through consecutive reductions. Upon subsequent permit transfer in 1986,

the Term Permit numbers were reduced to 90 head of cattle, year-long, based on original capacity estimate and forage utilization surveys from the 1970's range analysis. The permit was again reduced to 60 head year-long in 1989, without supporting forage use or administrative documentation, and was placed in non-use status. In 1991, the Term Permit was further reduced when transferred to the current permittees (Winkle Brothers) without either environmental analysis or administrative decision protocol. The allotment remained in non-use status until 1993, when the permitted number of 14 head of livestock was stocked. Capacity estimates, based on the 1970's range analysis, and subsequent soils and topographical assessments at the Forest and allotment level, vary between 64-125 head. In the past ten years since the Winkle family has managed the Tule Allotment, Frank Hayes believes that "they have demonstrated a commitment to the responsibilities of the Forest permit which exemplifies dedicated land stewardship, including intensive livestock management abilities to obtain effective distribution, forage use, and herbaceous/wetland recovery" (pers comm. Frank Hayes, January 24, 2002).

The Tule Allotment has primarily been grazed on a year-long basis, with an intensive grazing program implemented since 1996. Elevation on the allotment ranges from 4,500 to 7,000 feet. Upland vegetation overstory is primarily pinon/juniper (48%), mountain brush (24%), Arizona cypress (18%), grassland (5%), chaparral (4%), pine (1%), and riparian hardwood (1%) (USFS 2001g).

Seventy-eight percent of the soils on the allotment have no capacity. In 1973, 88% of the full and potential capacity acres were rated in fair or better condition and of these 84% had a downward trend. By 1987, the Forest Plan Environmental Impact Statement rated 60% of the soil conditions as satisfactory while the remaining 40% were unsatisfactory (USFS 2001g).

In this reach, Eagle Creek is a wide, steep walled canyon with well-developed terraces. Its substrate consists mostly of a variety of particle sizes but is dominated by cobble and gravel sand bottom. Streamflow is perennial and Eagle Creek has experienced several high flow flood events in the last ten years. The Eagle Creek riparian area is characterized by deciduous riparian speices such as alders, cottonwoods, sycamores, maples, willow, and baccharis. Vegetation is predominantly seedlings and saplings with a few remnants of old growth trees scattered along the stream course. Regeneration of riparian species is occurring, and canopy densities are moderate between 40-70%. Mesquite bosques dominate the terraces (USFS 2001g).

The Tule addendum outlines a site visit along Tule Creek by District Fisheries biologist, Bill Wall. As described, riparian recovery was indicated by multiple age classes within the riparian community. Remnant old growth of walnut, sycamore, and a few cottonwoods were present. The channel and its banks were recovering and considered stable in regard to bankfull events. No significant ungulate presence or damage was detected. Gullying within the canyon wall was minimal with evidence of healing in those that were present (USFS 2001c).

No loach minnow have been documented along the allotment boundary according to the allotment Summary Sheet. Loach minnow were documented at the first crossing downstream of Honeymoon Campground in 1950, 1994, 1995, 1996, and 1997. This location is approximately

16 miles upstream from the northern border of the allotment. The closest known population of spikedace to the Tule Allotment is at P-Bar, five miles downstream. Spikedace also occur six miles upstream near Sheep Wash confluence. This area has an abundance of suitable habitat, and it is thought that spikedace persist in Eagle Creek between Sheep Wash and the PD diversion dam (USFS 2001g). Therefore, it is thought that the one mile of critical habitat on this allotment is occupied by spikedace.

The critical habitat within Eagle Creek on the Tule Allotment is limited to the far southwestern portion of the allotment and is described as a shallow water habitat, with slow to moderate flows that are usually available between April and mid July and between September and December. Due to a reduction in sinuosity and entrenched stream channels, there is a limited low to moderate flow velocity habitat (backwater components and quality pools) during the spring rains/snow melt and the monsoons. Instream cover is also lacking due to lack of a woody debris component and embeddedness with the cobble substrate within Eagle Creek (USFS 2001c). Over the past 125 years, increased sediment inputs from indirect effects (overland flow, destabilization of ephemeral and intermittent channels, and the creation of gully washes) and direct effect (riparian loss and channel widening) have increased embeddedness within loach minnow and spikedace critical habitat on the Tule Allotment.

Dark Canyon Allotment

The Dark Canyon Allotment is located within the Eagle Creek and San Francisco 5th code watersheds. Dark Canyon encompasses 9% of the total Eagle Creek watershed and less than 1% of the Lower San Francisco River watershed. According to the addendum for the Dark Canyon Allotment there are a total of two miles of perennial flow and 144 miles of intermittent flow within the allotment. Approximately two river miles are within critical habitat for the loach minnow and spikedace on Eagle Creek along the western side of the allotment (USFS 2001e). The quality of this critical habitat is not in optimal condition due to embeddedness of the cobble substrate within Eagle Creek and poor instream cover due to the lack of a woody debris component (USFS 2001e).

The Dark Canyon Allotment was administratively suspended in 1992 with total non-use required for 3 years. The allotment remained in non-use until it was stocked with an average of 9 horses since 1996. This is approximately 16% of the capacity of the allotment. This use was on the Coronado Pasture resting the bulk of the allotment since 1996. The authorized use in 2001 was rotated through the Spur, Knight, and Painted Bluffs pastures, which grazed the allotment at 39% of capacity. The perennial riparian waters on this allotment are within the Eagle Creek Pasture that is limited to use only for travel through (trailing) or working livestock.

The Dark Canyon Allotment has primarily been grazed on a year-long basis. Elevation ranges from 3,400 to 7,400 feet. According to the Dark Canyon addendum the upland vegetation overstory is primarily pinon/juniper (33%), Arizona cypress (31%), mountain brush (19%), grassland (9%), chaparral (7%), and riparian hardwood (1%). The allotment range condition is

the status of a unit of range in terms of specific values of potentials for grazing or browsing animals. One percent of the allotment is in excellent condition, 26% of the allotment is in good condition, 40% of the allotment is in fair condition, 19% of the allotment is in poor condition, and 14 % of the allotment is in very poor condition (USFS 2001e). For the past four years the Dark Canyon Allotment has been stocked below the permitted numbers on the term grazing permit. The reduced grazing pressure on the allotment has allowed for recovery of parts of the allotment.

Loach minnows are known to inhabit Eagle Creek roughly 20 miles upstream of the Dark Canyon Allotment on the Mud Springs Allotment. Suitable habitat for the species occurs in roughly 4 miles of Eagle Creek that flows within the allotment along the allotment border (Eagle Creek riparian pasture). This area was surveyed in 1996 and 1997; however the species was not detected. The absence of the species in this portion of the Eagle Creek cannot be assumed given the presence of an upstream source population, availability of suitable habitat, and difficulty in sampling for the species.

Spikedace were first recorded in Eagle Creek in 1985 when it was collected as larval fish from the Dark Canyon area on lower Eagle Creek (Bestgen 1985). Subsequent surveys in 1987 found spikedace to be common in the creek within 50% of the allotment (Marsh *et al.* 1990). The species has not been documented in this portion of Eagle Creek since 1989 although surveys are limited. Approximately 4 miles of Eagle Creek borders the western portion of the allotment and provides potentially occupied habitat for spikedace. Two major drainages on the allotment (Dark and Whitewater canyons) empty directly into Eagle Creek. Potential habitat within the allotment occurs within a 3 to 4-mile reach of Eagle Creek, portions of East Eagle and Dry Prong creeks, and in Robinson Canyon. The nearest known habitat occupied by spikedace is at P-Bar (½ mile downstream) in 1989. Spikedace were also documented near the Sheep Wash confluence with Eagle Creek on the Double Circles Allotment, approximately 7 miles upstream. This area has an abundance of suitable habitat, and it is thought that spikedace persist in Eagle Creek between Sheep Wash and the PD diversion dam (USFS 2001g). Therefore, it is thought that the one mile of critical habitat on this allotment is occupied by spikedace.

The critical habitat within Eagle Creek on the Dark Canyon Allotment is described as a shallow water habitat, with slow to moderate flows that are usually available between April and mid July and between September and December. Due to a reduction in sinuosity and entrenched stream channels, there is a limited low to moderate flow velocity habitat (backwater components and quality pools) during the spring rains/snow melt and the monsoons. Instream cover is also lacking due to lack of a woody debris component and embeddedness with the cobble substrate within Eagle Creek (USFS 2001d).

The Forest completed formal consultation on June 30, 1999, and the resultant Biological Opinion issued concluded that the proposed action may have adverse effects to the loach minnow and spikedace. This determination was based on the potential for direct and indirect effects from

livestock trailing along, through, and across Eagle Creek while moving cattle among pastures and for shipping. Fisheries surveys and assessments of condition changes in aquatic habitats have not been completed as required in the terms and conditions of the 1999 Biological Opinion (USFS 2001d). These annual monitoring reports help to establish the baseline conditions of the allotment and identify were improved ecological conditions on the allotment have occurred.

Effects of the Action

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

Direct and Indirect Effects of Grazing on Listed Fishes And Their Critical Habitat

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).

It is doubtful that any grazing scheme will improve a local hydrologic circumstance over that found under ungrazed conditions (Platts 1990, Belsky *et al*. 1999). Platts (1990) indicates that the two primary reasons why grazing strategies of any type have not protected riverine-riparian systems in the past is because streamside areas are generally incorporated into the larger pastures and not identified as distinct areas needing specialized management, and because the range is generally overstocked.

The effects of livestock grazing within the project area on spikedace and loach minnow survival and recovery, as well as on their critical habitat, from the proposed ongoing livestock grazing and its management would occur through four mechanisms: 1) watershed alteration; 2) physical alteration of streambanks, stream channels, water column, and the riparian vegetation community; 3) alteration of the faunal and floral 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 difficult 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, agriculture, roads, or other watershed effects. Information presented by the Forest Service for this consultation indicates that the watershed conditions in many of the allotments have significant areas in unsatisfactory condition. We recognize the limitations in the applicability of these soil condition data, but directly applicable data were not available. Additionally, the range conditions for many of the allotments are mostly in poor to fair condition, with some reaching good condition.

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 Alteration of Streambanks, Stream Channels, Water Column, and Riparian Vegetation Community

Cattle will occur in limited areas of streambanks within two of the allotments (East Eagle and Dark Canyon). 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 width and decreases stream 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, if allowed access to riparian corridors designated as critical habitat during extended time periods especially during growth periods, are likely 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 these species' populations.

Although the majority of the riparian areas on Eagle Creek within and adjacent to the allotments are excluded from livestock use through fencing and topographic features, some areas remain accessible to livestock. Even where fencing exists, there will inevitably be some use of the riparian area due to cows gaining access through broken fences. Fence maintenance is imperative to improving the watershed and reducing direct impacts to the spikedace, improving habitat for the loach minnow, and reducing impacts to the critical habitat for both species.

Riparian alteration would be limited on Eagle Creek, but would also occur in higher density on tributary streams. Although the tributary streams are both perennial and non-perennial and currently do not support spikedace or loach minnow, the condition of their streambanks and riparian vegetation contributes to the condition of Eagle Creek. 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.

Effects of grazing in the riparian areas have been summarized by many authors including Szaro and Pase 1983; Warren and Anderson 1987; Platts 1990; Schulz and Leininger 1990; Schulz and Leininger 1991; Stromberg 1993. Many of these changes in the structure, function, and composition of the riparian community can be expected to occur in Eagle Creek, Robinson Canyon, and Chitty Creek. 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).

3) Alteration of the Faunal Community

Livestock use of the riparian corridor causes 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 from its baseline because of altered stream channel

characteristics, because of sediment deposition, or because of nutrient enrichment (Rinne 1988; Meehan 1991; Li *et al*. 1994). This change in the food base of many aquatic vertebrates, particularly fish, may contribute to loss of, or 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).

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 are often contributors of sediment to stream courses. Fences are of concern because where they are near streams and/or in floodplains, they assist in the creation erosion channels and can negatively effect the channel banks. The continued use and maintenance of existing waterlots and stocktanks within the allotments increases the potential for both authorized and unauthorized stocking of non-native fish and bullfrogs. Flood events may then cause breaches in these water developments and allow non-native fish to enter tributaries and major waterways.

Allotment-Specific Analysis of Effects

<u>East Eagle</u>

Livestock use within loach minnow and spikedace habitat on the East Eagle Allotment is limited to trailing cattle along, through, and across the stream course while moving cattle among pastures and for shipping. Due to the rugged topography and limited access points within the allotment, trailing of livestock along the canyon bottoms is the only practical method available to the operator. Livestock trail through approximately 3 miles of Eagle and East Eagle creeks, both of which are occupied by loach minnow, during two or three separate occasions each year during the period May through October. In addition, the permit allows for many more cattle than are currently being grazed on this allotment. The number of cow/calf could increase from 222 to 410 during the last 7 years of the permit. Livestock cross the creek approximately 12 to 15 times during the move across the allotment. Approximate width of the directly disturbed area is about 15 feet per crossing. About 9 of these stream crossings are on vehicular trails. Trailing occurs during part of the loach minnow and spikedace spawning season. Direct take of loach minnow from livestock within the stream corridor has never been documented but is expected to occur from livestock: stepping on or creating hazards to fish and larvae (loach minnow are especially vulnerable because they occupy the stream bottom and do not move when there is a disturbance), and crushing or dislodging eggs deposited by loach minnow on the underside of rocks. Likely indirect effects include suffocating these eggs due to increases in sediment, removal of riparian vegetation which may influence water temperatures and impact prey availability, and sloughing off and trampling of streambanks which may increase embeddedness and sedimentation and influence changes in stream morphology.

Upstream watershed conditions can have serious effects on downstream aquatic habitats. The East Eagle Allotment is in the headwaters of Eagle Creek, an extremely important native fish stream. While being managed under the resource protection Memorandum of Understanding and reduced stocking rates, there have been recent improvements in range condition on the allotment with almost 90% of capacity acres rated in fair condition. Riparian fencing, development of offsite water, active cattle management on the allotment, and livestock exclusion immediately downstream on National Forest and private lands, has resulted in improvement in the regeneration of riparian areas.

Although watershed assessments completed for the Forest Plan in the early 1980's indicated that 81% of the allotment was in unsatisfactory watershed condition (USFS 2001b). More recent data analysis and field visits by Forest and District biologists and range management specialists indicate that watershed and soil conditions have improved dramatically in the last 20 years, with an estimated 70% of the allotment in satisfactory condition (Csargo and Myers 1998, Walls 2001, USFS 2002b). These conditions are expected to continue under the permit which expires this year. Unsatisfactory conditions remaining in drainages associated with Dry Prong and lower East Eagle may still impact loach minnow, spikedace, and aquatic habitats with increased sedimentation and alterations in the hydrograph. Sediment may be flushed regularly due to high stream flows on the East Eagle Allotment. The loach minnow is much more sensitive than spikedace to adverse effects from excess sediment in the aquatic ecosystem due to its placement of eggs on the underside of flattened rocks. The amount of fine sediments in Eagle Creek appear to vary substantially depending upon the stretch of stream and the length of time since major flooding. Some surveys have noted large amounts of fine sediment (Kynard 1976) and other have noted little (Marsh *et al.* 1990). Sediment loads are of particular concern on this allotment since it is known to be occupied by loach minnow.

The potential adverse effects of the ongoing livestock management activities on the East Eagle Allotment are not restricted to loach minnow and spikedace habitat on those creeks where trailing occurs, but also extends downstream. Effects of sedimentation from tributaries, including intermittent and ephemeral channels, form important buffers between upland impacts and the mainstem or perennial stream (Erman *et al.* 1977, Mahoney and Erman 1992, Osborne and Kovacic 1993). The extent and magnitude of the potential impacts to loach minnow downstream from the East Eagle Allotment as discussed could range from short distances to much greater than the 25 river miles that the Forest uses as a guideline. However, some of these impacts to streambanks and associated vegetation from trailing along East Eagle Creek are being minimized by herding livestock along an existing two-track road which traverses the canyon bottom. While stream channel stabilization and rebuilding stream banks may be affected by the recurrent trailing of livestock, more of the observed impacts have been attributed to vehicle travel along the two-track roads in East Eagle and Eagle creeks (USFS 2001b).

Water quality, watershed condition, and riparian conditions within the allotment may have some indirect effects to critical habitat of spikedace and loach minnow on the allotment due to levels of embeddedness, sedimentation and changes in stream morphology. Embeddedness was

considered moderate in Eagle Creek on the allotment, but may have increased between 1987 and 1997 (USFS 2001f). There is a lack of backwater habitat in Eagle Creek and bank cutting was rated as moderate. Riparian conditions on the allotment were rated at risk but improving. Off-site sediment sources were also rated at risk (USFS 2001f). These conditions report some of the constituent elements for loach minnow and indicate that critical habitat is not in optimal condition on the allotment. The increased number of cattle trailing in the stream and grazing in the uplands will inhibit recovery of the stream and of the native fish in Eagle Creek.

Although riparian vegetation is improving within East Eagle Allotment, documentation indicates that riparian conditions are in very poor condition (USFS 2001b). At one time the area was likely a classic riparian gallery dominated by sycamores. However, excessive flows have almost eliminated riparian vegetation, with little recovery evident (USFS 2001b). However, livestock foraging within the riparian zones are limited to the time when trailing occurs. Limited impacts are expected to occur to riparian vegetation from herbivory, provided livestock are trailed efficiently and not allowed to loaf in the canyon bottoms. Continued improvement in riparian condition within the allotment is expected.

Effects of livestock grazing on the East Eagle Allotment are only a small part of the total additive and cumulative impacts to loach minnow and spikedace in the Eagle Creek drainage. For example, the watershed land area that feeds into the Dry Prong drainage on the East Eagle Allotment is as large as that of the cumulative acreage of the 6th code watershed in East Eagle Creek. The land area drained by Middle Prong of Eagle Creek from non-Forest Service lands is almost equal in size.

Mud Springs Allotment

Loach minnow have been documented along the allotment border at the first crossing downstream of Honeymoon campground. In addition, approximately six miles of Eagle Creek within the allotment, some of this located on private land, is classified as critical habitat for loach minnow and spikedace. The closest known occurrence of spikedace to this allotment is at Sheep Wash, approximately eight miles downstream from the southern border of the Mud Springs Allotment.

Livestock do not have direct access to any occupied or critical habitat for either loach minnow or spikedace on this allotment. However, trailing through Eagle Creek will occur just upstream on the East Eagle Allotment generally during June and November for the next three years. Loach minnow breeding in this area generally occurs following the spring runoff (March and April) and fall breeding (following the high flows in August or October), although documentation shows that loach minnow may breed through June (Sublette et al. 1990). In addition, trailing on the East Eagle Allotment occurs through existing roadways, both in East Eagle, Dry Prong, and upper Eagle Creek, and is at least 5 miles above any main drainage that has livestock impacts on the Mud Springs Allotment.

The existing watershed and riparian conditions found on this allotment are primarily a result of current and historical livestock grazing and have resulted in reduced ground cover, stream channel down cutting and widening, alteration of hydrologic processes, and degradation of aquatic, fisheries and riparian conditions (USFS 2000a). Livestock grazing is expected to influence riparian and aquatic habitat conditions through both direct and indirect (upland and watershed) impacts. Livestock grazing within all of the pastures on this allotment will generate sediment that enters occupied critical loach minnow habitat in Eagle Creek during runoff events and affect the species. Sedimentation may affect loach minnow by modifying the abundance or diversity of the invertebrate food base. This is especially crucial since Eagle Creek is thought to be in some state of impairment (USFS 2001b).

Indirect effects to loach minnow within the Mud Springs Allotment and its critical habitat in Eagle Creek may occur through the continued impacts of livestock on upland soils and vegetation. Approximately 50% of the Mud Springs Allotment is in unsatisfactory watershed condition with roughly 38% of the soils in impaired or unsatisfactory condition. An additional 44% of the allotment is rated as having impaired soil conditions, while the remaining 18% of the allotment has satisfactory soil conditions. Vegetation in the watershed plays a role in the pattern of water movement in the stream itself. Therefore, reduced vegetation and impaired soils in the uplands creates adverse habitat conditions in the stream channel for loach minnow and spikedace. Riparian vegetation is improving along Eagle Creek. Given these unsatisfactory edaphic and vegetative conditions, continued trampling and grazing by livestock are likely to generate sediments that enter Eagle Creek from the allotment impacting the loach minnow and the constituent elements associated with successful spawning and recruitment.

Baseline/Horsesprings Allotment

As discussed above, livestock grazing may cause long-term changes to the watershed and its function. With the information available, it is difficult to discriminate watershed alteration effects caused by current livestock grazing on the Baseline/Horsesprings Allotment from those caused by past grazing, current grazing on upstream allotments, upstream residential development, agriculture, roads, or other human activities. However, given that:

1) On the Baseline/Horsesprings Allotment overall ground cover is sparse, often only 40-60%, and inadequate to prevent soil erosion on terraces (USFS 2001a). In addition, in regard to spikedace and loach minnow and their critical habitat (according to District Fisheries Biologist, Bill Wall) 62% of the allotment acres are in unsatisfactory watershed condition (USFS 2001a).

2) Eagle Creek streambanks are unstable, the stream channel is degraded, and riparian and terrace vegetation conditions are poor (Olmstead 1919, Leopold 1946, Marsh *et al.* 1990, Arizona Game and Fish Department 1994).

3) Livestock grazing has been the predominant and most pervasive land use on the allotment and surrounding area for the past 100 years (Leopold 1946, Marsh *et al*. 1990, USFS 1994).

4) Overuse by livestock is known to adversely impact vegetation condition, erosion levels, soil compaction, streambank stability, and stream channel characteristics (see preceding and following discussion);

we conclude that livestock grazing on Baseline/Horsesprings Allotment has historically contributed to downstream degradation of aquatic habitats that may have impacted native fish including loach minnow and spikedace. Improved livestock management and associated upland conditions, improved trends in riparian and aquatic conditions both upstream and downstream of this allotment, and the fact that the allotment does not encompass perennial riverine habitats of Eagle Creek, indicate effects to native fish will be indirect and come from overland flows which may contribute excessive sediment into downstream habitat, which may limit the availability of sand and cobble substrates with low to moderate amounts of fine sediment and substrate embeddedness necessary for spikedace and loach minnow reproduction.

Given the intermittent nature of the stream in this area and the short stretch of stream channel used for trailing cattle upstream of the allotment, few direct effects to spikedace and loach minnow from cattle grazing under the proposed management are expected and the probability of direct effects occurring is very low. On the other hand, indirect effects from modification of the watershed, stream channel and riparian zone are certain to occur and would result in short and long-term adverse effects to spikedace and loach minnow and their critical habitat. Although only a short stretch of Eagle Creek with intermittent flow is present within the Baseline/Horsesprings Allotment, the indirect effects of the proposed livestock grazing are not restricted to the area of Eagle Creek on the allotment, but also extend downstream.

Anecdotal information indicates that Eagle Creek flowed perennially on this allotment earlier in the last century. This loss of flow is undoubtedly due to a complex mix of water use and watershed condition factors. However, existing information regarding effects of livestock grazing on infiltration and runoff patterns indicate that amelioration of livestock impacts on the Baseline/Horsesprings Allotment and elsewhere in the watershed would contribute to improvement of the hydrologic regime of the Eagle Creek; however, that improvement may not be detectable against the background "noise" of other factors affecting flow in Eagle Creek.

<u>Double Circles Allotment</u>

Critical habitat for both species occurs within the allotment for approximately three miles, eleven miles downstream of the allotment boundary where Eagle Creek re-enters the Apache-Sitgreaves National Forests, and immediately upstream of the allotment for approximately 13 miles (USFS 2000a) (Map 5). Although the presence of loach minnow on the allotment is unknown, it is thought that spikedace occur within Eagle Creek on the allotment.

The allotment is generally rated in poor to fair condition (USFS 2000d). In addition, 61% of the acres on the allotment are considered to be in unsatisfactory condition (USFS 1998). These deteriorated conditions have indirect effects to spikedace regarding levels of embeddedness, sedimentation, and changes in stream morphology. Livestock grazing within all of the pastures on this allotment could generate sediment that may enter occupied or critical loach minnow or spikedace habitat in Eagle Creek during runoff events and affect the species. Sedimentation may affect the food base for spikedace.

Livestock do not have direct access to any occupied or critical habitat for either loach minnow or spikedace on this allotment. The existing watershed and riparian conditions found on this allotment are primarily a result of current and historical livestock grazing and have resulted in reduced ground cover, stream channel down-cutting and widening, alteration of hydrologic processes, and degradation of aquatic, fisheries and riparian conditions (USFS 2000a). Resource activities that affect water quality, such as the removal of riparian vegetation, sedimentation, or control of water levels, can affect spikedace and loach minnow habitat quality.

The Forest has implemented several measures to mitigate the direct effects of grazing on the Eagle Creek watershed within the Double Circles Allotment. Eagle Creek will continue to be rested from livestock grazing continuing from 1994 and livestock will not be allowed within the wetted stream channel area of Eagle Creek. Fences will remain in place, providing a buffer zone between the agricultural lands and Eagle Creek. Native herbaceous and woody species planted within this buffer zone will persist. These measures are reducing some of the direct effects of grazing but do not completely removing the pressures of grazing that occur on a watershed level.

Tule Allotment

Although sporadic surveys since 1934 have failed to locate loach minnow on the allotment, they are known to occur 16 miles upstream. Potential suitable habitat exists along the allotment border. However, the habitat trend within Eagle Creek has been increased embeddedness and a greater proportion of fine material in the stream channel (USFS 2001c). This trend may inhibit future occupancy of the allotment by loach minnow.

The closest documented population of spikedace to the Tule Allotment is at P-Bar, five miles downstream. Spikedace also occur six miles upstream of the allotment near Sheep Wash confluence on the Double Circle Allotment. This area has an abundance of suitable habitat, and although surveys are sparse, it is thought that spikedace persist in Eagle Creek between Sheep Wash and the PD diversion dam (USFS 2001g). Therefore, the Service concludes that the one mile of critical habitat on this allotment is occupied by spikedace.

A general watershed condition assessment was made for the Forest in the Environmental Impact Statement for the A-S National Forests. Based on this broadscale assessment completed in the early 1980's, about 60% of the Tule Allotment was considered in satisfactory/untreatable

watershed condition, while 40% was considered unsatisfactory. Recent field reviews and documentation of riparian and watershed conditions show substantial improvement (Martinez 2001a and 2001b, pers comm. Frank Hayes, January 24, 2002) since the last range analysis was completed and these conditions are expected to continue for this 3 year permit. An extensive re-analysis soil and watershed conditions has not been completed. The Biological Assessment notes that identified areas under heavy forest/woodland tree canopy are of watershed concern and will not improve significantly with the implementation of any grazing management (USFS 2001g). When Eagle Creek was assessed using the Proper Functioning Conditioning method, the drainage was functioning at risk with an upward trend. However, the time frames associated with full recovery are estimated to extend beyond the life of this grazing permit and in excess of 50 to 100 years, in part dependent on regrowth and incorporation of sufficient woody vegetation and coarse woody debris. The rebuilding of adequately sized functioning floodplains, as well as the narrowing of currently wide and shallow channels will also take significant time to restore. Due to apparently unstable flow regimes of some major tributaries, along with flow augmentation and removal through pumping, the future configuration of a stable Eagle Creek system will likely be different from what it was and may take centuries to equilibrate (USFS 2001g).

The majority of perennial waters and riparian areas in this allotment exist along Tule Creek. Since steep canyon walls parallel the riparian zone, the only access is from the mouth of the canyon, which will remain fenced to exclude cattle from Tule Creek.

Dark Canyon Allotment

Livestock use within potential loach minnow habitat on the Dark Canyon Allotment is limited to trailing cattle along, through, and across Eagle Creek while moving cattle among pastures and for shipping. Due to the rugged topography and limited access points within the allotment, trailing of livestock along the canyon bottoms is the only practical method available to the operator.

Under the proposed action for the Dark Canyon Allotment, livestock will have direct access to Eagle Creek while cattle are entering and leaving the allotment, as well as when they are being moved from pasture to pasture for the remainder of the ten year permit. Livestock will be moved through the Eagle Creek riparian pasture during a two week period in May and again in October each year. The Forest Service has indicated that a fishery biologist will select the livestock crossing points out of riffle areas to be avoided that could be inhabited by the spikedace. Direct access to Eagle Creek on the Dark Canyon Allotment may affect spikedace by crushing or disrupting eggs, larvae or adult fish. Repeated crossing of livestock may alter aspects of stream morphology that influence suitability for the species. The accumulation of sediments in the interstitial spaces of cobbles and gravels in riffle habitats is especially detrimental to successful reproduction of loach minnow, and may reduce the aquatic invertebrate food base of both loach minnow and spikedace.

Indirect effects to spikedace within the Dark Canyon Allotment and its critical habitat in Eagle Creek may occur through both the direct use of Eagle Creek and the impacts caused by livestock grazing on upland soils and vegetation. Trailing of cattle may cause eggs to be covered by sediments generated from livestock wading in the creek or trampling the streambank.

Approximately 50% of the Dark Canyon Allotment is in satisfactory and 50% in unsatisfactory watershed condition with roughly 70% of the soils in impaired or unsatisfactory condition. Although riparian vegetation is improving along Eagle Creek, presently about 60% is in unsatisfactory condition. Given these unsatisfactory soil and vegetative conditions, continued trampling and grazing by livestock are likely to generate excessive sediments that enter Eagle Creek from the allotment, impacting loach minnow and spikedace reproduction and recruitment. In addition, continued grazing on the allotment will likely slow the recovery of watershed and soil conditions.

Effects to Southwestern Willow Flycatcher

Allotment-Specific Analysis of Effects

East Eagle Allotment

The effects to Southwestern Willow Flycatcher are not being analyzed on this allotment.

Mud Springs and Double Circles Allotments

Currently, no willow flycatchers are known to nest along streamside vegetation on Eagle Creek. However, increases in flycatcher populations have been observed where grazing has been reduced, modified, or eliminated from riparian areas as along Eagle Creek. As noted in the guidance criteria (USFS 1998), Harris *et al.* (1987) observed flycatchers to increase by 61 percent over a five-year period after grazing was reduced. For the recovery of the flycatcher, dense riparian habitat (preferably native plants) must be restored, riparian ecosystems rehabilitated, and watersheds improved. Therefore, it is not only important to describe effects that might occur directly on the lands that are being grazed, but how grazing would impact the entire watershed. Grazing is presently one of the most significant stressors on rehabilitation and maintenance of flycatcher habitat in the action area.

The fundamental approach to recovering an endangered species is to remove the threats to its existence. In the case of the flycatcher, the evidence and field examples in the literature indicate that, with respect to livestock grazing, recovery of habitat would occur most rapidly with total exclusion of livestock from those areas that are described as providing potential habitat and where grazing is a significant stressor.

The effects of grazing in the uplands on riparian systems has been addressed above. In summary, the draft recovery plan mentions that excessive livestock grazing activities in the uplands contribute to changes in surface runoff quantity and intensity, sediment transport, soil chemistry,

and infiltration and water holding capabilities of the watershed; flood flows may increase in volume while decreasing in duration, and low flows may decrease in volume and increase in duration (Brown *et al.* 1974, Gifford and Hawkins 1978, Johnson 1992). The Service stresses that 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 the uplands where the soil conditions and riparian habitat in upland tributaries are unsatisfactory will continue to delay recovery and result in unnatural flooding. Unnatural flooding subsequently topples existing trees, and shallow rooted saplings and poles, and continues to erode rivers, as evidenced by current conditions along parts of Eagle Creek. The proposed grazing strategy will delay improvement of the environmental baseline on the allotment. As a result, the proposed strategy of grazing in degraded uplands will continue to adversely affect the flycatcher. Although Eagle Creek will be excluded from grazing, damage to riparian areas along the creek could be caused by upland grazing activities.

The status of the species and the effects of the proposed grazing action can be summarized in the following points:

1. The flycatcher is extremely endangered, and loss of riparian habitat is the primary cause;
2. Potential habitat exists within the action area on portions of Eagle Creek;
3. Riparian habitat varies between satisfactory and unsatisfactory within the action area;
4. Upland range conditions are, at least in part, in unsatisfactory condition;
5. Poor watershed conditions can lead to larger, unnatural flooding, which in turn leads to erosion of streambanks and loss of riparian habitat.

These conditions are likely to continue throughout the life of this project. Past and current grazing on the Apache National Forest have resulted in conditions on the allotment that are poor in some areas. The Service recognizes the importance of tributaries as potential flycatcher habitat, but finds there is still some uncertainty as to the extent to which Eagle Creek may be used by flycatchers in the future. Surveys have not documented any flycatchers within the Double Circles or Mud Springs Allotment. While grazing would occur in the upland areas adjacent to Eagle Creek, grazing does not occur in Eagle Creek.

No critical habitat for flycatchers currently exists; therefore, none will be affected by the proposed action.

<u>Baseline/Horsesprings Allotment</u>
The effects to Southwestern Willow Flycatcher are not being analyzed on this allotment.

<u>Tule Allotment</u>
The effects to Southwestern Willow Flycatcher are not being analyzed on this allotment.

Dark Canyon Allotment
The effects to Southwestern Willow Flycatcher are not being analyzed on this allotment.

Cumulative Effects

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

Loach minnow and Spikedace

Cumulative adverse effects to the stream ecosystems and watersheds come from many small actions that do not individually threaten the entire system, but taken together result in deterioration. The incremental nature of sediment deposition from many sources in the watershed is a classic case of cumulative effects, where the whole rather than one source is the primary concern (Waters 1995). In 1991, the American Fisheries Society adopted a position statement regarding cumulative effects of small modifications to fish habitats (Burns 1991). That statement concludes that accumulation of localized or small impacts, often from unrelated human actions, poses a serious threat to fisheries.

Although the majority of the upper Gila River watershed is managed by the Forest Service, management of private lands along the Eagle Creek and the Gila River also contributes to the degradation of loach minnow and spikedace habitat downstream. Livestock grazing on private in-holdings has severely reduced the quantity and diversity of riparian vegetation, which increases potential streambank erosion. The increase in bank erosion has serious detrimental sedimentation effects on loach minnow and spikedace habitat. Watershed specialists in the Forest recognize that significant impacts occur from flows in Dry Prong and Middle Prong drainages, originating from uplands that are part of the greater watershed area. The most notable recent occurrence of this impact came in August 1999 when significant rainfall events in the headwaters of both drainages triggered very short furation flood events (2-4 hours) outside bankfull levels which carried tremendous logging slash debris. This impact caused significant downcutting and loss of recovered riparian vegetation in Dry Prong and upper Eagle Creek at and above Honeymoon campground. Persistence of non-native fishes in Eagle Creek and its tributaries continues to impact loach minnow and spikedace populations. To ensure the continued existence of these species, cumulative adverse effects of many smaller actions must be reduced.

Southwestern Willow Flycatcher

Cumulative effects are expected to be similar to those described for the spikedace and loach minnow in regard to Eagle Creek. Many activities without a Federal nexus occur and are expected to continue to occur in suitable, or potential habitat of the southwestern willow

flycatcher and in the watersheds of such habitats throughout the project area. Livestock grazing on the private and other non-Forest Service lands outside of allotments have the same effects as those described here but are not subject to consultation. Pasture development and livestock developments (corrals, wells, etc.) on private land adjacent to, and within five miles of, riparian areas provides suitable habitat for cowbirds with resulting increased incidence of cowbird parasitism. Nest parasitism combined with high grazing levels within the riparian zone, whether public or private, can depress willow flycatcher nesting or eliminate nesting entirely.

Conclusion

Spikedace

After reviewing the current status of the spikedace, the environmental baseline for the action area, the effects of the proposed action of livestock grazing on the six allotments contained in this biological opinion, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the spikedace, or result in the destruction or adverse modification of its critical habitat. We present these conclusions for the following reasons:

1. The Forest has implemented fencing around the riparian corridor in order to reduce the adverse effects of the action to the spikedace and its critical habitat.
2. The Forest proposes to take action to ensure that range condition does not deteriorate on Forest lands in the watershed of spikedace habitat, and to improve range condition in areas of fair or poor condition.
3. The number of spikedace in the project area is already very low due to predation by nonnative fish and degraded habitat conditions.

Loach Minnow

After reviewing the current status of the loach minnow, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed is not likely to jeopardize the continued existence of the loach minnow, or result in the destruction or adverse modification of its critical habitat. We base our biological opinion on the following reasons:

1. The Forest has implemented fencing around the riparian corridor in order to reduce the adverse effects of the action to the loach minnow and its critical habitat.
2. The Forest proposes to take action to ensure that range condition does not deteriorate on Forest lands in the watershed of loach minnow habitat, and to improve range condition in areas of fair or poor condition.
3. The number of loach minnow in the project area is already very low due to predation by nonnative fish and degraded habitat conditions.

Southwestern Willow Flycatcher

After reviewing the current status of the southwestern willow flycatcher, the environmental baseline for the action area, the cumulative effects, and the anticipated effects of the proposed action, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the southwestern willow flycatcher. The Service presents this conclusion for the following reasons:

1. The occurrence of Southwestern willow flycatchers in the project area has not been detected due to a number of factors including low numbers, lack of suitable habitat, and the degraded habitat conditions.
2. The likelihood of Southwestern willow flycatcher occupying the habitat in the project area during the life of these projects is very low due to the low quality and quantity of habitat.
3. Although upland conditions will continue to negatively affect the riparian corridor, riparian fencing has been installed in the riparian areas along Eagle Creek of the project area to reduce the adverse effects.

INCIDENTAL TAKE STATEMENT

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

The measures described below are non-discretionary, and must be undertaken by the Forest so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Forest has a continuing duty to regulate the activity covered by this incidental take statement. If the Forest (1) fails to assume and implement the terms and conditions or (2) fails to require the (applicant) to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to

the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the [agency or applicant] must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)].

Amount or Extent of Take Anticipated

Spikedace

East Eagle, Mud Springs, Baseline/Horsesprings, Double Circles, and Tule
Due to the lack of information on populations of spikedace in the area and changes to instream habitat over times, no take is anticipated for spikedace on these allotments.

Dark Canyon

The Service anticipates that the proposed grazing on Dark Canyon Allotment will result in incidental take of spikedace. The taking of spikedace is expected to result primarily from harm and/or harassment, which will result from effects that alter the suitability of the habitat for spikedace. Additional take will result during trailing and periods when exclosure fences are breached. The Service anticipates, however, that incidental take of spikedace associated with the proposed action will be difficult to quantify because: dead or impaired individuals are difficult to find and losses may be masked by seasonal fluctuations in environmental conditions and fish numbers. Therefore, we define incidental take in terms of habitat characteristics, and use this surrogate measure to identify when take has been exceeded. The Service concludes that the authorized level of incidental take from the proposed action will be considered exceeded under any of the following conditions:

1. If a small (<5) number of livestock breach or access any portion of the excluded riparian/stream corridor of Eagle Creek for more than 7 days during critical life cycle periods for spikedace (March-June or following bank-full fall flows that may trigger spawning), or if a relatively large number (10+ head) or animals breach the exclosure during these critical time periods for any period of time.

2. If forage utilization standards are exceeded by ten percent on any successive three entries within a given pasture on the allotment, and applied rest does not demonstrate effective recovery of herbaceous forage plants.

3. If livestock trailing in the aquatic or riparian corridor results in a 10% increase in embeddedness as a result of fines deposited or moved into the stream system at selected reaches as a direct result of this action. Standard Forest Service methodologies will be used to determine baseline conditions and the level at which deposition and embeddedness is considered significant or can be correlated to the proposed action.

Loach Minnow

East Eagle

The Service anticipates that the proposed grazing on East Eagle Allotment will result in incidental take of loach minnow. The taking of loach minnow is expected to result primarily from harm and/or harassment, which will result from effects that alter the suitability of the habitat for loach minnow. Additional take will result during trailing and periods when exclosure fences are breached. The Service anticipates, however, that incidental take of loach minnow associated with the proposed action will be difficult to quantify because: dead or impaired individuals are difficult to find and losses may be masked by seasonal fluctuations in environmental conditions and fish numbers. Therefore, we define incidental take in terms of habitat characteristics, and use this surrogate measure to identify when take has been exceeded. The Service concludes that the authorized level of incidental take from the proposed action will be considered exceeded under any of the following conditions:

1. If a small (<5) number of livestock breach or access any portion of the excluded riparian/stream corridor of Eagle Creek for more than 7 days during critical life cycle periods for spikedace (March-June or following bank-full fall flows that may trigger spawning), or if a relatively large number (10+ head) or animals breach the exclosure during these critical time periods for any period of time.

2. If forage utilization standards are exceeded by ten percent on any successive three entries within a given pasture on the allotment, and applied rest does not demonstrate effective recovery of herbaceous forage plants.

3. If livestock trailing in the aquatic or riparian corridor results in a 10% increase in embeddedness as a result of fines deposited or moved into the stream system at selected reaches as a direct result of this action. Standard Forest Service methodologies will be used to determine baseline conditions and the level at which deposition and embeddedness is considered significant or can be correlated to the proposed action.

Mud Springs

The Service anticipates that the proposed grazing on Mud Springs Allotment will result in incidental take of loach minnow. The taking of loach minnow is expected to result primarily from harm and/or harassment, which will result from effects that alter the suitability of the habitat for loach minnow. Additional take will result during periods when exclosure fences are breached. The Service anticipates, however, that incidental take of loach minnow associated with the proposed action will be difficult to quantify because: dead or impaired individuals are difficult to find and losses may be masked by seasonal fluctuations in environmental conditions and fish numbers. Therefore, we define incidental take in terms of habitat characteristics, and use this surrogate measure to identify when take has been exceeded. The Service concludes that the authorized level of incidental take from the proposed action will be considered exceeded under any of the following conditions:

1. If a small (<5) number of livestock breach or access any portion of the excluded riparian/stream corridor of Eagle Creek for more than 7 days during critical life cycle periods for spikedace (March-June or following bank-full fall flows that may trigger spawning), or if a relatively large number (10+ head) or animals breach the exclosure during these critical time periods for any period of time.

2. If forage utilization standards are exceeded by ten percent on any successive three entries within a given pasture on the allotment, and applied rest does not demonstrate effective recovery of herbaceous forage plants.

Baseline/Horsesprings
Due to the lack of information documenting the presence of populations of loach minnow in the area and changes to instream habitat over time, no take is anticipated for loach minnow on this allotment.

Double Circles
Due to the lack of information documenting the presence of populations of loach minnow in the area and changes to instream habitat over time, no take is anticipated for loach minnow on this allotment.

Tule
Due to the lack of information documenting the presence of populations of loach minnow in the area and changes to instream habitat over time, no take is anticipated for loach minnow on this allotment.

Dark Canyon
Due to the lack of information documenting the presence of populations of loach minnow in the area and changes to instream habitat over time, no take is anticipated for loach minnow on this allotment.

Southwestern Willow Flycatcher

Mud Springs and Double Circles Allotments
Because no Southwestern willow flycatchers have been detected in the action area in recent times (USFWS 2000), we conclude that no take of Southwestern willow flycatcher is expected to occur.

Effect of the take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to spikedace or loach minnow or result in the destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures:

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take on loach minnow and spikedace:

1. Protect riverine and riparian habitat from significant grazing and trailing effects within the East Eagle and Mud Springs allotments.

2. Implement the proposed action in a manner that will result in an upward trend for all pastures within the allotment. Verify the upward trend through monitoring.

3. Monitor aquatic and riparian conditions, including constituent elements of critical habitat and ensure adherence to the incidental take statement by monitoring those activities that may result in take.

Terms and conditions

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

The following terms and conditions implement reasonable and prudent measure #1 for loach minnow and spikedace:

1.1 The Forest shall prevent overuse of riparian areas by livestock through the following measures:

1.1.1 Perform random checks of fencing of Eagle Creek to ensure that trespass cattle are not using these areas. If the fences are found to have been damaged they shall be immediately repaired. If any livestock are found within critical habitat on Eagle Creek, they will be immediately removed.

1.1.2 Closely monitor utilization and physical damage levels to banks and existing vegetation with Eagle Creek during periods of cattle use.

The following terms and conditions implement reasonable and prudent measure #2 for loach minnow and spikedace:

2.1 Monitoring of aquatic and riparian conditions, including all constituent elements of critical habitat, shall be conducted at year 3, 6, and 9, or a minimum of every 3 years. Monitoring actions shall be in adherence with an established monitoring protocol developed within two years of the final decision, and the Forest Service shall have Service approval of that protocol prior to implementation. The following criteria will be met:

2.1.1 Aquatic and riparian corridor site inspections shall be conducted by a journey-level fish biologist.

2.1.2 The biologist will survey stream habitats for suitability, occupancy, and overall condition with respect to bank stability, stream morphology, and embeddedness. An interdisciplinary team, including a journey-level biologist, will evaluate monitoring data and assess the effect to federally listed species and/or habitats. The Applicant or their representative should be asked to participate in these reviews.

2.1.3 The biologist will evaluate riparian vegetation, upland conditions, watershed and soil survey results, and provide a determination of whether or not these data support the absence of any measurable on-going effect on the species or its habitat.

2.1.4 Key areas for completing this assessment should be those that are ecologically relevant to the species, and will be identified during establishment of the protocol.

2.2 If monitoring does not show improvement of unsatisfactory conditions or maintenance of existing satisfactory conditions during the period covered by this consultation, the Forest shall evaluate the grazing management and identify and implement changes as appropriate. Ensure that the language in the term grazing permit allows for this type of adaptive management.

The following terms and conditions implement reasonable and prudent measure #3 for loach minnow and spikedace.

3.1 Monitor forage utilization on pastures within all allotments within three weeks after livestock exit each pasture.

3.2 Forage use monitoring will be completed for at midpoint of pasture use and on exit from pasture. Monitoring will be completed using applicable Forest Service standards as outlined in the Range Analysis handbook, or other established Forest Service techniques. Ocular observations shall be supported by physical measurements (i.e., clip and weigh, grazed plants, stubble height, etc.). Monitoring shall occur in key areas, which are to include the most ecologically sensitive areas for the loach minnow (e.g., riparian areas, tributary channels, source areas of sediment).

3.3 All monitoring required as part of this incidental take statement and reporting of the effectiveness of the terms and conditions shall be completed annually, and submitted to the Arizona Ecological Services Field Office at least 30 days prior to the issuance of the Annual Operating Plan. This report shall summarize for the previous calendar year: 1)

application and effectiveness of the terms and conditions; 2) documentation of direct take, if any; 3) utilization monitoring summary and analysis; 4) fish monitoring data; 5) progress made toward completion of multi-year terms and conditions; and 6) any suggestions for improving how terms and conditions are to be applied. If, at any time, expected monitoring results are not accomplished (e.g., utilization levels exceeded, monitoring is not completed on schedule), report these findings and any corrective actions taken to the AESO within15 days.

Disposition of Dead or Injured Listed Animals

Upon finding a dead or injured threatened or endangered animal, initial notification must be made to the 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. The notification shall be sent to the Law Enforcement Office with a copy to this office. 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.

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. The Service recommends the following:

1. The Forest Service should consider reducing livestock utilization levels within the allotments to more rapidly improve watershed conditions.

2. The Forest Service should consider excluding all livestock access, including trailing and crossings, from Eagle Creek to provide maximum protection and recovery potential for loach minnow and spikedace.

3. The Forest Service should consider identifying the sources of sediment input into Eagle Creek and develop and implement programs to mitigate those impacts.

4. The Forest Service should consider implementing appropriate portions of the Loach Minnow Recovery Plan, and Spikedace Recovery Plan. The Forest Service should consider reintroduction of these species into historical habitats on the National Forest lands.

5. The Forest Service should consider implementing a basin-wide program for monitoring of loach minnow, spikedace, and its accompanying native fish community. Descriptive linear

habitat mapping should be considered along all occupied, suitable, or potential habitat to identify suitability or capability for loach minnow and other components of the native fish community. The Service recommends surveys and monitoring be conducted by journey-level fish biologists with expertise in southwestern fishes and desert stream habitats. The Service recommends that the monitoring program be coordinated with any existing monitoring or surveying efforts to avoid over sampling. The Service recommends that monitoring protocols and habitat suitability criteria be agreed upon with the New Mexico and Arizona Game and Fish Department and the Service to ensure consistency and validity, and to avoid redundancy of effort.

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

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the this biological opinion. 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 that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

The Service appreciates your cooperation throughout this consultation process. For further information, please contact Jennifer Graves (x232) or Debra Bills (x239). Please refer to the following consultation numbers: (1) 2-21-01-F-309 for the East Eagle Allotment, (2) 2-21-01-F-105 for the Mud Springs Allotment, (3) 2-21-95-F-020R for the Baseline/Horsesprings Allotment, (4) 2-21-01-F-105 for the Double Circles Allotment, (5) 2-21-01-F-310 for the Tule Allotment, and (6) 2-21-01-F-308 for the Dark Canyon Allotment in future correspondence concerning these projects.

Sincerely,

/s/ David L. Harlow
Field Supervisor

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

District Ranger, Clifton Ranger District, Apache-Sitgreaves National Forest, Duncan, AZ
Gary and Darcy Ely, Tucson, AZ
John Anderson, Bar X Conservatory, Goodyear, AZ
Delbert Motes, Upper Eagle Creek, Clifton, AZ
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Jim and Clarice Holder, Safford, AZ
Regional Supervisor, Arizona Game and Fish Department, Phoenix, AZ
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Center for Biological Diversity, Tucson, AZ
Director, Arizona Cattlegrower's Association, Phoenix, AZ

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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. MS Thesis. New Mexico State University, Las Cruces. 62 pp.

Anderson, A.A. and D.A. Hendrickson. 1994. Geographic variation in morphology of spikedace, Meda fulgida, in Arizona and New Mexico. The Southwestern Naturalist 39(2):148-155.

Arizona Game and Fish Department. 1994. Eagle Creek survey, July 1994. Phoenix, AZ. 15 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.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.

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.

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.

Barrett, J. C. 1992. Turbidity-induced changes in reactive distance of rainbow trout. Transactions of the American Fisheries Society 121:437-443.

Barrowclough, G.F. and R.J. Gutierrez. 1990. Genetic variation and differentiation in the spotted owl (*Strix occidentalis*). Auk 107:737-744.

Bent, A.C. 1960. Life histories of North American flycatchers, larks, swallows and their allies. Dover Press, New York, New York. 555 pp.

Bestgen, K.R. 1985. Results of identification of collections of larval fish made in the upper Salt and Gila Rivers, Arizona. U.S. Fish and Wildlife Service, Albuquerque, NM. 7pp.

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.

Brown, B.T. 1988a. Breeding Ecology of a Willow Flycatcher Population in Grand Canyon, Arizona. Western Birds 19:25-33.

Brown, B.T. 1988b. Monitoring bird population densities along the Colorado River in Grand Canyon: 1987 breeding season. Final Report to the Glen Canyon Environmental Studies. Bureau of Reclamation, Salt Lake City, Utah. 26 pp.

Brown, M. 1990. Fall fish count trip to Eagle Creek. Arizona Game and Fish Department, Phoenix, AZ. 2pp.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). *Western Birds* 24:241-257.

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

Coor, C.C. 1992. Down on the Blue. Blue River, Arizona, 1878-1986. Blue River Cowbelles. Art Printing West, Goodyear, AZ.

Csargo and Myers. 1998. Trip report on Livestock trailing on Eagle creek, East Eagle Allotment. U.S. Forest Service.

Deacon, J.E., and W.L. Minckley. 1974. Desert fishes. Pages 385-488, *in* G.W. Brown, jr., ed., Desert Biology, Vol.2. Academic Press, New York, New York.

DeLoach, C.J. 1991. Saltcedar, an exotic weed of western North American riparian areas: a review of its taxonomy, biology, harmful and beneficial values, and its potential for biological control. Report to the Bureau of Reclamation, Boulder City, NV, Contract No. 7-AG-30-04930.

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.

Duncan, R.B. and J.D. Taiz. 1992. A preliminary understanding of Mexican spotted owl habitat and distribution in the Chiricahua Mountains and associated sub-Mogollon mountain ranges in southeastern Arizona. Pages 58-61 *in* A.M. Barton and S. A. Sloane (eds.) Proceedings of the Chiricahua Mountains Research Symposium, Southwestern Parks and Monuments Association, Tucson, Arizona.

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.

Finch, D.M. and S.H. Stoleson, eds. 2000. Status, ecology, and conservation of the southwestern willow flycatcher. Gen. Tech. Rep. RMRS-GTR-60. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 131 p.

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

Fletcher, K. 1990. Habitat used, abundance, and distribution of the Mexican spotted owl, *Strix occidentalis lucida*, on National Forest System Lands. U.S. Forest Service, Southwestern Region, Albuquerque, New Mexico. 78 pp.

Fletcher, K. and H. Hollis. 1994. Habitat used, abundance, and distribution of the Mexican spotted owl, *Strix occidentalis lucida*, on National Forest System Lands. U.S. Forest Service, Southwestern Region, Albuquerque, New Mexico. 78 pp.

Forsman, E.D., E.C. Meslow, and H.M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs 87:1-64.

Ganey, J.L. 1988. Distribution and habitat ecology of Mexican spotted owls in Arizona. MS Thesis. Northern Arizona University, Flagstaff, Arizona.

Ganey, J.L. and R.P. Balda. 1989. Distribution of habitat use of Mexican spotted owls in Arizona. Condor 91:355-361.

Ganey, J.L. and R.P. Balda. 1994. Habitat selection by Mexican spotted owls in Northern Arizona. The Auk 111(1):162-169.

Ganey, J.L., W.M. Block, J.K. Dwyer, B.E. Strohmeyer, and J.S. Jenness. 1998. Dispersal, movements, and survival rates of juvenile Mexican spotted owls in Northern Arizona. Wilson Bulletin 110(2):206-217.

Ganey, J.L. R.B. Duncan, and W.M. Block. 1992. Use of oak and associated woodlands by Mexican spotted owls in Arizona. Pages 125-125 *in* P.F. Ffolliott, G.J. Gottfried, D.A. Bennett, V.M. Hernandez C., A. Ortega-Rubio, and R.H. Hamre, eds. Ecology and management of oak and associated woodlands: perspectives in the southwestern United States and northern Mexico. USDA Forest Service General Technical Report RM-218, Ft. Collins, Colorado.

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

Gutierrez, R.J., M.E. Seamans, C.A. May, and M.Z. Peery. 1997. Demography of two Mexican spotted owl (*Strix occidentalis lucida*) populations in Arizona and New Mexico: 1996 annual report. Unpublished report, Humboldt State University. 19 pp.

Gutierrez, R.J., M.E. Seamans, C.A. May, and M.Z. Peery. 1998. Demography of two Mexican spotted owl (*Strix occidentalis lucida*) populations in Arizona and New Mexico: 1997 Final Report (Contract No. 53-82FT-4-07). Unpublished report, Humboldt State University, 16 pp.

Hanna, W.C. 1928. Notes on the dwarf cowbird in southern California. Condor 30:161-162.

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.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow flycatcher surveys in the Sierra Nevada. Western Birds 18:27-36.

Harrison, H.H. 1979. A field guide to western birds' nests of 520 species found breeding in the United States west of the Mississippi River. Houghton Mifflin Company, Boston, Massachusetts. 279 pp.

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

Henderickson, D.A. 1987. Memo - update on nongame fish activities, August 26, 1987. Arizona Game and Fish Department, Phoenix,, AZ. 3 pp.

Hendrickson, D.A. 1993. Evaluation of razorback sucker and Colorado squawfish reintroduction programs in central Arizona based surveys of fish populations in the Salt and Verde rivers from 1986 to 1990. Arizona Game and Fish Department, Phoenix, Arizona.

Howell, S.N.G. and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York, New York. 851 pp.

Hubbard, J.P. 1987. The Status of the Willow Flycatcher in New Mexico. Endangered Species Program, New Mexico Department of Game and Fish, Sante Fe, New Mexico. 29 pp.

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

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

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

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

King, J.R. 1955. Notes on the life history of Traill's Flycatcher (*Empidonax traillii*) in southeastern Washington. The Auk 72:148-173.

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

Kynard, B.E. 1976. A study of the pollution sources and their effect on the aquatic habitat of Eagle Creek watershed, Apache-Sitgreaves National Forest, Arizona. University of Tucson, AZ. 82 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, A. 1951. Vegetation of southwestern watersheds in the nineteenth century. The Geographical Review 41: 295-316.

Ligon, J.S. 1961. New Mexico Birds and where to find them. The University of New Mexico Press, Albuquerque, New Mexico. 360 pp.

Madsen, M.J. 1935. A biological survey of streams and lakes of apache and crook national forests, Arizona. Department of Commerce, Bureau of Fisheries.

Mahoney, D.L. and D.C. Erman. 1992. The role of streamside bufferstrips in the ecology of aquatic biota. California Riparian Systems Conference, Sept. 17-19, 1981.

Marlow, C. B. and T. M. Pogacnik. 1985. Time of grazing and cattle-induced damage to streambanks. Pp. 279-284. *in* Johnson, R.R., C. D. Ziebell, D. R. Patton, P. F. Ffolliott, and R. H. Hamre, eds. Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference. April 16-18, 1985, Tucson, AZ. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station General Technical Report RM-120, Ft. Collins, Colorado.

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.

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.

Marsh, P.C. 1993. Memorandum to interested parties on Eagle Creek sampling, summer 1993. Arizona State University, Center for Environmental Studies, Tempe, AZ. 2pp.

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

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

Mayfield, H.F. 1977a. Brown-headed cowbird: agent of extermination? American Birds 31:107-113.

Mayfield, H.F. 1977b. Brood parasitism: reducing interactions between Kirtland's warblers and brown-headed cowbirds. Chapter 11 *in* Endangered birds: management techniques for preserving threatened species (S.A. Temple, ed.). University of Wisconsin Press, Madison, Wisconsin.

Maynard, W.R. 1995. Summary of 1994 survey efforts in New Mexico for southwestern willow flycatcher (*Empidonax traillii extimus*). Contract # 94-516-69. New Mexico Department of Game and Fish, Sante Fe, New Mexico. 48 pp.

McCabe, R.A. 1991. The little green bird: ecology of the willow flycatcher. Palmer publications, Inc., Amherst, Wisconsin. 171 pp.

McCarthey T.D., C.E. Paradzick, J.W. Rourke, M.W. Sumner, and R.F. Davidson. 1998. Arizona Partners In Flight southwestern willow flycatcher survey: 1997 Survey and Nest Monitoring Report. Arizona Game and Fish Department Technical Report XX, Phoenix, Arizona.

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

Megahan, W. F., J. P. Potyondy, and K. A. Seyedbagheri. 1992. Best management practices and cumulative effects from sedimentation in the South Fork Salmon River: an Idaho case study. Pp. 401-414 *in*: Watershed Management. Naiman, R.J., Ed. Springer-Verlag, New York.

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.

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.

Minckley, W.L. 1980. Tiaroga cobitis Girard Loach minnow. Page 365 *In* D.S. Lee, C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer, Jr. (eds.). Atlas of North American freshwater fishes. North Carolina State Museum of Natural History, Raleigh, North Carolina.

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

Minckley, W.L., and J. E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species." Science 159: 1424-1432.

Minckley, W.L. and M.R. Sommerfeld. 1979. Resource inventory for the Gila River complex, eastern Arizona. USDI Bureau of Land Management, Safford, AZ. 570 pp.

Muiznieks, B.D., S.J. Sferra, T.E. Corman, M.K. Sogge, and T.J. Tibbitts. 1994. Arizona Partners In Flight southwestern willow flycatcher survey, 1993. Draft report: Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona. Draft of April 1994. 28 pp.

Muncey, R. J., G. J. Atchison, R. V. Bulkley, B. W. Menzel, L. G. Perry, and R. C. Summerfelt. 1979. Effects of suspended solids and sediment on reproduction and early life of warm water fishes: a review. U.S. Environmental Protection Agency, EPA Report 600/379-042, Washington, DC.

Murphy, M. L., C. P. Hawkins, and N. H. Anderson. 1981. Effects of canopy modification and accumulated sediment on stream communities. Transactions of the American Fisheries Society 110:469-478.

Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11: 72-82.

Olmstead, F.H. 1919. A report on flood control of the Gila River in Graham County, Arizona. U.S. Congress. Sixty-fifth, third session. Senate Document 436. Washington, D.C. 94 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 stips in water-quality restoration and stream managment. Freshwater Biology 29: 243-258.

Papoulias, D., D. Valenciano, and D.A. Hendrickson. 1989. A fish and riparian survey of the Clifton Ranger Distric. Arizona Game and Fish Department, Phoenix, AZ. 165 pp.

Paradzick, C.E., T.D. McCarthey, R.F. Davidson, J.W. Rourke, M.W. Sumner, and A.B. Smith. 2001. Southwestern willow flycatcher 2000 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 175. Arizona Game and Fish Department, Phoenix, Arizona.

Paxton, E., S.M. Langridge, and M.K. Sogge. 1996. Banding and Population Genetics of Southwestern willow flycatchers in Arizona-1997 Summary Report. Colorado Plateau Research Station. U.S. Geological Survey Biological Resources Division. Northern Arizona University, Flagstaff, Arizona. 63 pp.

Peterson, R.T. 1990. A field guide to western birds. Third edition. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.

Phillips, A.R. 1948. Geographic variation in *Empidonax traillii.* The Auk 65:507-514.

Phillips, A.R., J. Marshall, and G. Monson. 1964. The Birds of Arizona. University of Arizona Press, Tucson, Arizona. 212 pp.

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

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

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. 1986. Distribution, status, biology, and conservation of the spikedace (Meda fulgida) in New Mexico. Endangered Species Report No. 15. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 93 pp.

Propst, D.L., 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.

Ridgely, R.S. and G. Tudor. 1994. The Birds of South America: Suboscine Passerines. University of Texas Press, Austin, Texas.

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

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

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

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.

Seamans, M.E. and R.J. Gutierrez. 1995. Breeding habitat of the Mexican spotted owl in the Tularosa Mountains, New Mexico. The Condor 97:944-952.

Sferra, S.J., R.A. Meyer, and T.E. Corman. 1995. Arizona Partners In Flight 1994 southwestern willow flycatcher survey. Final Technical Report 69. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Phoenix, Arizona. 46 pp.

Sferra, S.J., T.E. Corman, C.E. Paradzick, J.W. Rourke, J.A. Spencer, and M.W. Sumner. 1997. Arizona Partners In Flight southwestern willow flycatcher survey: 1993-1996 summary report. Arizona Game and Fish Department Technical Report 113. 104 pp.

Shreve, F. 1931. Physical conditions in sun and shade. Ecology 12:96-104.

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 riparain habitat: a review of our knowledge. Pp. 1001-1103 In: Developing strategies for rangelend management. National Research Council/National Academy of Sciences, Eds. Westview Press, Boulder, CO.

Sogge, M.K. 1995a. Southwestern willow flycatcher (*Empidonax traillii extimus*) monitoring at Tuzigoot National Monument. 1995 progress report to the Natl. Park Serv. National Biological Service, Colorado Plateau Research Station, Northern Arizona University, Flagstaff, Arizona. 20 pp.

Sogge, M.K.. 1995b. Southwestern willow flycatcher surveys along the San Juan River, 1994 - 1995. Final report to Bureau of Land Management, San Juan Resource Area. National Biological Service, Colorado Plateau Research Station, Northern Arizona University, Flagstaff, Arizona. 27 pp.

Sogge, M.K.. 1995c. Southwestern willow flycatchers in the Grand Canyon. Pages 89-91 *in* E. T. LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac eds., Our Living Resources: a Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems. U.S. Department of the Interior, National Biological Service, Washington, DC.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbitts. 1997. A southwestern willow flycatcher survey protocol and breeding ecology summary. National Park Service, Colorado Plateau Research Station, Northern Arizona University, Technical Report, NRTR-97/12. 37 pp.

Sogge, M.K. and T.J. Tibbitts. 1992. Southwestern willow flycatcher (*Empidonax traillii extimus*) surveys along the Colorado River in Grand Canyon National Park and Glen Canyon National Recreation Area. National Park Service Park Studies Unit, Northern Arizona University, Flagstaff, Arizona. 43 pp.

Sogge, M.K. and T.J. Tibbitts. 1994. Distribution and status of the southwestern willow flycatcher along the Colorado river in the Grand Canyon - 1994. Summary Report. National Biological Service, Colorado Plateau Research Station, Northern Arizona University, Flagstaff, Arizona. 37 pp.

Sogge, M.K., T.J. Tibbitts, and S.J. Sferra. 1993. Status of the southwestern willow flycatcher along the Colorado River between Glen Canyon Dam and Lake Mead - 1993. Summary Report. National Park Service Cooperative Park Studies Unit, Northern Arizona University, U.S. Fish and Wildlife Service, and Arizona Game and Fish Department., Flagstaff, Arizona. 69 pp.

Spencer, J.A., S.J. Sferra, T.E. Corman, J.W. Rourke, and M.W. Sumner. 1996. Arizona Partners In Flight 1995 southwestern willow flycatcher survey. Technical Report 97, March 1996. Arizona Game and Fish Department, Phoenix, Arizona. 69 pp.

Stiles, F.G. and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Comstock, Ithaca, New York. 364 pp.

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

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

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

Tibbitts, T.J., M.K. Sogge, and S.J. Sferra. 1994. A survey protocol for the southwestern willow flycatcher (*Empidonax traillii extimus*). Technical Report NPS/NAUCPRS/NRTR-94-04. National Park Service, Colorado Plateau Research Station at Northern Arizona University, Flagstaff. 24 pp.

U.S. Department of Agriculture (USDA). 1998. USDA Forest Service biological Assessment for Reauthorizing Livstock Grazing in the Southwestern Region.

U.S. Fish and Wildlife Service (USFWS). 1986a. Endangered and threatened wildlife and plants; determination of threatened status for the spikedace. Federal Register 51(126):23769-23781. July 1, 1986.

U.S. Fish and Wildlife Service (USFWS). 1986b. Endangered and threatened wildlife and plants; determination of threatened status for the loach minnow. Federal Register 51(208):39468-39478. October 28, 1986.

U.S. Fish and Wildlife Service (USFWS). 1991. Mexican spotted owl status review. Endangered species report 20. Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (USFWS). 1993. Endangered and threatened wildlife and plants; final rule to list the Mexican spotted owl as threatened. Federal Register 58:14248-14271.

U.S. Fish and Wildlife Service (USFWS). 1994a. Endangered and threatened wildlife and plants; designation of critical habitat for the threatened spikedace (Meda fulgida). Federal Register 59(45):10906-10915. March 8, 1994.

U.S. Fish and Wildlife Service (USFWS). 1994b. Endangered and threatened wildlife and plants; designation of critical habitat for the threatened loach minnow (Tiaroga cobitis). Federal Register 59(45):10898-10906. March 8, 1994.

U.S. Fish and Wildlife Service (USFWS). 1994c. Notice of 90-day and 12-month findings on a petition to reclassify spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis) from threatened to endangered. Federal Register 59(131):35303-35304. July 11, 1994.

U.S. Fish and Wildlife Service (USFWS). 1995a. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694-10715.

U.S. Fish and Wildlife Service (USFWS). 1995b. Endangered and threatened wildlife and plants; final rule to designate critical habitat for the Mexican spotted owl. Federal Register 60:29914-29951.

U.S. Fish and Wildlife Service (USFWS). 1995c. Mexican spotted owl recovery plan. Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (USFWS). 1997a. Final determination of critical habitat for the southwestern willow flycatcher. Federal Register 62(140):39129-39146.

U.S. Fish and Wildlife Service (USFWS). 1997b. Correction; final determination of critical habitat for the southwestern willow flycatcher. Federal Register 62 (161): 44228.

U.S. Fish and Wildlife Service (USFWS). 1998a. Endangered and threatened wildlife and plants; revocation of critical habitat for the Mexican spotted owl, loach minnow, and spikedace. Federal Register 63(57):14378-14379.

U.S. Fish and Wildlife Service (USFWS). 2000a. Endangered and threatened wildlife and plants; final designation of critical habitat for the spikedace and loach minnow. Federal Register 65(80):24328-24372.

U.S. Fish and Wildlife Service (USFWS). 2000b. Arizona Ecological Services Field Office Scientific Collecting Report for Permit Number SP 910735. December 20, 2000.

U.S. Fish and Wildlife Service. 2001. Draft Southwestern Willow Flycatcher Recovery Plan, Region 2, Albuquerque, NM.

U.S. Forest Service (USFS) 1994. Biological Evaluation for Baseline/Horsesprings Allotment

U.S. Forest Service (USFS) 1997. Final Environmental Analysis Baseline/Horsesprings Allotment Management Plan

U.S. Forest Service (USFS). 1998a. Allotment Summary Sheets, Tule Allotment.

U.S. Forest Service (USFS). 1998b. Allotment Summary Sheet, Double Circles Allotment.

U.S. Forest Service (USFS). 1998c. Allotment Summary Sheet, Mud Springs Allotment.

U.S. Forest Service (USFS). 1998d. Biological Assessment for Reauthorizing Livestock Grazing in the Southwest Region.

U.S. Forest Service (USFS). 1999. Chiricahua leopard frog, Wester Yellow-billed Cuckoo Addendum, Dark Canyon Allotment.

U.S. Forest Service (USFS). 2000a. Biological Assessment for Ongoing Grazing.

U.S. Forest Service (USFS). 2000b. Chirichua leopard frog; Western Yellow-billed Cuckoo Addendum, Baseline/Horsesprings Allotment

U.S. Forest Service (USFS). 2000c. Chiricahua leopard frog; Western Yellow-billed Cuckoo Addendum, East Eagle Allotment Ongoing Grazing.

U.S. Forest Service (USFS). 2000d. Grazing Consultation Forms Double Circles Allotment

U.S. Forest Service (USFS). 2000e. Grazing Consultation forms for Mud Springs Allotment

U.S. Forest Service (USFS). 2000f. USDA Forest Service Southwestern Region Biological Assessment for Ongoing Grazing.

U.S. Forest Service (USFS). 2001a. Addendum to the Biological Assessment and Evaluation In Regards to Baseline/Horsesprings Grazing Allotment

U.S. Forest Service (USFS). 2001b. Addendum to the Biological Assessment and Evaluation In Regards To the East Eagle On-Grazing

U.S. Forest Service (USFS). 2001c. Addendum to the Biological Assessment and Evaluation In Regards to Tule Ongoing Grazing.

U.S. Forest Service (USFS). 2001d. Addendum to the Consultation Forms in Regards to Dark Canyon Ongoing Grazing

U.S. Forest Service (USFS). 2001e. Allotment Summary Sheets for Dark Canyon Allotment.

U.S. Forest Service (USFS). 2001f. Allotment Summary Sheets for East Eagle.

U.S. Forest Service (USFS). 2001g. Biological Assessment and Evaluation In Regards to Tule Ongoing Grazing.

U.S. Forest Service (USFS). 2001h. Chiricahua leopard frog Addendum, Tule Allotment.

U.S. Geological Survey. 1994. Water resources data, Arizona, water year 1994. U.S. Geological Survey water-data report AZ-94-1.

Unitt, P. 1987. *Empidonax traillii extimus*: An endangered subspecies. Western Birds 18:137-162.

Vallentine, J.F. 1990. Grazing management. Academis 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.

Walkinshaw, L.H. 1966. Summer biology of Traill's Flycatcher. Wilson Bulletin 78:31-46.

Wall, W. 2002. Clarification of Unsatisfactory Watershed Condition. U.S. Forest Service.

Wall, W. 2001. Trip report by Bill Wall up East Eagle and Dry Prong. U.S. Forest Service.

Ward, J.P. Jr., and W.M. Block. 1995. Mexican spotted owl prey ecology *In* Mexican Spotted Owl Recovery Plan. U.S. Department of the Interior, Fish and Wildlife Service, Albuquerque, New Mexico.

Waters, T.F. 1995. Sediment in streams. Sources, biological effects, and control. American Fisheries Society, Monograph 7, Bethesda, MD. 251 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.

White, G.C., A.B. Franklin, and J.P. Ward, Jr. 1995. Population Biology. *In* Mexican Spotted Owl Recovery Plan. U.S. Department of the Interior, Fish and Wildlife Service, Albuquerque, New Mexico.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to brown-headed cowbird parasitism. M.S. Thesis, California State University, Chico, California. 25 pp.

Whitfield, M.J. 1994. A brown-headed cowbird control program and monitoring for the southwestern willow flycatcher, South Fork Kern River, California, 1994. Prepared for the California Department of Fish and Game. Kern River Research Center, Weldon, California. 12 pp.

Whitfield, M.J. and K.M. Enos. 1996. A Brown-headed Cowbird control program and monitoring for the Southwestern Willow Flycatcher, South Fork Kern River, California, 1996. Final report to the U.S. Army Corps of Engineers, Contract DACW05-96-P-0900. Weldon, California: Kern River Research Center. 16 pp.

Whitfield, M.J. and C.M. Strong. 1995. A brown-headed cowbird control program and monitoring for the southwestern willow flycatcher, South Fork Kern River, California. Calif. Dept. Fish and Game, Bird and Mammal Cons. Program Report 95-4, Sacramento, California. 17 pp.

Willard, F.C. 1912. A week afield in southern Arizona. The Condor 14:53-63.

Willey, D.W. 1993. Home range characteristics and juvenile dispersal ecology of Mexican spotted owls in southern Utah. Final Report 1992-93. UDWR Contract No. 91-2577, Amendment #1.

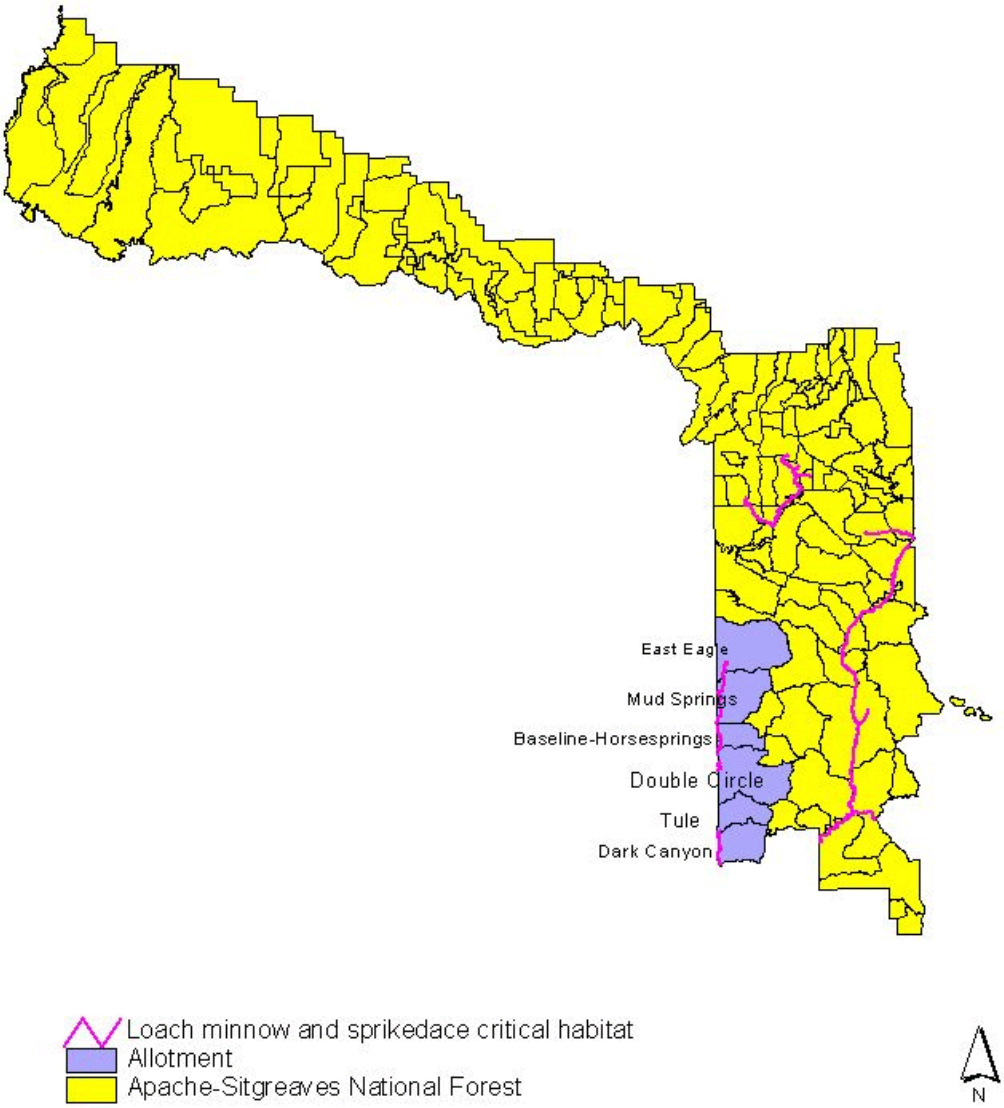
Williams, J.E., D.B. Bowman, J.E. Brooks, A.A. Echelle, R.J. Edwards, D.A. Hendrickson, and J.J. Landye. 1985. Endangered aquatic ecosystems in North American deserts with a list of vanishing fishes of the region. Journal of the Arizona-Nevada Academy of Science 20(1):1-62.

Wood, D. J., S. G. Fisher, and N. B. Grimm. 1990. Pools in desert streams: limnology and response to disturbance. Journal of the Arizona-Nevada Academy of Science 26:171-182.

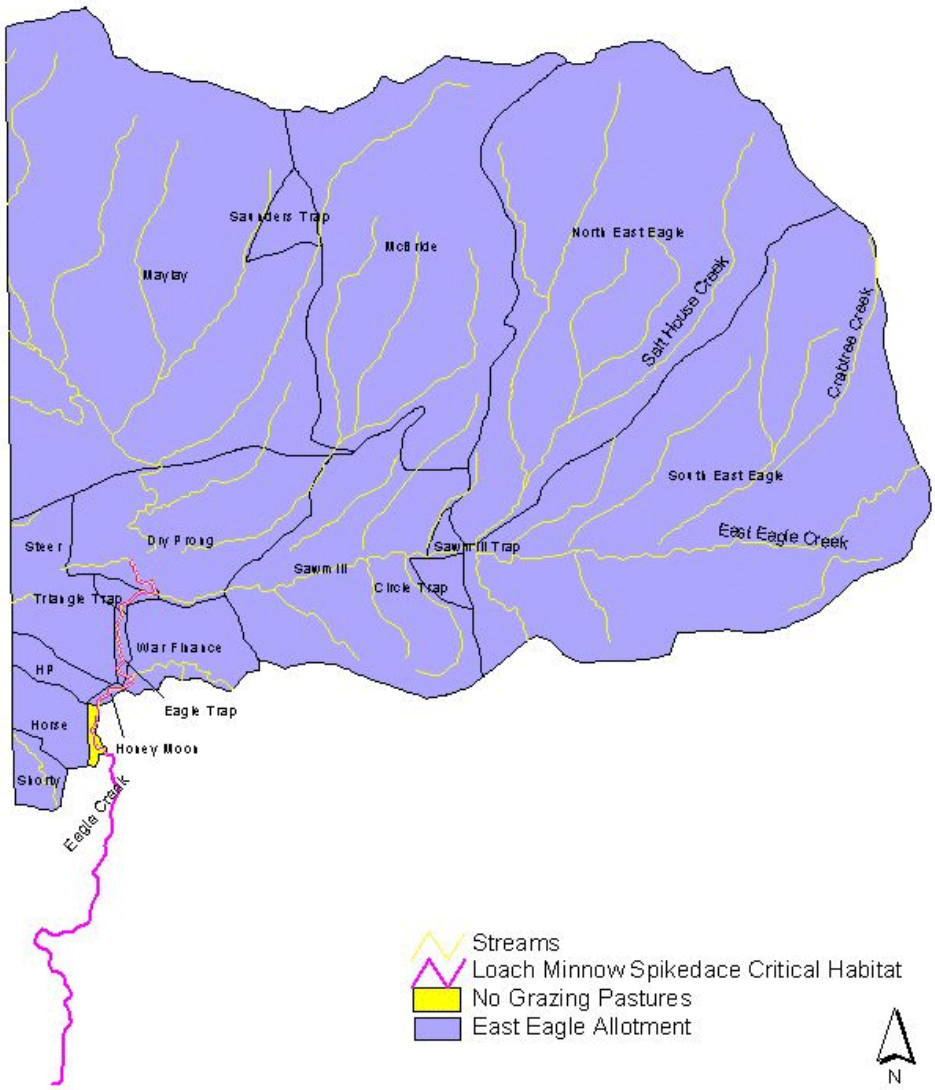
York, J.C. and W.A. Dick-Peddie. 1969. Vegetation changes in southern New Mexico during the past hundred years. Pp. 157-166 In: Arid lands in perspective. McGinnes, W.G. and B.J. Goldman, Eds. University of Arizona Press, Tucson, AZ.

Appendix A: Maps

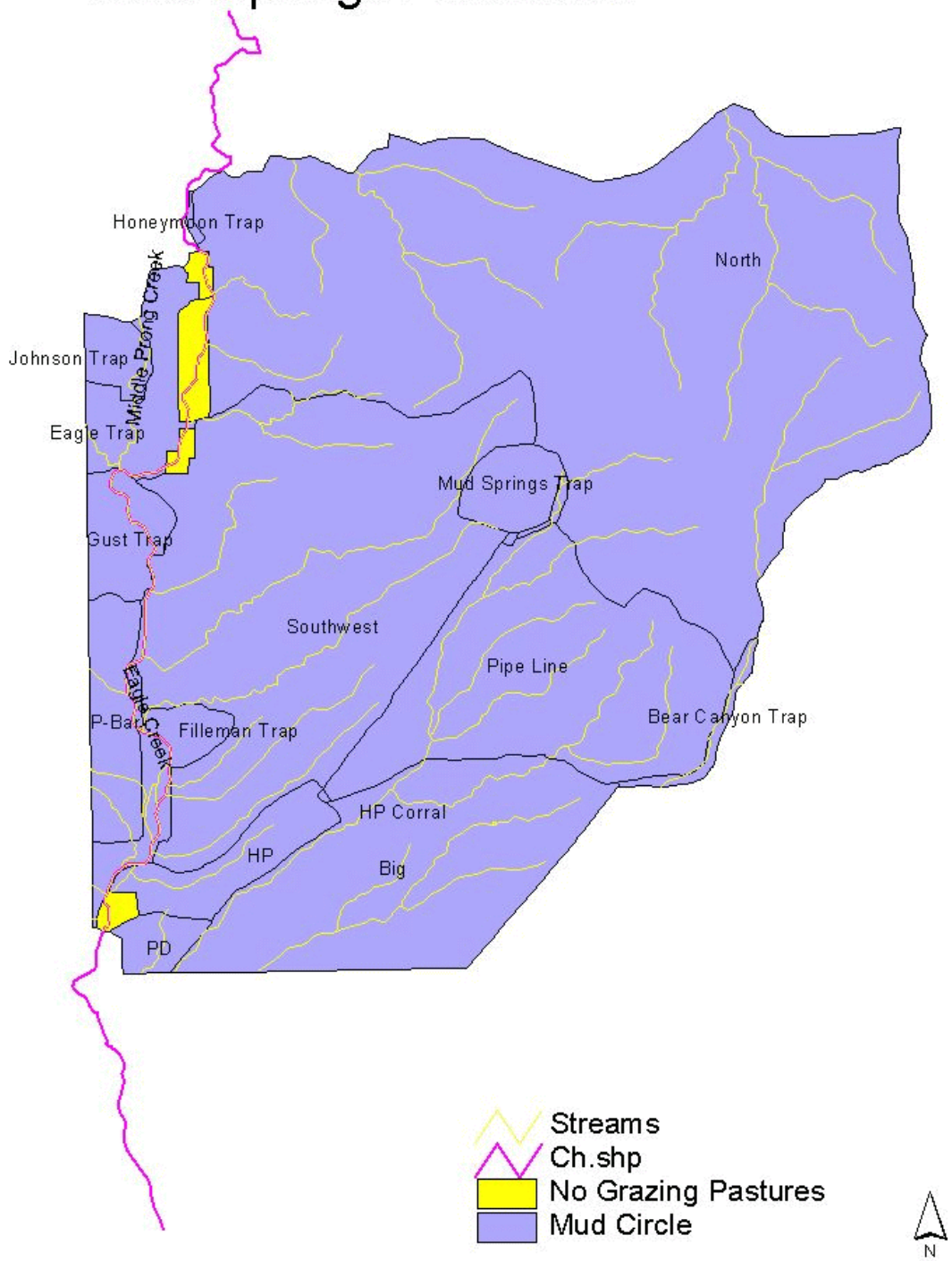
Appendix A, Map 1: Location of allotments on the Apache-Sitgreaves National Forest



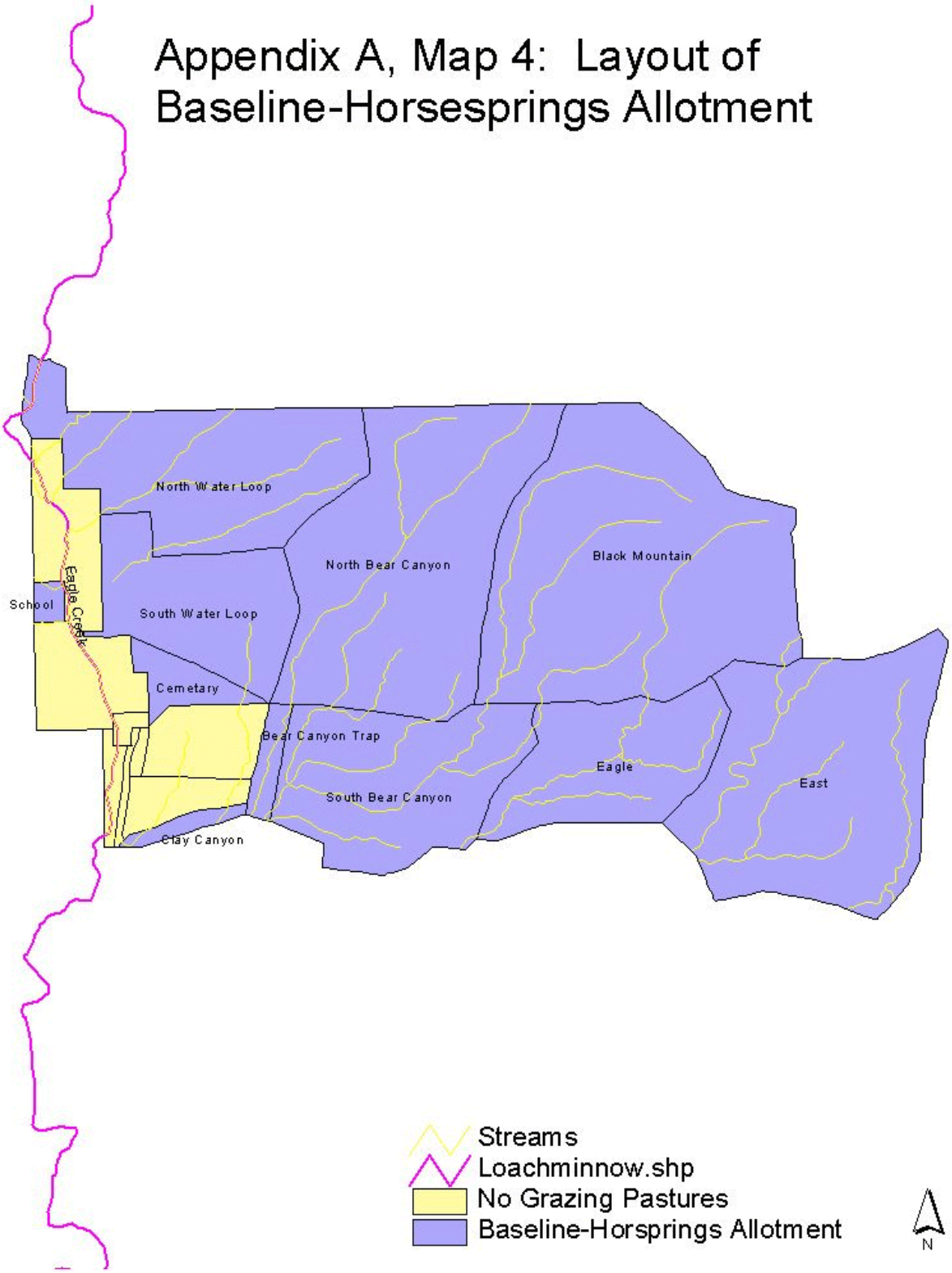
Appendix A, Map 2: Layout of East Eagle Allotment



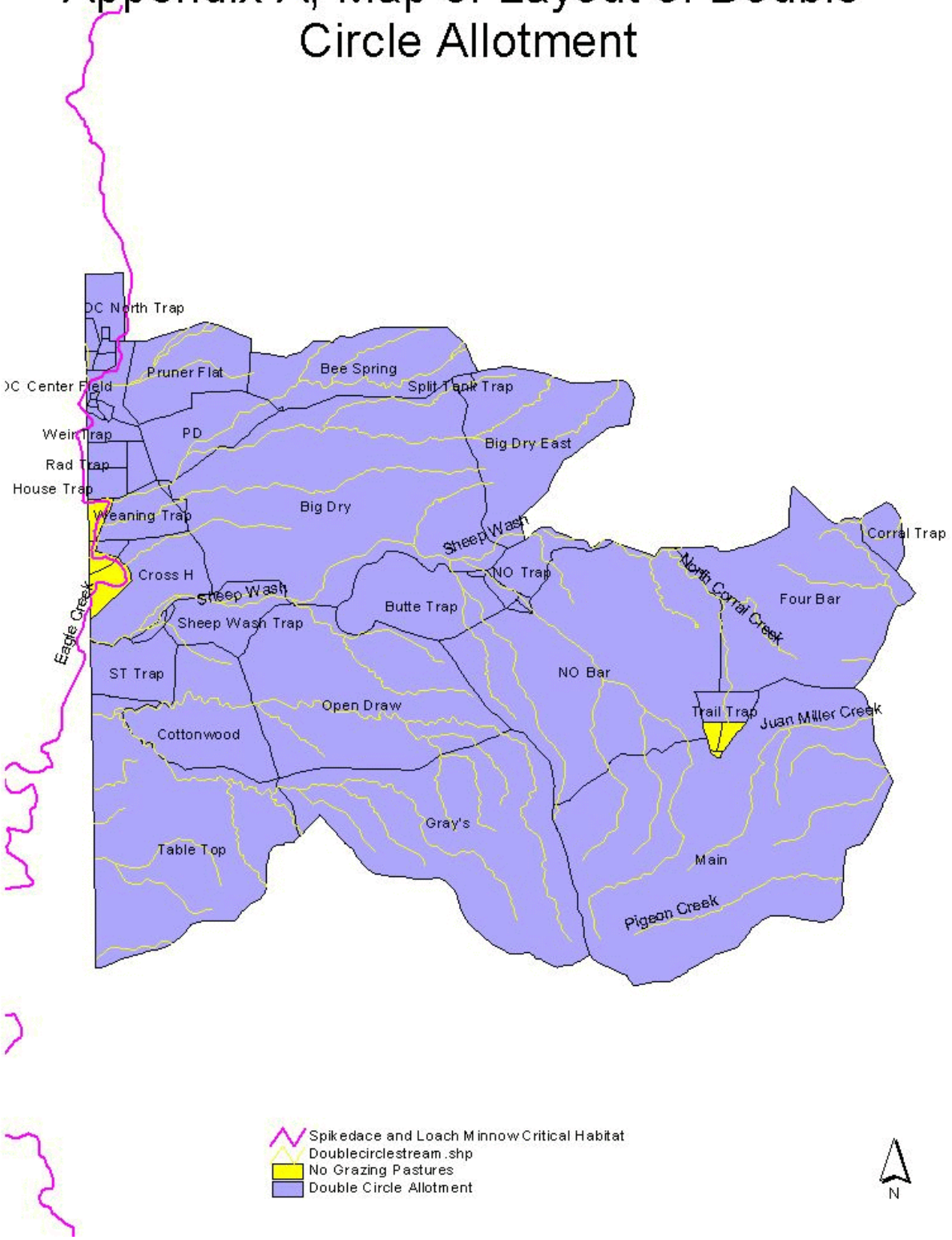
Appendix A, Map 3: Layout of Mud Springs Allotment



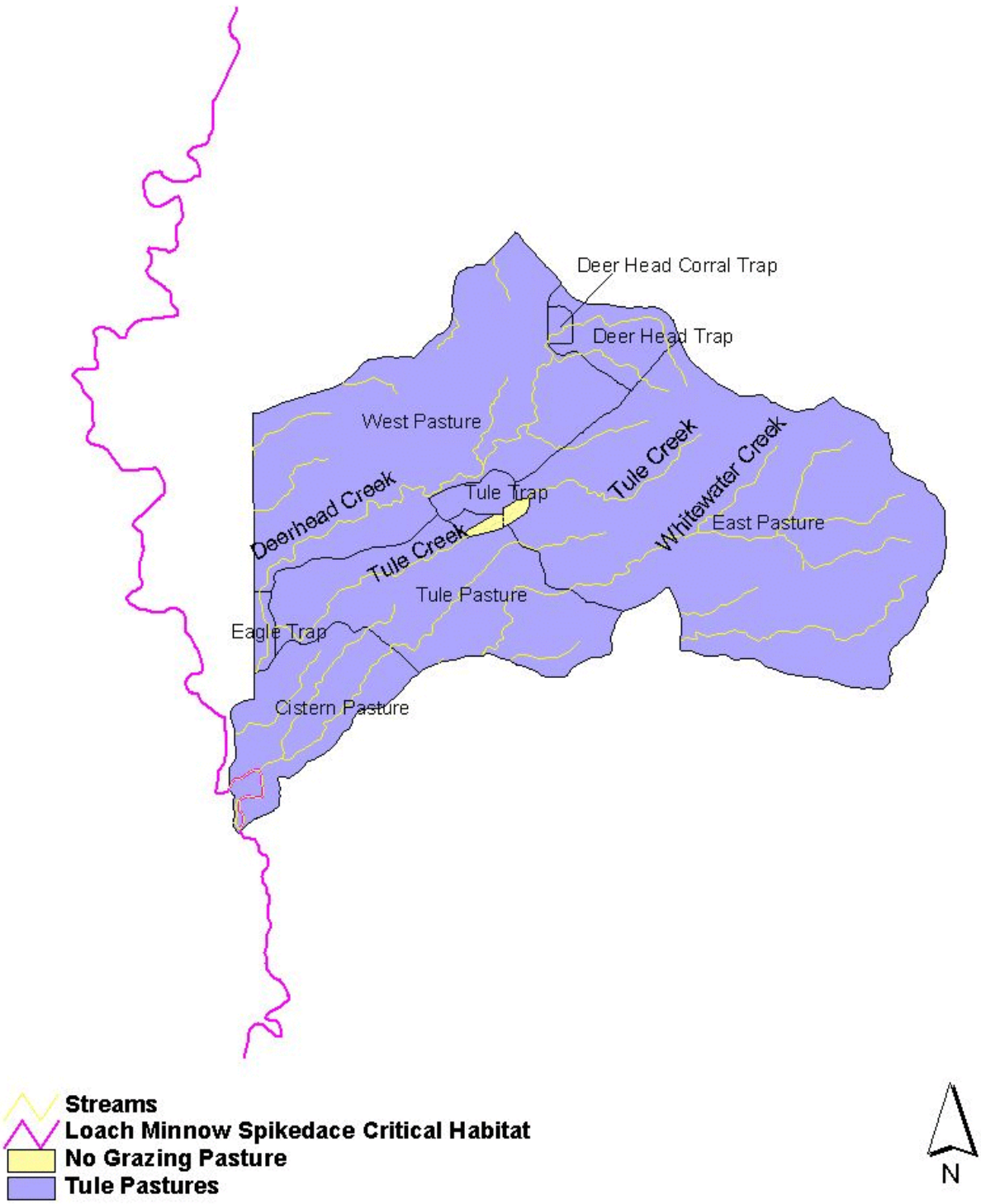
Appendix A, Map 4: Layout of Baseline-Horsesprings Allotment



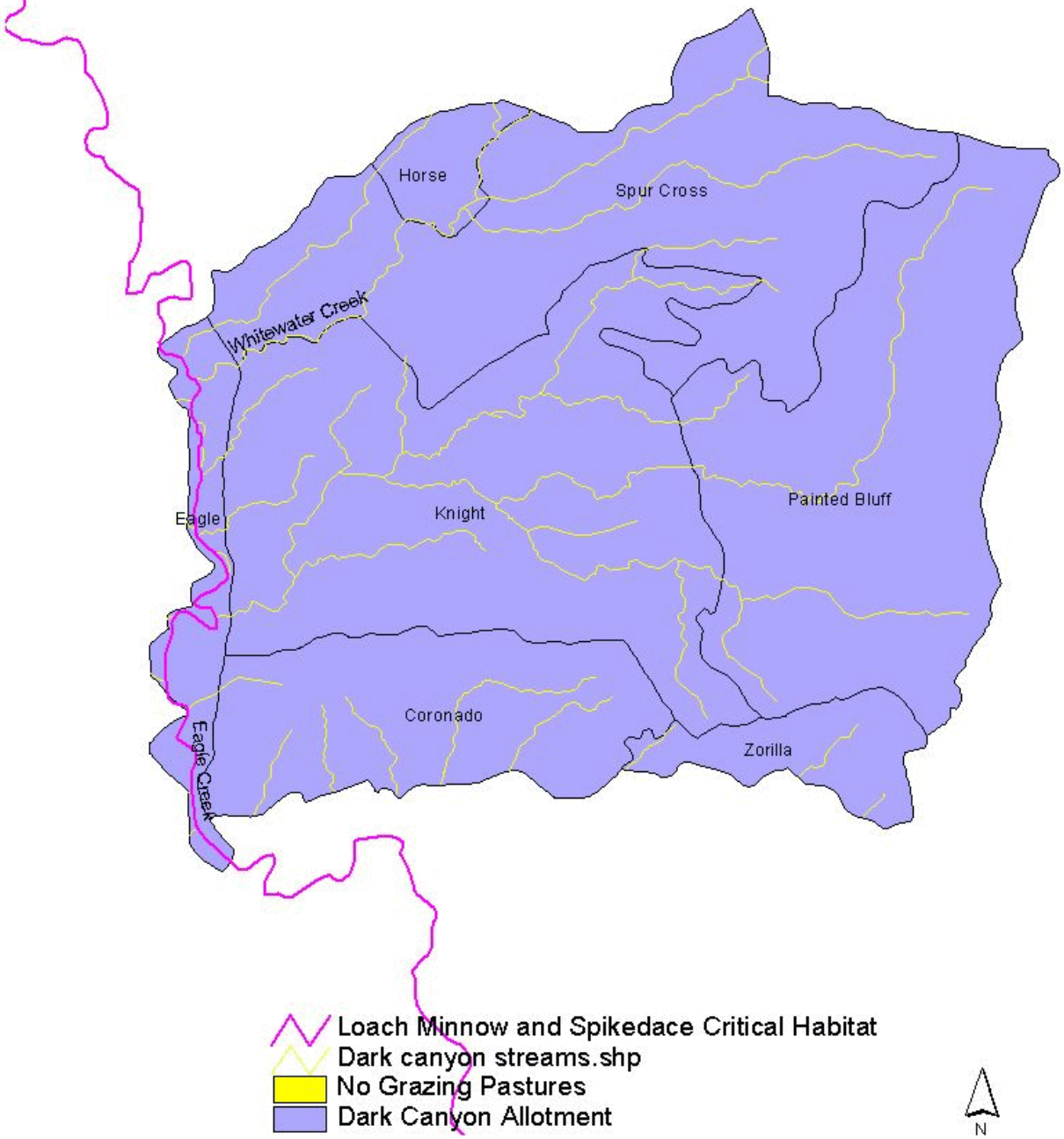
Appendix A, Map 5: Layout of Double Circle Allotment



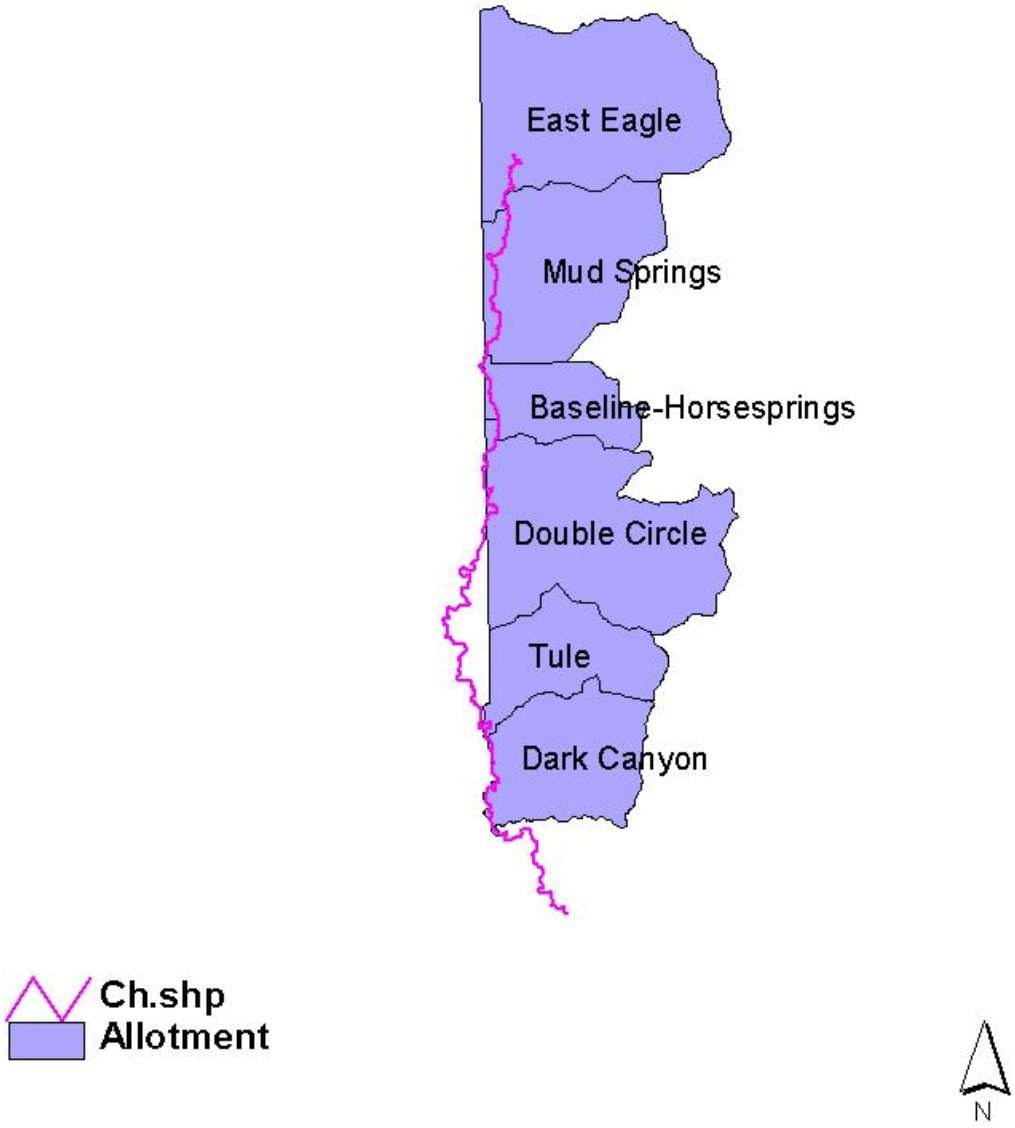
Appendix A, Map 6: Layout of Tule Allotment



Appendix A, Map 7: Layout of Dark Canyon Allotment



Map 8: Loach Minnow and Spikedace Critical Habitat Within the Eagle Creek Watershed



Appendix B: Tables

Table 1. Rangewide population status for the southwestern willow flycatcher based on 1993 to 1999 survey data for Arizona, California, Colorado, New Mexico, Nevada, Utah, and Texas[1].

State	Number of sites with WIFL territories 1993-99[2]	Percentage of sites with WIFL territories 1993-99	Number of territories[3]	Percentage of total territories
Arizona	81	45 %	297	33 %
California	52	29 %	183	20 %
Colorado	5	3 %	48	5 %
Nevada	10	6 %	44	5 %
New Mexico	28	15 %	321	35 %
Utah	6	3 %	22	2 %
Texas	?	?	?	?
Total	182	100 %	915	100 %

[1]Sogge *et al.* 2000.
[2]Site boundaries are not defined uniformly throughout the bird's range.
[3] Total territory numbers recorded are based upon the most recent years survey information from that site between 1993 and 1999.