Little Colorado Spinedace
(Lepidomeda vittata)

5-Year Review:
Summary and Evaluation

Photo by Arizona Game and Fish Department

U.S. Fish and Wildlife Service
Arizona Ecological Services Office
Phoenix, Arizona

5-YEAR REVIEW
Little Colorado Spinedace/*Lepidomeda vittata*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Southwest (Region 2), Wendy Brown, Endangered Species Recovery Coordinator, (505) 248-6664; Brady McGee, Endangered Species Recovery Biologist, (505) 248-6657.

Lead Field Office: Arizona Ecological Services Office, Shaula Hedwall, Senior Fish and Wildlife Biologist, (928) 226-0614 x103; Steven L. Spangle, Field Supervisor, (602) 242-0210 x244.

Cooperating Field Office: Arizona Fish and Wildlife Conservation Office, Stewart Jacks, Project Leader, (928) 338-4288 x20.

1.2 Methodology used to complete the review:

This review was conducted by Arizona Ecological Services Office (AESO) staff using information from species survey and monitoring reports, the 1998 Little Colorado River Spinedace (*Lepidomeda vittata*) Recovery Plan (Recovery Plan) (USFWS 1998), peer-reviewed journal articles, and documents generated as part of section 7 and section 10 consultations. We discussed potential recommendations to assist in recovery of the species with recognized spinedace experts.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

The FR notice initiating this review was published on January 11, 2006 (71 FR 1765). This notice opened a 90-day request for information period, which closed on April 11, 2006. We received comments from the Arizona Game and Fish Department (AGFD) and from Mr. Jim Crosswhite, owner of the EC Bar Ranch on Nutrioso Creek.

1.3.2 Listing history

Original Listing
FR notice: 32 FR 2001 (USFWS 1967)
Date listed: March 11, 1967
Entity listed: Species, *Lepidomeda vittata*
Classification: Threatened. This was the original listing of the spinedace under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa(c)).

Revised Listing
FR notice: 52 FR 35034 (USFWS 1987)
Date listed: October 16, 1987
Entity listed: Species, *Lepidomeda vittata*
Classification: Threatened, with critical habitat. Areas designated as critical habitat are 15 miles of East Clear Creek, Coconino County, from its confluence with Leonard Canyon upstream to C.C. Cragin ("Blue Ridge") Reservoir, and 13 miles of the creek above the reservoir to Potato Lake; eight miles of Chevelon Creek, Navajo County, from the confluence with the Little Colorado River (LCR) upstream to the confluence of Bell Cow Canyon; and five miles of Nutrioso Creek, Apache County, from the Apache-Sitgreaves National Forest boundary upstream to Nelson Reservoir Dam (USFWS 1987).

1.3.3 Associated rulemakings:

Since the time of listing, a special rule pursuant to section 4(d) of the Act was completed (40 FR 44415, Sept. 26, 1975) for the Little Colorado spinedace (spinedace). In accordance with this special rule (50 CFR 17.44 (t)), take of individual spinedace is prohibited except when authorized through the issuance of a valid State permit. Specifically, the special rule regulates take of spinedace for educational purposes, scientific purposes, zoological exhibition, and other conservation purposes consistent with the Act through applicable State Fish and Wildlife Conservation laws and regulations. No Federal permit under section 10(a)(1)(A) of the Endangered Species Act is required.

1.3.4 Review History:

A 5-year review was initiated on July 22, 1985, (50 FR 29901) for all species listed before 1976, and in 1979-1980 a notice of completion with no change in status was published on July 7, 1987 (52 FR 25522). A second 5-year review was initiated on November 6, 1991, (56 FR 56882) for all species listed before 1991, but no document was prepared for this species.

1.3.5 Species' Recovery Priority Number at start of 5-year review:

2 - The degree of threat is high, the potential for recovery is high, and the listed entity is a species (48 FR 43098).

1.3.6 Recovery Plan or Outline

Name of plan or outline: Little Colorado River Spinedace Recovery Plan
Date issued: January 9, 1998
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? Yes.

2.1.2 Is the species under review listed as a DPS? No.

2.1.3 Was the DPS listed prior to 1996? N/A

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy? No.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan?

Yes, the spinedace has a final, approved recovery plan (USFWS 1998).

2.2.1.1 Does the recovery plan containing objective, measurable criteria?

No, the recovery plan does not contain objective, measurable criteria for when the species could be considered for delisting (USFWS 1998). In addition, the five listing factors that are relevant to the species are not addressed in the recovery criteria. The recovery plan lists four goals that do provide a benchmark for measuring progress toward recovery. The goals of the existing recovery plan are to: 1) protect existing spinedace populations, 2) restore depleted and extirpated spinedace populations, 3) protect and enhance existing habitats, and 4) ensure that spinedace continue to exist into the future.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

The spinedace is a small (about 4 inch) minnow native to the LCR drainage. Described in 1874 (data summarized in Miller and Hubbs 1960), few additional collections were made of the species prior to 1939. Based on the existing survey data and historical connectivity of the LCR tributaries, the species is believed to

have inhabited the northward flowing LCR tributaries of the Mogollon Rim, including the northern slopes of the White Mountains in Apache, Coconino, and Navajo counties, Arizona. Extensive collections summarized by Miller (1963) indicated that the spinedace was extirpated from much of the historical range between 1939 and 1960. Currently the range of the species is confined to disjunct locations within the East Clear Creek Watershed, Chevelon Creek, the upper LCR (including Nutrioso and Rudd Creeks), and Silver Creek (Figure 1).

Spinedace are omnivorous, and food items include chironomid larvae, other dipterans, filamentous green algae, and crustaceans (Runck and Blinn 1993, Blinn and Runck 1990). Spinedace are late-spring to early-summer spawners (Blinn 1993, Blinn and Runck 1990, Miller 1961, Minckley 1973, Minckley and Carufel 1967) although some females have been found to contain mature eggs as late as October (Minckley and Carufel 1967). A complete discussion of the taxonomic, distributional, and life history information of the spinedace has been compiled in the Little Colorado Spinedace Recovery Plan (USFWS 1998).

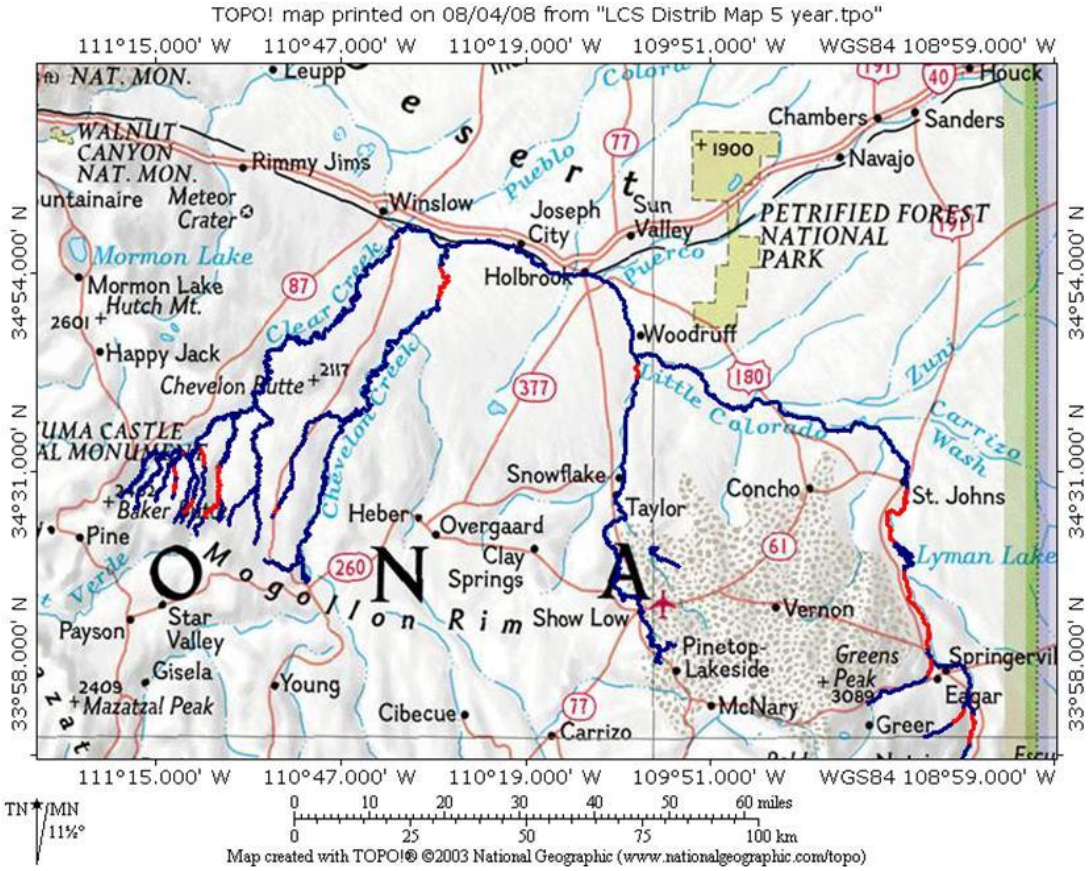

Figure 1. Approximate current (red) and historical (blue) distribution of spinedace (map developed by Recovery Team and updated August 2008).

2.3.1.2 Abundance, population trends, demographic features, or demographic trends:

The spinedace currently occupies portions of the streams it is known from historically within the East Clear Creek, Chevelon, Silver Creek, and upper LCR watersheds. However, populations are generally small and the true population size for any occupied stream is unknown due to the yearly fluctuations and difficulty in locating fish. Populations seem to appear and disappear over short time frames and this has made specific determinations on status and exact location of populations difficult. This tendency has been observed by both researchers and land managers (Miller 1963, Minckley 1965, Minckley 1973) and increases uncertainty over the actual status of any specific population. For example, the Silver Creek population was considered extirpated until fish were collected from the creek again in 1997. Prior to the surveys in July 1997, the spinedace had not been collected anywhere in the Silver Creek drainage since 1965, despite numerous surveys and attempts to locate them. Although the AGFD and others have surveyed Silver Creek since 1997, no spinedace have been located. This ephemeral nature makes management of the species difficult because responses of the population to changes within the watershed cannot be measured with certainty. In addition, small clusters of spinedace confined to limited habitat areas may be more vulnerable to extinction from random environmental, genetic, and demographic events (Schonewald-Cox 1983), and re-establishment of a local population would require immigration from another local area under proper environmental conditions.

In spring 2005, AGFD personnel surveyed several 328-foot transects in Rudd and Nutrioso Creeks. In Rudd Creek, only a single spinedace and a few speckled dace were captured. A total of seven spinedace were captured upstream of Nelson Reservoir in Nutrioso Creek. No spinedace were found below the reservoir, but many fathead minnow and green sunfish were captured. Surveys conducted in April 2006 in Nutrioso Creek located 128 spinedace upstream of Nelson Reservoir. The largest concentration of spinedace was found on the EC Bar Ranch. No spinedace were located downstream of Nelson Reservoir within critical habitat in Nutrioso Creek, or in Rudd Creek. However, in June 2006, AGFD located 415 spinedace in a drying pool in Nutrioso Creek that were moved into a more permanent pool on the EC Bar Ranch. AGFD also located approximately 74 spinedace in Rudd Creek. Surveys conducted in 2008 located spinedace above Nelson Reservoir, and above and below the gauging station on Nutrioso Creek. Spinedace were also located on lower Rudd Creek, below AGFD's property.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

Mitochondrial DNA work on the spinedace was initiated in the 1990s and indicated the existence of three sub-groups identifiable by geographic area (Tibbets et al. 1994): the East Clear Creek drainage, Chevelon Creek, and the

upper LCR, which includes Nutrioso and Rudd creeks. The study concluded that the genetic patterns seen were likely the result of populations isolated and differentiated by both natural and human-caused events. The East Clear Creek and Chevelon Creek sub-groups are more individually distinctive, likely the result of a higher degree of isolation, and possess unique haplotypes. Individuals from the upper LCR sub-group are more similar to each other. Possibly, until recent time, there was one population with considerable gene flow until various dams and diversions increased local isolation. The cause and exact time of the isolation of the three sub-groups are not known, but Tibbets et al. (1994) recommend that all of these populations be maintained to conserve genetic variation in this species. Spinedace from Silver Creek were not included in the study since none were available at the time. Though Silver Creek fish were located again in 1997, fish were not collected for genetic work and it is unknown whether they would fit into one of the three genetic sub-groups or possibly belong to a separate sub-group.

2.3.1.4 Taxonomic classification or changes in nomenclature:

There is no new information regarding taxonomic classification or changes in nomenclature.

2.3.1.5 Spatial distribution, trends in spatial distribution, or historical range:

Currently, we are consistently able to locate spinedace in the following areas: 1) West Leonard and Leonard Canyons on the Coconino National Forest; 2) Lower Chevelon Creek on the privately-owned Rock Art Ranch; 3) LCR on two properties owned by the AGFD (Becker Lake-Enders and Wenima Wildlife Areas); 4) Rudd Creek on the Apache-Sitgreaves National Forest; and 5) Nutrioso Creek on the privately-owned EC Bar Ranch. However, even though we usually can find fish in these locations, numbers are typically low (<100 fish) and tend to fluctuate, except on the Rock Art Ranch where numbers of spinedace currently tend to be much higher.

The most recent survey and habitat data for each watershed are indicated below:

Chevelon Creek Watershed: Currently, the spinedace occupies a section of Chevelon Creek, several miles upstream of Chevelon Creek's confluence with the LCR on the privately owned Rock Art Ranch. Chevelon Creek through the Ranch supports robust populations of spinedace, where large schools of fish (40-50 individuals) can be seen swimming in pools downstream of The Steps, something not seen in any other currently occupied area (Lopez et al. 1998).

On July 23, 2007, AGFD stocked 95 spinedace into five pools on West Chevelon Creek on the Apache-Sitgreaves National Forest. This tributary to middle Chevelon Creek contains only native fish at this time and is expected to provide habitat for spinedace. In July 2008, surveys located spinedace within the

perennial pools where they were originally stocked and downstream of the area in ephemeral reaches. It is unclear how many fish are still present or if they spawned in 2008. Further surveys and stockings of this area are needed in order to ensure that spinedace persist in this Chevelon Creek tributary if it is to contribute to recovery.

East Clear Creek Watershed: Spinedace currently occupy small, perennial pool habitats in West Leonard Canyon, Leonard Canyon (including Dines Tank), Bear Canyon, Dane Canyon, and Yeager Canyon. The populations and available habitat are all relatively small throughout the watershed, but West Leonard and Leonard Canyons continue to be one of the most dependable locations to find spinedace in the entire watershed. Bear, Dane, and Yeager Canyon populations are sustained by moving spinedace from West Leonard Canyon and Dines Tank to these areas.

Little Colorado River (including Nutrioso Creek and Rudd Creek): Spinedace have been documented in the LCR from Springerville downstream to St. Johns, Arizona (Dorum and Young 1995). Spinedace occur on both the AGFD Wenima and Becker Wildlife Areas within this reach of the LCR in small to moderate numbers. The most recent survey efforts in July 2005 found 39 spinedace at Wenima and 92 spinedace at Becker Wildlife Area. Surveys conducted in 2008 by the AGFD and Bureau of Land Management (BLM) also located spinedace above Lyman Lake in the LCR.

Spinedace have been located in middle Nutrioso Creek from the Apache-Sitgreaves Forest boundary upstream to Nelson Reservoir and from Nelson Reservoir upstream to Nutrioso, Arizona (Lopez et al. 2001a). Spinedace were first located in Rudd Creek in 1994 (Lopez et al. 2001b).

Silver Creek: Spinedace were thought to be extirpated from Silver Creek until a small number of fish were discovered in lower Silver Creek in July 1997 (Lopez et al. 1999). However, numerous surveys since then have failed to find spinedace, including an extensive survey in 2004 funded by a cooperative agreement with the BLM (McKell and Lopez 2005). It is believed that changes to the habitat since 1997 have likely increased habitat for non-native fishes and impacted our ability to capture spinedace during surveys. If spinedace are still present in Silver Creek, it may be that they exist at such low numbers, or in areas that have not been surveyed due to access restrictions, that our current sampling techniques are insufficient to detect them in this altered habitat.

2.3.1.6 Habitat or ecosystem conditions:

Available information indicates that suitable habitat for the Little Colorado spinedace is characterized by clear, flowing pools with slow to moderate currents, moderate depths, and gravel substrates (Miller 1963, Minckley and Carufel 1967). Cover provided by undercut banks or large rocks is often a feature. Spinedace

have also been found in pools and flowing water conditions over a variety of substrates, with or without aquatic vegetation, in turbid and clear water (Denova and Abarca 1992, Nisselson and Blinn 1991). Water temperatures in occupied habitats ranged from 58 to 78 degrees Fahrenheit (Miller 1963).

As with most aquatic habitats in the Southwest, the LCR basin contains a variety of aquatic habitat types and is prone to rather severe seasonal and yearly fluctuations in water quality and quantity. As would be expected for a species adapted to fluctuating physical conditions, the spinedace is found in a variety of habitats (Blinn and Runck 1990, Miller 1963, Miller and Hubbs 1960, Nisselson and Blinn 1989). It is unclear whether occupancy of these habitats reflects the local preferences of the species or its ability to tolerate less-than-optimal conditions. Both mountain streams and lower-gradient streams and rivers have provided habitat for the spinedace. Residual pools and spring areas are important refuges during periods of normal low water or drought. In the past, spinedace have been able to recolonize other stream reaches during wetter periods from these refugial areas. This ability to quickly colonize an area has been noted in the literature (Minckley and Carufel 1967) as well as in observations by others familiar with the species.

Native fishes associated with spinedace include speckled dace (*Rhinichthys osculus*), bluehead sucker (*Pantosteus discobolus*), Little Colorado sucker (*Catostomus spp.*), roundtail chub (*Gila robusta*), and Apache trout (*Oncorhynchus gilae apache*) (USFWS 1998). The list of non-native fishes is much larger and includes species with varying degrees of incompatibility with the spinedace's long-term survival. The presence of non-natives was one of the primary reasons the species was listed and may contribute to the disjunct distribution patterns observed and the spinedace's retreat to what may be suboptimal habitats (Bryan et al. 2002). Non-native fish may compete with, prey upon, harass, and alter habitat utilized by native fish. In the last 100 years, at least ten non-native fish species have been introduced into spinedace habitats. These include rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), golden shiner (*Notemigonus crysoleucus*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and others. Surveys in East Clear Creek have documented the presence of rainbow trout, fathead minnow, golden shiners, and brown trout (*Salmo trutta*) in the watershed (Denova and Abarca 1992). Data from research experiments and field observations indicate that at least the rainbow trout is a predator and potential competitor with the spinedace (Blinn et al. 1993, Bryan et al. 2002). Crayfish have also been introduced into habitats within the range of the spinedace. Crayfish threaten the continued existence of spinedace as they prey on, compete with, and modify the habitat of Little Colorado spinedace (Minckley and Craddock 1961, Lodge et al. 1985, White 1995). Though spinedace may remain extant in areas with a few or reduced non-natives, multiple predators may result in enhanced negative effects to spinedace. For example, research conducted by Bryan et al. (2002) found that when both rainbow trout and crayfish were present, spinedace had decreased

activity rates and decreased movements in and out of refuges as opposed to when only crayfish or trout were present.

2.3.1.7 Other:

Conservation/Recovery Actions Implemented

The AGFD, USFWS (both Ecological Services and Arizona Fish and Wildlife Conservation Office Staff), U.S. Forest Service (Coconino and Apache-Sitgreaves National Forests), BLM (Safford Field Office), Recovery Team members, private landowners, and livestock permittees work together to design and implement conservation actions to protect spinedace habitat, preserve genetic variance within each sub-group, and re-establish spinedace within the LCR basin. The following list of recovery actions represent the most significant of these efforts that have been accomplished to secure and maintain extant populations of the spinedace in spite of the factors (predominately drought, water development, and non-native species) that continue to adversely impact the status of the species. The cost of these projects has been shared by many partners, including State and Federal programs such as the AGFD Heritage Fund and USFWS Partners for Fish and Wildlife programs, as well as private grant programs and contributions from landowners.

- Since the species was listed in 1987, populations in East Clear Creek, Chevelon Creek, and the LCR have been sustained due to significant efforts to maintain fish in drought resistant habitats, rescue fish from drying habitats, and establish refuge facilities to maintain spinedace (e.g., Arboretum at Flagstaff, Grasslands Wildlife Area).
- The East Clear Creek Watershed Recovery Strategy for the Little Colorado Spinedace and Other Riparian Species (USDA 1999) identified activities to assist in the recovery of the spinedace and its habitat within the East Clear Creek Watershed on both the Coconino and Apache-Sitgreaves National Forests. Projects implemented under this strategy include the supplemental stocking of spinedace into Bear, Dane, and Yeager Canyons; improved livestock management within the watershed; and increased protection for headwater meadows and occupied spinedace habitats from detrimental land management activities.
- The AGFD secured habitat and water rights in multiple land acquisitions within the spinedace's range (e.g. Chevelon, Wenima, Becker, Grasslands, and Sipes Wildlife Areas) to protect stream flows in spinedace habitat and provide refuge sites for maintaining populations.
- The Arboretum at Flagstaff refuge and Grasslands Wildlife Area refuge are used to hold spinedace from two of the three identified genetic sub-groups of spinedace. Spinedace have also spawned in these areas, which may contribute to providing fish for reestablishment projects within its historical range.
- Mr. Jim Crosswhite's efforts to maintain and improve spinedace habitat on Nutrioso Creek on his EC Bar Ranch have aided in maintaining spinedace in

this creek, particularly during periods of drought. A Safe Harbor Agreement was established on the EC Bar Ranch to benefit spinedace and southwestern willow flycatchers.

- AGFD, USFWS, and Forest Service efforts to establish fish in new habitats such as Bear Canyon, Dane Canyon, Yeager Canyon, and West Chevelon have provided additional habitat for spinedace.
- AGFD conducted research on spinedace/trout interactions (Bryan et al. 2002). Northern Arizona University conducted research on spinedace life history and effects of crayfish on spinedace (Runck and Blinn 1993, Blinn and Runck 1990, White 1995). Arizona State University conducted research on genetic variation among and within spinedace populations (Tibbets et al. 1994).
- The Grand Canyon Wildlands Council and many volunteers labored in 2008 to remove crayfish from occupied spinedace habitat in Dines Tank, Leonard Canyon, Coconino National Forest.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

At the time of listing in 1987, significant reductions in stream and river habitat from impoundments and water development, and predation by and competition with non-native fishes had resulted in habitat loss and fragmentation throughout the spinedace's range. Habitat loss and fragmentation continue to be serious threats to the fish's existence. The final listing rule (USFWS 1987) also identified human uses, such as riparian destruction, urban growth, mining, timber harvest, road construction, livestock grazing, and other watershed disturbances (e.g., road construction and maintenance, recreational development and usage, fire management, and inter-basin water diversions) as having had detrimental effects to spinedace habitat. These activities have affected watershed function, runoff patterns, peak flows, seasonal flows, riparian vegetation, wet meadow functions, bank erosion, siltation, and water quality. Wildlife and fisheries management largely associated with providing hunting or fishing opportunities has altered the faunal component of the habitat. Introduction of non-native trout, baitfish, and crayfish at recreational lakes and reservoirs have increased competition for available resources and possibly predation on spinedace. In addition, there is concern that elk (*Cervus elaphus*) are much more abundant in the East Clear Creek watershed (and possibly in other areas) than they were historically, and that they may have a significant effect on the existing riparian and aquatic habitats (USFWS 2005). However, the main threats to the species' habitat continue to be water development resulting from increased human demand for water (including both groundwater pumping and surface water collection), drought, and the continued effects of invasive aquatic species (discussed in section 2.3.2.3).

Water Development

In the Southwest, aquatic habitats have been extensively modified or lost through the construction of dams and water diversions, the channelization of riparian areas, and increasing groundwater withdrawals (Rinne 2004). Many recent studies and assessments of the LCR watershed and its underlying groundwater resources indicate that these water resources are under increasing pressure from development (Bills et al. 2005). The North Central Arizona Water Supply Study Report of Findings (BOR 2006) predicts that by the year 2050, the human demand for water will be unmet in north central Arizona. Plans are underway to determine how additional water resources can be developed to provide for this unmet demand. Protecting water resources for environmental needs is included in these plans. However, it is likely that with the need for additional water for human uses, there would be additional stress put on environmental demands for water. In addition, there is high potential that extended drought, perhaps exacerbated through global climate change, will further stress water resources within the range of the spinedace.

The Kayenta and Black Mesa coal mining operations comprise the sum of mining operations at the Black Mesa Complex (Complex), which is composed of three contiguous leases and two surface rights-of-way and easements granted from the Hopi Tribe and Navajo Nation. Beginning in 2005, the project proponents proposed to conduct revisions to the life-of-mine mining plans for the Complex, to reconstruct the 273-mile-long coal slurry pipeline from the Black Mesa mining operation to the Mohave Generating Station, and to withdraw water from the C-aquifer at Leupp to convey water to the Complex for use in the coal slurry and other mining-related and public uses. At this time, the Black Mesa Project is not going ahead as planned. However, as part of an environmental impact statement to analyze the effects of the Black Mesa Project, two hydrologic models were developed to evaluate the impacts of proposed project pumping on groundwater in the C-aquifer in Arizona. The C-aquifer is located on the Colorado Plateau of northeastern Arizona, western New Mexico, and southern Colorado and is the aquifer that underlies the LCR Basin. A superposition groundwater model was developed by the U.S. Geological Survey for the purpose of making a preliminary determination of effects to federally-listed species within the project area (Leake et al. 2005). A full-flow groundwater model was developed to evaluate cumulative effects to surface water flow within the proposed project area (Papadopulos and Associates 2005). Though these models were created to evaluate potential effects from a specific project, these models provide information regarding the current and future effects of groundwater pumping in the upper LCR watershed, specifically in Clear Creek (which includes the East Clear Creek watershed) and Chevelon Creek.

Both models predicted depletion in baseflow from current and proposed groundwater withdrawals in lower Chevelon and Clear Creeks over the next 50 to 100 years. The flow model (Papadopulos and Associates 2005) predicted that,

based on current regional pumping, the base flow of Lower Chevelon Creek would be zero in 60 years. Currently, the most robust spinedace population left, Chevelon Creek near The Steps, and designated critical habitat are located in the area expected to lose surface flow. Based on the precarious status of the spinedace and current impacts to its habitat, any further reduction in flows should be considered significant. In addition, though the effects were not quite as dire, there is the potential for impacts to flow within lower Clear Creek as well. However, though lower Clear Creek likely supported spinedace historically, we have not detected spinedace in this area, likely due to the non-native fish and crayfish present throughout Clear Creek (Clarkson and Marsh 2005).

Drought and Climate

Continued drought and global climate change are likely to threaten spinedace. Studies have shown that since 1950, the snowmelt season in some watersheds of the western U.S. has advanced by about 10 days (Dettinger and Cayan 1995, Dettinger and Diaz 2000, Stewart et al. 2004). Such changes in the timing and amount of snowmelt are thought to be signals of climate change in high elevations (Smith et al. 2000, Reiners et al. 2003). The impact of climate change is the intensification of natural drought cycles and the ensuing stress placed upon high elevation montane habitats (IPCC 2007, Cook et al. 2004, Breshears et al. 2005, Mueller et al. 2005). Based upon the extended drought in the Southwest and documented changes in spinedace habitats in Arizona, climate change may permanently reduce the amount of habitat available for spinedace. Literature indicates that persistence is greater for species occupying larger patches of their historical range (Channell and Lomolino 2000). Since spinedace occupy small patches of habitat compared to their historical distribution, we may expect that climate change would exacerbate the threat of habitat loss and result in further fragmentation among existing populations.

It has become more difficult to find spinedace because drought conditions have reduced available habitat. In addition, drought conditions over the last decade have confounded cooperative recovery efforts for the Little Colorado spinedace throughout its range. During several of the last years, particularly in 2002 and 2006, spinedace have been salvaged from drying pools and either brought into captivity or moved to more permanent pools. Efforts to establish spinedace in additional habitats within currently occupied drainages have been thwarted over the last several years as spinedace were introduced to areas only to have the habitat dry within months of reintroduction. The lack of permanent waters within the range of the spinedace continues to impede recovery efforts.

The status of the spinedace has been declining within the East Clear Creek watershed since its 1987 listing. The Little Colorado Spinedace Recovery Plan (USFWS 1998) lists the East Clear Creek population as second in order of those populations in imminent danger of extinction, and states that the loss of any population of spinedace significantly increases the risk of extinction for the

species (USFWS 1998). Therefore, any impacts to this species in this watershed are considered extremely serious and warrant careful monitoring. The East Clear Creek population of spinedace has been recorded primarily from the mainstem of the creek and in portions of Leonard Canyon. As stated previously, this population fluctuates widely and is usually found in small, isolated pockets of habitat. A key factor in the presence of the fish appears to be the quantity of water in these systems. East Clear Creek and its tributaries in the Leonard Canyon watershed are ephemeral. Most of the flows are the result of runoff from snowmelt in March and April, with localized contributions from summer monsoon rains. Peak flows can be quite high and the most recent high flows were 1993. Some pools are found in the streams when there is no flowing surface water. Although these pools are often isolated, they provide the only fish habitat available during dry periods. Scattered pools, such as Dines Tank, normally persist through the seasonal dry periods. However, during drought conditions, many of these pools are not holding water.

The absence of water is a limiting factor for spinedace within Nutrioso Creek (below Nelson Reservoir) as well as the presence of non-native fish where water does occur, and excess vegetation in pools when water is available. The Apache-Sitgreaves National Forest indicated in their 2006 biological assessment and evaluation for the Nutrioso Wildland Urban Interface Project that the creek's incised channels and poor riparian condition would not adequately process large-scale or chronic disturbances within its drainage (USFWS 2006). The presence of non-native species, the current condition of Nutrioso Creek, and the general absence of water clearly has a negative impact to the spinedace and critical habitat.

Large seasonal variations in water discharge for Nutrioso Creek, above and below Nelson Reservoir, are known to occur primarily from snowmelt run-off and some spring rain events between mid-February to the beginning of May (ADEQ 2000). A turbidity study performed by the Arizona Department of Environmental Quality (ADEQ) in November 1999 and January 2000 indicates that the majority of the stream meets turbidity standards; however, a portion of the stream from the town of Nutrioso to Nelson Reservoir (about 7 miles) violates the Nephelometric Turbidity Units (NTU) standard (ADEQ 2000). This turbidity impairment is the result of excess sediment coming from the banks of the stream. The banks of the stream are incised due to channel degradation that created a loss in floodplain. The loss of floodplain in the channel increases the stream velocity during high flow events, thus increasing the erosion potential (ADEQ 2000).

AGFD surveys in 1994 indicate that Rudd Creek is not meeting the Apache-Sitgreaves National Forest standards regarding siltation and bank stability (USFWS 2006). The upper reaches do not meet the Forest's standards regarding satisfactory riparian condition and canopy cover due to the ongoing effects of past land management in the area (e.g., livestock grazing, etc.). Due to the creek's generally incised channels and poor riparian condition, it is not likely to handle

large-scale or chronic disturbances within its drainage without adversely affecting spinedace and/or its habitat (USFWS 2006).

In 1997, the habitat in Silver Creek consisted primarily of shallow riffle/run habitat with occasional, relatively small pools. Starting in 1999 and continuing to the present, the same areas now consist of almost exclusively deep, wide pool habitat due to extensive beaver dams. In addition, the extensive pool habitat, which extends for miles, has created prime habitat for non-native fish and crayfish. This change in habitat has made sampling the area extremely difficult. At this time, both the USFWS and AGFD are hopeful that spinedace still exist in lower Silver Creek. However, the prognosis for spinedace recovery in Silver Creek is bleak. The habitat is conducive to promoting non-native fish and crayfish, and there are fewer and fewer native fish found within Silver Creek.

In summary, extended drought cycles resulting in drought-intolerant habitats and increased development of groundwater resources are impacting habitat for spinedace within their historical range.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

There was no evidence at the time of listing that the spinedace was overused for any of these purposes, and we are unaware of any substantial impact from this factor since the species was listed.

2.3.2.2 Disease or predation:

In the listing decision, predation by non-native piscivorous fish was considered to be a major factor impacting the decline of the spinedace. Since the spinedace was listed, non-native fish and crayfish have continued to increase within the range of the spinedace and is likely one of the reasons the spinedace is so rare throughout the majority of its historical range. It is likely that competition and predation by non-native aquatic species is the most consequential factor preventing the recovery of spinedace and other native aquatic species in the Southwest (Rinne 2004, Clarkson et al. 2005, Olden and Poff 2005, Schade and Bonar 2005). Since listing, several studies have documented the potential adverse effects of non-native fishes and crayfish on spinedace (Blinn et al. 1993, White 1995, Bryan et al. 2002, Sweetser et al. 2002). However, most of the research and effort to document predation has focused on rainbow trout. Though trout are a documented predator of spinedace (Blinn et al. 1993) and may interact with other predators to increase detrimental effects to spinedace (Bryan et al. 2002), introduced trout species are not likely the greatest non-native threat to spinedace at this time due to their inability to reproduce outside of reservoirs and AGFD's management of rainbow trout as a put-and-take fishery. Based on data in our files, invasive species such as smallmouth bass and green sunfish, which are extremely piscivorous fish, are increasing in abundance and distribution

throughout the range of the spinedace. These fishes, as well as others, have the potential to completely remove spinedace from habitats through predation. The current threat that these fishes pose in the East Clear Creek Watershed and Chevelon Creek is immense, and all efforts should be made to remove them from these habitats. In addition to predation, non-native fishes may also spread parasites that can cause high fish mortality in new host species (Stone et al. 2007).

There are non-native species present throughout the spinedace-occupied portion of Chevelon Creek, but green sunfish and crayfish, both predators of spinedace, were found to be uncommon in areas where spinedace numbers were highest (Lopez et al. 1998). However, AGFD has reported that over the last year or two, largemouth bass appear to be increasing in abundance above The Steps (M. Lopez, AGFD, pers. comm., July 25, 2008). At this time, the distribution and abundance of largemouth bass in this reach and how they may be impacting spinedace populations in the area is unknown but likely a threat as largemouth bass are highly piscivorous. In addition, Willow Springs Lake, a reservoir located at the head of Chevelon Creek, contains a thriving population of smallmouth bass (*Micropterus dolomieu*). Though smallmouth bass are currently located approximately 40 miles upstream of known spinedace locations in Chevelon Creek, their occurrence in the reservoir and potential to move downstream are a threat to spinedace and other native fish in the drainage. In addition, we are unaware of current surveys within Chevelon Creek to monitor any movement of bass downstream of the reservoir. The presence of these predatory, non-native fishes may adversely impact the future abundance and persistence of spinedace in Chevelon Creek.

In October 2007, non-native green sunfish (multiple size classes), largemouth bass, and yellow bullhead (*Ameiurus natalis*) were detected near the boat ramp and in the Bear Canyon arm of the C.C. Cragin (Blue Ridge) Reservoir, East Clear Creek watershed. These nonnative species had not been located there prior to this time and if they were to access the upstream drainages, these predatory fishes could derail recovery efforts in the watershed. High-flow events during the winter 2007-2008 could have allowed these fish to spread up and down stream of these locations. Surveys conducted in summer 2008 did not locate these non-native fishes upstream of C.C. Cragin Reservoir. Currently Bear Canyon is the only occupied habitat located upstream of the reservoir. However, future efforts will be made to stock spinedace in Miller and Kehl Canyons, which are also located upstream of the reservoir.

Non-native species (fish and crayfish) also occur throughout the LCR mainstem, Nutrioso Creek, Rudd Creek, and Silver Creek. Non-natives fishes and crayfish have likely influenced the fragmented distribution and poor persistence of spinedace throughout their historical range.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Federal and State regulations directly or indirectly affect spinedace populations. The primary areas of regulatory authority affecting the spinedace are the Endangered Species Act (Act); AGFD Commission Order 40, Heritage Fund, and State Wildlife Action Plan; and the National Environmental Policy Act (NEPA). As described below, these regulatory mechanisms have been ineffective in arresting the decline of this species.

Endangered Species Act

The Act (1973, as amended; 16 USC 1531 et seq.) is the primary Federal law providing protection for the spinedace. Beyond the actual listing of the species, these protections are afforded particularly through sections 7, 9, and 10 of the Act. Section 7 of the Act requires Federal agencies to ensure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of listed species or adversely modify their critical habitat. Section 7 also encourages Federal agencies to use their authorities to carry out programs for the conservation of listed species. Section 9 of the Act includes prohibitions against possessing, selling, importing, exporting, and taking listed species. Section 10 of the Act provides a process whereby private landowners can gain an exemption to the section 9 take prohibitions (i.e., a section 10(a)(1)(B) permit) provided such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under a Safe Harbor Agreement, participating property owners voluntarily undertake management activities on their property to enhance, restore, or maintain habitat benefiting species listed under the Act. Safe Harbor Agreements encourage private and other non-Federal property owners to implement conservation efforts for listed species by assuring property owners they will not be subject to increased property use restrictions if their efforts attract listed species to their property or increase the numbers or distribution of listed species already on their property. Application requirements and issuance criteria for enhancement of survival permits through Safe Harbor Agreements are found in 50 CFR 17.22(c).

We regularly consult under Section 7 of the Act with Federal agencies for actions affecting the spinedace, including the Forest Service, BLM, Federal Highway Administration, and Army Corps of Engineers. We also consult on all of our own projects that may affect listed species (e.g., Sportfish and Wildlife Restoration Program, Safe Harbor Agreements, and Partners for Fish and Wildlife projects). Information in our files indicates that approximately 29 formal consultations have been completed or are underway for actions affecting Little Colorado spinedace range-wide. Adverse effects to Little Colorado spinedace have occurred due to these projects and many of these consultations have required reasonable and prudent measures to minimize effects of incidental take on Little Colorado spinedace. However, as is the case with many aquatic species, it is difficult, if not impossible, to quantify the actual incidental take of spinedace to date.

The USFWS has not carried out law enforcement actions regarding spinedace under the take prohibitions of ESA section 9.

AGFD Orders and State Wildlife Action Plan

The Heritage Fund (Title 17, Chapter 2, Article 6) is a state program for the Identification, Inventory, Acquisition, Protection, and Management of sensitive species and their habitats. This fund has been used to acquire the Chevelon, Wenima, Becker, Grasslands, and Sipes Wildlife Areas to aid in conservation of spinedace and spinedace habitats.

As a requirement of the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program in 2000, Congress asked each state wildlife agency to develop a "comprehensive wildlife conservation strategy"—a wildlife action plan—that evaluates wildlife conservation needs and outlines the necessary action steps. The AGFD State Wildlife Action Plan (Plan) identifies the spinedace as a Tier 1a Species of Greatest Conservation Need. The Plan describes conservation actions that may be implemented to address stressors specific to individual species. The Plan identifies several stressors as having significant impacts to spinedace. These stressors are listed along with conservation actions that would alleviate or remove the impacts to spinedace and their habitats. Some of the identified actions are being implemented as described above, in collaboration with the USFWS, Forest Service, BLM, and others. However, other actions fall outside the scope of work for the AGFD and there is no funding or land management authority to allow them to be implemented. Nonetheless, the plan lists a comprehensive set of actions that would bring better habitat conditions for spinedace if they could all be implemented.

In addition, the AGFD regulates the take of spinedace in Arizona through a 4(d) special rule under the Act and through the administration of scientific collecting permits.

National Environmental Policy Act

The NEPA may provide some protection for the spinedace for projects with a Federal nexus (undertaken, funded, or authorized by Federal agencies). The NEPA requires that the planning process for Federal actions be documented to ensure that effects on the environment are considered. The NEPA process is intended to help public officials make better decisions based on an understanding of the environmental consequences of their actions and to take actions to protect, restore, and enhance the environment (40 CFR 1500.1). Carrying out the NEPA process ensures that agency decision makers have information about the environmental effects of Federal actions and information on a range of alternatives that will accomplish the project purpose and need.

For environmental impacts that are significant, the Federal agency must identify means to mitigate these impacts (40 CFR 1502.16). For projects undertaken, funded, or authorized by Federal agencies, NEPA would at least require that any significant adverse impacts to the human environment, including impacts to the natural and physical environment (40 CFR 1508.14), be considered. Because most of the currently occupied and potential habitat occurs on the Coconino and Apache-Sitgreaves National Forests, projects that occur on these forests that are mandated to comply with NEPA may provide consideration of impacts to the spinedace and its habitat.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

At the time of listing, the issues discussed under this factor included the introduction of non-native fishes that is discussed above (2.3.2.3 Disease and Predation) and the past indiscriminate use of piscicides to establish sportfish in drainages occupied by spinedace and other "undesirable" fishes. Today, piscicide is predominately used to remove non-native fish and restore habitats for native species, such as spinedace.

Current conditions throughout the LCR watershed are likely due to the historical land-management practices listed above. Stream and upland grassland habitats remain severely impacted from past grazing, development, and various other land-management practices (e.g., water diversions), particularly in the lower LCR (Young et al. 2001). Some historical background on riparian conditions in the East Clear Creek watershed is contained in the Hydro Science (1993) report. The present conditions of streams in the area are not the conditions that would have existed without the overgrazing that began in the late 1800's and continued through the 1950's. Even if some stream reaches are considered "functional" today, it does not mean that they are in good condition relative to the pre-overuse baseline. A wide, gravel-cobble wash is a very different system compared to a narrow, meandering stream channel bordered by riparian vegetation. Most streams within the East Clear Creek, Chevelon, Nutrioso, and Rudd watersheds are now ephemeral. While this may be the current baseline condition, the amount of time when there are no flows may have increased as bank storage declined due to erosive gullying and downcutting, and runoff increased as vegetation was reduced. This has had a significant effect on the availability and quantity of fish habitat in the stream reaches within these watersheds (USFWS 2005).

Other natural or manmade factors that could impact the spinedace today include the risk of high-severity wildfires within the watersheds supporting the spinedace. Loss of vegetation and soil to burning could result in increased ash and sediment inputs to the stream, as well as increased water temperatures, all of which affect habitat for the various life stages (i.e., adult, juvenile, larval) of spinedace. Ash flows, particularly, are toxic to fish and could wipe out entire populations in a single event. Cumulatively, the impacts of a landscape level, high-severity wildfire could be catastrophic and result in extirpation of a population or portions

of a population within the fire area. Though there are areas on the Coconino and Apache-Sitgreaves Forest that are currently at high-risk for stand-replacing fires, most of these areas already have actions that are currently being implemented to reduce the potential effects of wildland fire on spinedace and their habitat. Projects to reduce the potential for high-severity fire in these watersheds include the Eager South Wildland Urban Interface (WUI) Project, East Clear Creek Watershed Health Project, Nutrioso WUI Project, and Victorine WUI Project.

2.4 Synthesis

At the time of listing in 1987, habitat loss based on past water development projects and predation from introduced non-native fish were considered the major threats to spinedace. Threats to the spinedace have worsened since listing, and their impact on existing populations and habitats is expected to increase further into the foreseeable future over the next 50 to 100 years. Water-development projects are expected to increase within the range of the spinedace as human populations and the demand for water grows. Recent hydrologic studies predict that portions of Chevelon Creek, including occupied and critical habitats, will lose surface flow within the next 50 years based on today's pumping levels. Currently there are no plans in place to protect these areas from groundwater withdrawal. Non-native, predatory fish and crayfish are likely to expand their ranges within occupied spinedace habitat. While the lowest end of Chevelon Creek is threatened by drying, the upper end is threatened by the downstream expansion of smallmouth bass from Willow Springs. Populations in East Clear Creek are threatened by the recent introduction of green sunfish. In addition, the current effects of extended drought and climate change have reduced the number of drought-resistant, perennial pools within occupied habitats, further fragmenting small populations of spinedace. Finally, our ability to measure how these threats are impacting actual numbers of fish is complicated by the tendency for spinedace to disappear from sampling sites from one year to the next and not be found for several years thereafter, which makes management of the species extremely difficult because responses of the population to changes within the watershed cannot be measured with certainty.

The USFWS acknowledges that the AGFD, Forest Service, and others have made significant efforts to conserve Little Colorado spinedace. In particular, AGFD staff has expended countless hours to survey habitat, document locations, and work with their partners to identify additional habitats and refugia where spinedace populations could be maintained. All of these actions have benefited the species. However, the continued invasion of non-native aquatic species into spinedace habitat and the on-going and future reductions in surface water (due to both drought and surface and groundwater pumping) are threats that are increasing in magnitude, extend to existing spinedace populations, and are contributing factors to the spinedace's continuing decline throughout its range. Within the foreseeable future (50 years) the complete loss of baseflow to the area that supports the largest population of spinedace has been predicted by two different hydrologic models based upon current groundwater pumping; we expect the rate of groundwater pumping to increase in the future as the human population in the area increases. There are very few habitats within the range of the species that are currently

able to be occupied due to lack of water or presence of multiple predators, so at this time, recovery options are limited. Areas that are currently able to support spinedace are relatively small, fragmented habitats that frequently have no connection to other habitats due to lack of water.

As defined in the Act, the term "endangered species" means any species which is in danger of extinction throughout all or significant portion of its range. Based upon the current and foreseeable threats to the spinedace and its habitat, we recommend reclassifying the species from "threatened" to "endangered."

The AGFD stated in their April 11, 2006, comment letter regarding the five-year review that reclassifying the Little Colorado spinedace to "endangered" would not improve its biological status or protection, nor would it effectively address the current threats to this species. AGFD believes that a change to "endangered" for this species would further reduce their operational flexibility to help establish additional native fish refuges through loss of the 4(d) rule for aquatic stocking in regard to regulating take of the species. However, based upon the threats currently affecting the continued existence of Little Colorado spinedace, we believe that it meets the definition of an endangered species. By maintaining only a few pools with fish, both instream and out of drainage, and not having a current plan to deal with ongoing non-Federal groundwater withdrawals and the increasing threat from non-native aquatic species, it is clear that the spinedace is in danger of extinction throughout all or a significant portion of its range within the foreseeable future.

3.0 RESULTS

3.1 Recommended Classification:

____ **Downlist to Threatened**
_X_ **Uplist to Endangered**
____ **Delist** (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
____ **No change is needed**

3.2 New Recovery Priority Number: The spinedace is currently classified as 2 (high degree of threat/high potential for recovery). We recommend changing this designation because the potential for recovery is low. The recommendation would be to classify the spinedace as a 5C, because of the high degree of threat, the low recovery potential, the listed entity is a species, and there is potential conflict due to increased water development for human needs. At this time, we have not been able to identify a means to address the current and future loss of water to spinedace habitats and increasing dominance of non-native species. If we cannot determine how to effectively address these threats, our ability to manage the spinedace into the future is unknown. Because threats to the spinedace's existence are difficult to alleviate, and intensive management (with an uncertain probability of success) is needed to continue to maintain existing spinedace populations into the future, the recovery potential at this time is low.

3.3 Listing and Reclassification Priority Number

Reclassification (from Threatened to Endangered) Priority Number: 2 - The degree of threat is high with imminent immediacy and the listed entity is a species (48 FR 43098).

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The following recommendations for future actions were the result of discussions on the status of the species and the species' needs with recognized spinedace experts. All the actions listed below address the threats described in the Five-Factor Analysis and will provide important benefits for the recovery of the Little Colorado spinedace.

1. We recommend that the USFWS, AGFD, Forest Service, and other cooperators develop and implement a plan to remove warm-water non-native fishes and manage upper Chevelon Creek (including tributaries, reservoirs, and stock tanks) down through Chevelon Creek Reservoir for native aquatic species within the next three to five years. Upper Chevelon Creek should maintain surface flow in the foreseeable future as the headwater water rights for the reservoirs are held by AGFD (Willow Springs Lake, Woods Canyon Lake, and Bear Canyon Lake), and the Forest Service

(Apache-Sitgreaves National Forest) manages the land base for the entire upper watershed. Sport-fishing opportunities in this watershed could include roundtail chub and native trout species.

2. We recommend that the USFWS, AGFD, Forest Service, and other cooperators develop and implement a plan to renovate C.C. Cragin Reservoir to remove warm-water non-native fishes and manage the watershed for native aquatic species. The removal of green sunfish, yellow-bullhead, and largemouth bass from the reservoir would prevent these species from accessing occupied habitats above the reservoir and assist in maintaining and enhancing spinedace populations within the watershed.

3. We recommend that the USFWS, AGFD, and other partners work with private land owners and Federal land-management agencies along Silver Creek to develop a comprehensive management plan for the watershed. We need to develop a plan for the watershed that addresses the management of non-native species.

4. We recommend that the USFWS, AGFD, and other partners work with Federal and non-Federal entities to ensure that environmental flows are protected in future water development plans within the historical range of the spinedace. Efforts to work with the Coconino Plateau Water Advisory Council and the Bureau of Reclamation regarding future water use on the Coconino Plateau may assist with this effort. In addition, the USFWS should actively work with non-Federal water users to determine if Habitat Conservation Plans, Safe Harbor Agreements, or cooperative conservation efforts may be options for maintaining instream flow.

5. We recommend that the USFWS, AGFD, Forest Service, and other partners evaluate the LCR watershed and identify portions of the watershed that would be managed for native fish (including the spinedace), and actions required in these areas to support native species. The replication of each sub-group within its portion of the watershed into perennial waters not subject to drying due to extended drought or at risk of loss due to new surface or groundwater pumping would provide stability for the species over time.

6. We recommend that the Forest Service, AGFD, USFWS, and other partners continue to implement and support the East Clear Creek Watershed Recovery Strategy for the Little Colorado Spinedace and other Riparian Species. The actions that have been implemented to date, particularly the supplemental stocking of spinedace and improved livestock management, have greatly assisted in sustaining spinedace within the East Clear Creek Watershed.

7. We recommend that the USFWS take an active leadership role to work with our state and Federal partners to initiate a preliminary program of aggressive development of novel technologies to assist with the control of invasive non-native fishes and other aquatic organisms. These technologies could be applied in the Southwest and elsewhere. We will be unable to meet many of our aquatic species recovery goals if we are unable to control aquatic invasive species. The Little Colorado spinedace is

one of many species currently threatened with extinction due to our inability to control invasive species, such as crayfish. Increased ability to control invasive aquatic species would also support the Region 2 Strategic Habitat Conservation goals and the State's Wildlife Action Plans.

8. We recommend that the Recovery Plan be updated and revised to include objective and measurable delisting criteria that address the five-listing factors as required by section 4(f)(1)(B)(ii) of the Act.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Little Colorado Spinedace *(Lepidomeda vittata)*

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
_X__ Uplist to Endangered
____ Delist
____ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: 2 - The degree of threat is high with imminent immediacy and the listed entity is a species (48 FR 43098).

Review Conducted By: Shaula J. Hedwall, U.S. Fish and Wildlife Service, Arizona Ecological Services Flagstaff Sub-Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Arizona Ecological Services, U.S. Fish and Wildlife Service

Approve _____ Date 8/14/08

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Region 2

Approve _____ Date 10/6/08