Arkansas River Shiner
(Notropis girardi)

5-Year Review:
Summary and Evaluation

South Canadian River - Photos by Daniel Fenner, USFWS

U.S. Fish and Wildlife Service
Oklahoma Ecological Services Field Office
Tulsa, Oklahoma

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5-YEAR REVIEW
Arkansas River shiner (*Notropis girardi*)

1.0 GENERAL INFORMATION

1.1 Listing History

Species: Arkansas River basin population of the Arkansas River shiner

Date listed: November 23, 1998

FR citation(s): November 23, 1998. Endangered and Threatened Wildlife and Plants; Final Rule to List the Arkansas River Basin Population of the Arkansas River Shiner (*Notropis girardi*) as Threatened; Final Rule. 63 FR 64772.

Classification: Threatened; Distinct Population Segment (Arkansas River basin population).

Critical habitat designation: October 13, 2005. Endangered and Threatened Wildlife and Plants: Final Designation of Critical Habitat for the Arkansas River Basin Population of the Arkansas River Shiner (*Notropis girardi*); Final Rule. 70 FR 59808.

1.2 Methodology used to complete the review

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a 5-year review is to assess the status of each threatened species and endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Endangered and Threatened Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) recently evaluated the biological status of the Arkansas River shiner as part of a Species Status Assessment (SSA) completed in October 2018. The SSA report (Service 2018, entire) contains the scientific basis used to inform this 5-year review and will guide the development of recovery planning and implementation.

The 2018 SSA report presents our evaluation of the best available scientific information, including the species' life history and ecology, species resource needs such as river flows and habitat complexity, stressors that affect those needs, and an assessment of current and future condition of the species. The report included input from tribes, state wildlife agencies, academic researchers, federal agencies, and non-governmental organizations engaged in Arkansas River shiner conservation efforts throughout its range and was developed by a team of biologists spanning multiple Service field offices and regions. The SSA was independently reviewed by multiple partners and their comments were incorporated into the report.

Additionally, we solicited additional information for this 5-year review from interested parties through a March 19, 2020, Federal Register Notice announcing this review (85

FR 15795). On March 30, 2020 we sent the notice to Native American Tribes within the range of the species, and to partners involved in Arkansas River shiner and/or Southern Great Plains fishes conservation. Information received from this data request was evaluated as a part of this 5-year review and considered in our determination of any change in status to this species.

1.3 FR Notice citation announcing the species is under active review

March 19, 2020. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 10 Species in Arizona, Arkansas, Kansas, Missouri, New Mexico, Oklahoma, Texas, and Mexico. Notice of Initiation of Reviews; request for information. 85 FR 15795.

2.0 REVIEW ANALYSIS

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

Section 3(15) of the Act defines ‘‘species’’ to include ‘‘any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife . . .’’ On February 7, 1996, the Fish and Wildlife Service and the National Marine Fisheries Service published a joint policy (DPS policy) (61 FR 4722) to clarify our interpretation of the phrase ‘‘distinct population segment of any species of vertebrate fish or wildlife’’ for the purposes of listing, delisting, and reclassifying species under the Act. The policy identifies the following three elements to be considered in deciding whether to list a possible DPS as endangered or threatened under the Act: The discreteness of the population segment in relation to the remainder of the species or subspecies to which it belongs; the significance of the population segment to the species or subspecies to which it belongs; and the conservation status of the population segment in relation to the Act’s standards for listing.

The Service listed the Arkansas River basin population of the Arkansas River shiner as a DPS in 1998 (63 FR 64772), in accordance with the DPS policy. The Arkansas River basin population was determined to be discrete based on natural, geographic isolation from the non-native, introduced population in the Pecos River in eastern New Mexico. The Arkansas River basin population was determined be significant because it represents the only surviving natural occurrence of the taxon. The Pecos River population of Arkansas River shiner was determined to be non-significant because it was introduced and is located outside of the species’ historical range and, is not essential for recovery of the species within its historic range.

2.2 Is there relevant new information for this species regarding the application of the DPS policy?

A 2010 assessment examined the genetic status of the Arkansas River shiner as well as potential hybridization with the Arkansas River shiner and other fish species (Osborne *et al.* 2010, entire). Results from the study showed that genetic diversity (mitochondrial

DNA and microsatellite loci) of the Arkansas River shiner population in the Pecos River was comparable to the South Canadian River (native range) populations, suggesting that the Pecos River population could serve as refuge for future reintroduction in the species' native range. Although the Pecos population could aid in conservation of the species, existing native populations currently serve that capacity.

The same study examined population differentiation between the Pecos River population and the South Canadian River populations in NM and OK. Their pairwise test assessing population differences was not significant. Whereas their exact test of population differentiation, considered a more powerful test under their study conditions, was significant between the Pecos and South Canadian River populations. The authors noted, however, that unique haplotypes/alleles occurred in very low frequencies (0.3-1.4%) and suggested that the failure to detect all alleles/haplotypes in all three populations could have been an artifact of limited samples, or a consequence of population founding in the Pecos River. Given the minor differences between population structure and the possibility that those differences could be attributed to sample size, we cannot conclude that the Arkansas River shiner population of the Pecos River is different from the South Canadian River population and therefore does not meet the significance standard in the DPS policy (61 FR 4722).

2.3 Recovery Criteria

At present, the Arkansas River shiner does not have an approved recovery plan. The Service is currently drafting a recovery plan, which we anticipate making available for public review within the next year.

2.4 Updated Information and Current Species Status

Our SSA report (Service 2018) provides a detailed assessment of the species' biology, habitats, stressors, and current and future condition, which is summarized below.

2.4.1 Biology and Habitat

The Arkansas River shiner is a minnow (family Cyprinidae) once widespread and common in the western portion of the Arkansas River basin in Kansas, New Mexico, Oklahoma, Arkansas, and Texas. This species is no longer found in over 83 percent of its historical range (3,896 river miles) and now appears (Figure 1) to be entirely restricted to portions of the South Canadian River (or identified as Canadian River on USGS topographic maps) in eastern New Mexico, the Texas panhandle, and Oklahoma (673 river miles) (63 FR 64772; as analyzed in Chapter 4 of the Species Status Assessment). A non-native, introduced population of the Arkansas River shiner occurs in the Pecos River in New Mexico, just outside of the species' historical native range (Bestgen *et al.* 1989, p. 228).

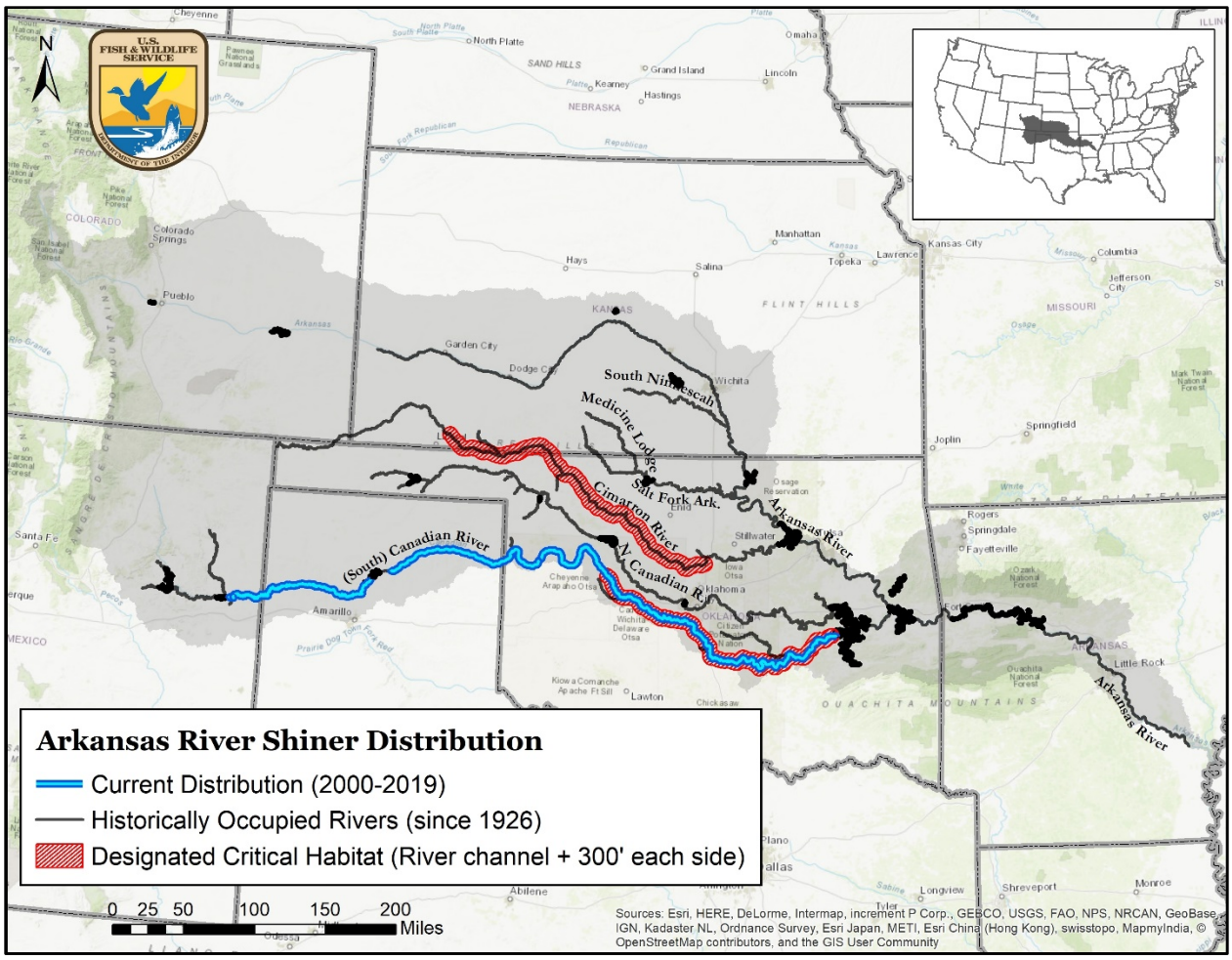

Figure 1. Arkansas River shiner historical and current distribution and critical habitat designation.

Within the Arkansas River basin, the Arkansas River shiner historically occupied main channels of wide, shallow, sandy bottomed rivers and larger streams (Moore 1944, p. 209). Adults prefer shallow channels where currents flow over clean fine sand, and generally avoid calm waters and silted stream bottoms (Lewis and Dalquest 1955, p. 10; Cross 1967, p. 136; Polivka and Matthews 1997, entire; Wilde *et al.* 2000, pp. 39-42). The species has adaptations to tolerate the adverse conditions of the drought-prone prairie streams they inhabit, including a high capacity to endure elevated temperatures and low dissolved oxygen concentrations (Matthews 1987, entire; Polivka and Matthews 1997, p. 7).

Arkansas River shiners are a member of a reproductive guild that broadcast spawns semibuoyant eggs, which are kept suspended and hatch in flowing water. This reproductive strategy appears to be an adaptation to highly variable environments where stream flows are unpredictable and suspended sediments and shifting sand can cover eggs laid in nests or crevices (Bonner 2000, p. 35). Without stream flow, eggs sink to the bottom where they may be covered with silt and die (Platania and Altenbach 1999, p. 565). After hatching, the fish larvae will continue to develop in the stream current. It

takes approximately three to five days for eggs and larvae to develop before the larvae are capable of moving out of the main channel to seek refuge (Moore 1944, pp. 211-212; Platania and Altenbach 1998, p. 566). This downstream movement over three to five days makes river length of over 130 miles essential for their successful development (Platania and Altenbach 1998, p. 566, Wilde *et al.* 2000, p. 107; Perkin and Gido 2011 p. 374).

A natural flow regime to support wide, shallow braided rivers (channel complexity) with a connection to the floodplain also is essential for attenuating downstream movement of eggs and larvae, allowing for a shorter distance to develop and seek refuge, as compared to a single threaded and narrower channel having higher velocities (Worthington *et al.* 2014, entire). Without moderate to high flow events and maintenance of historical base flows, vegetation begins to encroach within the banks, resulting in a narrower river over time (Poff *et al.* 1997, pp. 773–777; Mammoliti 2002, pp. 223–224). As the river becomes more entrenched and narrows, habitat complexity typical of a wide and shallow Great Plains river is lost and the river's connection to its' historical floodplain is diminished. An adequate combination of river length, natural flow regime, and a sufficient degree of channel complexity and floodplain connection should allow the species to repopulate upstream areas that would otherwise not occur if eggs and larva are transported downstream over greater distances (Dudley and Platania 1999, p. 428; Bond *et al.* 2000, entire; Worthington *et al.* 2014, entire).

2.4.2 Threats Analysis (threats, conservation measures, and regulatory mechanisms)

Historically, Arkansas River shiner inhabited six major river systems (Lower and Upper Arkansas River, Cimarron River, North Canadian River, and Lower and Upper South Canadian River), each of which we refer to as local populations or 'resiliency units' in the SSA. A full description of our analysis (analytical methods, threats, current condition, and future condition for the Arkansas River shiner can be found in the SSA report (Service 2018); below, we present a summary of the results of the SSA.

Summary of Threats and Five-Factor Analysis

Through our SSA analysis, we have evaluated the effects of all factors identified in section 4(a)(l) of the Act. Stressors affecting the viability of the Arkansas River shiner include altered flow regimes (Factor A), impoundments and other stream fragmentation (Factor A), modified geomorphology (Factor A), decreased water quality (Factor A) and the introduction of invasive species (Factors A and C). The source of many of these stressors is related to the construction of dams and their impoundments (a body of water confined within an enclosure) which, in most cases, has drastically altered the natural flow regime and fragmented habitat. Water demands, primarily through surface and groundwater extraction, have also resulted in significant declines to the species' habitat, affecting its overall distribution. A summary of those stressors are provided below and are described in more detail in the SSA.

Altered Flow Regimes

Arkansas River shiners need a combination of varying flows (timing, duration, and magnitude) to support viable populations and maintain suitable habitat. Low flow periods (including isolated pooling) can impair or eliminate appropriate habitat for the species, and while adult Arkansas River shiner are adapted to and can typically survive these events for a short time, populations that regularly experience these conditions face a compromised reproductive success rate and may not persist (Moore 1944 pp. 210-211; Bonner 2000 p. 34; Wilde *et al.* 2000, p. 107). Flow regime alterations that we considered in the SSA report include dams and their associated impoundments, the effects dams have on the natural flow regime, surface and groundwater extraction, and the effect of climate change on precipitation and drought.

Stream Fragmentation and Modified Geomorphology

Dams often fragment aquatic habitat and create impassable physical barriers to fish movement (Bestgen and Platania 1991, pp. 228; Pringle 1997, pp. 427–428; Alo and Turner 2005, pp. 1144–1146; Perkin and Gido 2011, entire). Juvenile and adult Arkansas River shiner likely would be capable of passing downstream through small fish barriers such as weirs (low dams built to raise the level of water upstream), low-water crossings, and natural or manmade falls. However, no life stage of Arkansas River shiner is likely capable of successfully passing downstream through most reservoirs large enough to act as water supply or hydroelectric sources. Likewise, due to the small size and limited swimming ability of the Arkansas River shiner, upstream movement of adults (during spawning) would likely be prohibited by any impoundments (regardless of type or function), weirs, falls, pipeline reinforcement structures, and many low-water crossings that do not allow for natural flows and corresponding lower water velocities.

When fish pass downstream of a smaller barrier, they remain isolated below the barrier and are unable to return to spawning areas upstream. This often results in an incremental and progressive extirpation from an upstream to downstream direction (Perkin and Gido 2011, p. 374). Because of its need for unimpeded, flowing water to successfully reproduce, Arkansas River shiner have been eliminated from shorter (generally less than 136 mi) reaches and typically persist only in river segments that are above a minimum threshold (Perkin and Gido 2011, entire).

Drastic alterations to the natural flow regime in the South Canadian River have contributed to the decline or loss of wide, shallow sand-bed river channels that are characteristic of Arkansas River shiner habitat. Impoundments often reduce the magnitude and frequency of high flows, leading to bank stabilization and channel narrowing; the alteration of streambank riparian communities; effects to in-stream nutrient uptake which supports ecosystem development; and the alteration of sediment transport and river substrate dynamics (Poff *et al.* 1997, pp. 773–777; Mammoliti 2002, pp. 223–224). Alterations to the natural flow regime has reduced the Arkansas River shiner's overall reproductive success and ability to re-populate some upstream areas (SSA 2018, entire).

Degraded Water Quality

Suitable water quality is necessary for a healthy aquatic community. Water quality may become impaired through direct contamination or the alteration of freshwater chemistry. Contaminants enter the environment through both point and nonpoint sources including spills, industrial pathways, municipal effluents, and storm water and agricultural runoff. These sources may contribute organic compounds, heavy metals, pesticides, herbicides, and a wide variety of newly emerging contaminants to the aquatic environment. An additional type of water quality impairment is the modulation of water quality parameters such as dissolved oxygen, temperature, and salinity levels. Dissolved oxygen levels may be reduced due to increased nutrient levels (*i.e.*, nitrogen and phosphorous) from agricultural runoff or wastewater effluent (eutrophication). Increased water temperature from more frequent low-flow/drought conditions and climate change can also exacerbate low dissolved oxygen levels, particularly when low-flow conditions strand fish in isolated pools. Similarly, fish stranded in isolated pools can be subjected to naturally concentrated salinity. Additionally, many freshwater systems and shallow aquifers have become increasingly saline due to salinized water recharge (Hoagstrom 2009, p. 35). This effect largely stems from irrigation return flows that have flushed accumulated salts from irrigated lands back into the aquatic system.

Chloride concentrations have been increasing in the upper South Canadian River (Service 2018, p. 127). Additionally, arsenic levels in many of the rivers within the historical range of the Arkansas River shiner are above the Environmental Protection Agency's established levels for human health for the consumption of organisms but not above levels designed to protect freshwater aquatic communities. Arsenic levels have increased over time in the Cimarron River to the point that golden shiners (*Notemigonus crysoleucas*) exhibited avoidance behavior even though concentrations were below a toxic level (Hartwell *et al.* 1989, p. 452). It is a reasonable presumption that Arkansas River shiner also would demonstrate avoidance behavior at similar concentrations of arsenic, possibly resulting in additional river fragmentation and effects to the species' ability to move throughout the system.

Introduction of Invasive Species

The alteration of the hydrologic regime and geomorphology of rivers resulting from impoundments can cause the proliferation of larger, piscivorous fish not normally associated with unimpounded prairie rivers. In a system similar to the Arkansas River Basin, eighteen fish species were introduced or immigrated into the Solomon River basin of Kansas following impoundment. Increased competition from these nonnative species may have contributed to the decline of native fish species (Eberle *et al.* 2002, pp. 182, 188). While Arkansas River shiner declines throughout the species' range cannot be attributed to predation by invasive fishes, the fish community in the Lower South Canadian River appears to be shifting to more lentic (still water) adapted species (Service 2018, pp. 66-68). The Upper South Canadian River (between Ute Reservoir

and Lake Meredith) is an exception, where the native fish community is generally intact (Service 2018, pp. 66–68).

Synergistic Effects

In using the SSA framework to analyze the best available scientific information, as documented in the SSA report, we fully assess not only individual effects on the Arkansas River shiner, but also their potential cumulative impacts at the population level. Specifically, we incorporate cumulative effects into our analysis when we characterize the current and future conditions for each population. Because the SSA framework considers not just the presence of the factors but also the degree to which they collectively influence the species' viability, our assessment integrates the cumulative impacts of stressors.

Many of the above-summarized risk factors may act synergistically or additively on the Arkansas River shiner. The combined impact of multiple stressors is likely more harmful than a single stressor acting alone. For example, resiliency of the Arkansas River shiner (in the Upper South Canadian River resiliency unit) is considered moderate due to river impoundment in combination with other stressors acting synergistically. The river is unimpeded for 179 river miles, which translates to a fair condition. However, our flood frequency analysis in the Upper South Canadian River resiliency unit shows a decline to a level of null to fair, meaning high flow events that are responsible for maintaining and expanding channel complexity have significantly declined compared to historical conditions. As a result, the river channel has narrowed dramatically in many areas, resulting in additional locations of unfavorable habitat for the Arkansas River shiner and a poor condition category for this habitat metric. This condition limits the access to and formation of new habitat necessary for egg/larval retention and refugia. A comparison of the hydroperiod (period of time under which the stream bed is covered by water) between pre-impoundment and post-impoundment conditions revealed that that discharge in some reaches of the river saw a greater than 90 percent decrease in discharge as compared to historical pre-impoundment conditions). Lastly, low-flow conditions in this stretch of the river are in a poor to fair condition, meaning that low-flow days are common or increasing and some areas are vulnerable to drying in drought years, which could affect the length of unimpeded river and lead to limited upstream movement and additional channel narrowing. For a full explanation of our habitat factor analysis, see chapter 4 of the SSA report.

Conservation Actions

The Service, State agencies, and academic partners have been conducting river monitoring (general monitoring of fish community throughout the South Canadian River). Information from those surveys were used in our SSA analysis and will continue to be used to develop recovery criteria and monitor the status of populations in the future.

The Canadian River Municipal Water Authority (in conjunction with several other partners) has a management plan in place for the Arkansas River shiner, which was initiated in 2005. This plan aims to maintain and improve habitat in the South Canadian River upstream of Lake Meredith in Texas, to Logan, New Mexico. The implementation of the management plan has improved riparian health through the removal of non-native trees and may have slowed the rate of habitat decline. However, the plan does not sufficiently address maintenance of river flows required by Arkansas River shiner, including baseflows that maintain river connectivity allowing for fish movement and moderate to high flows that are effective in maintaining wide and complex river channels. Even with this conservation plan in place, habitat has continued to decline and current resiliency of Arkansas River shiner of the Upper South Canadian River is in a moderate condition. Through recovery planning efforts, the Service will continue to work with the Canadian River Municipal Water Authority to identify additional actions that may provide more suitable flows for native fishes in the South Canadian River.

Efforts are underway regarding captive propagation of Arkansas River shiners at the Tishomingo National Fish Hatchery and possibly the Kansas Aquatic Biodiversity Center, although those efforts are still in their early stages and mass production of fishes for potential re-introductions has not yet been developed. Additional propagation efforts by the Oklahoma Department of Wildlife Conservation are currently in their planning stages.

Species Viability - Summary of Current and Future Condition

To assess Arkansas River shiner viability, we used the three conservation biology principles of resiliency, representation, and redundancy (together, the 3Rs) (Shaffer and Stein 2000, pp. 306–310). Briefly, resiliency supports the ability of the species to withstand environmental and demographic stochasticity (for example, wet or dry, warm or cold years), representation supports the ability of the species to adapt over time to long-term changes in the environment (for example, climate changes), and redundancy supports the ability of the species to withstand catastrophic events (for example, droughts, large pollution events). In general, the more redundant and resilient a species is and the more representation it has, the more likely it is to sustain populations over time, even under changing environmental conditions that result from natural and anthropogenic stressors. Using these principles, we identified the species' ecological requirements for survival and reproduction at the individual, population, and species levels, and described the beneficial and risk factors influencing the species' viability.

Current Population Resiliency

Within this analysis, resiliency is based on a combination of demographic species factors and habitat/flow factors, which we classified as high, moderate, low, or null for each resiliency unit (*i.e.,* river systems). The null rating is used for rivers when Arkansas River shiner have been extirpated. Based on the demographic and habitat factors used to describe resiliency in the SSA report, we described an overall level of

resiliency by river (Table 1). Our analysis found that in the two resiliency units currently occupied by the Arkansas River shiner, both units have an overall moderate level of resiliency. For a full explanation of our resiliency analysis, see chapter 4 of the SSA report.

Table 1. Current resiliency summary table for the Arkansas River shiner.

CURRENT RESILIENCY *Arkansas River shiner*										
	Demographic Factors				Habitat/Flow Factors					*CURRENT RESILIENCY*
	Capture Ratio	Probability of Capture Trend	Relative Abundance	Relative Abundance Trend	Stream Fragment Length	Channel Narrowing	Flood Frequency	Hydroperiod	Low Flow	
Lower Arkansas	Ø	na	Ø	Ø	Ø	na	na	na	na	Ø
Upper Arkansas	Ø	na	Ø	Ø	Fair	Fair to Good	Poor & Good	Poor & Good	Poor & Good	Ø
Cimarron	Ø	na	Ø	Ø	Good	Null to Good	Null & Fair	Poor & Fair	Poor & Good	Ø
North Canadian	Ø	na	Ø	Ø	Fair	Null	Null to Good	Poor to Fair	Poor to Good	Ø
Lower S. Canadian	Poor & Good	Poor & Good	Poor to Fair	Poor	Good	Null to Good	Poor to Fair	Poor to Fair	Fair & Good	MODERATE
Upper S. Canadian	Good	Good	Good	Good	Fair	Poor	Null to Fair	Null to Fair	Poor to Fair	MODERATE

Current Species Representation

Best-available information suggests that the Arkansas River shiner has representation in the form of genetic diversity in three areas: (1) The South Canadian River upstream of Lake Meredith, Texas (from samples in the headwaters of the South Canadian River in New Mexico and its tributary Reveulto Creek), (2) The South Canadian River downstream of Lake Meredith, Texas (in Oklahoma) and (3) the introduced population in the Pecos River, New Mexico. Genetic diversity is relatively high in each of these three populations, but there does not appear to be significant differences in genetic makeup between the three populations (Osborn 2010 – see additional discussion in section 2.2 above).

Representation in the form of ecological diversity across the extant populations of Arkansas River shiners is unknown. Given the species' historical wide-ranging geographic distribution and varying habitat conditions among Arkansas River basin rivers, it is likely that ecological diversity was lost when the Arkansas River shiner was extirpated from these rivers.

Current Species Redundancy

Historically, Arkansas River shiner inhabited six major river systems, as described in the *Current Population Resiliency* section above. Without the presence of dams, it is likely that each of these local populations dispersed throughout the Arkansas River basin and exhibited some level of genetic exchange between these large rivers. However, the species is now extirpated from all but two (Upper and Lower South Canadian River) river systems and the species' overall distribution has declined from

3,896 to 673 river miles, an 83 percent decline. More recent (although relatively limited) surveys within the last 5-10 years have failed to capture Arkansas River shiner within Texas downstream of Lake Meredith and far western Oklahoma, suggesting the Lower South Canadian River population's distribution may be contracting. Additional information provided to the Service as a part of our solicitation for additional information supports our current analysis of the species' distribution. Given the current level of redundancy across the range, the species as a whole has a higher risk of future extinction as compared to historical conditions.

Future Resiliency, Representation, and Redundancy

To assess future condition in the SSA report, we identified four future scenarios that best represent the potential range of outcomes, based on differing stressors and conservation actions that affect Arkansas River shiner populations. Details on these scenarios can be found in Chapter 5 of the SSA report, with an overview outline provided below:

Scenario 1 - Continuation of Existing Trends

- Water demands continue at the existing rate
- Current rate of climate related emissions continues
- No additional conservation implemented

Scenario 2 - Water Conservation with Flow Trends Stabilizing

- Water demands stabilize, resulting in no changes to future flows
- Current rate of climate related emissions is mitigated – assuming no future effect to flows
- Water conservation is implemented

Scenario 3 - Species Conservation and Continuation of Existing Trends

- Water demands continue at the existing rate
- Current rate of climate related emissions continues
- Species targeted conservation action are implemented

Scenario 4 - Species and Water Conservation with Flow Trends Stabilizing

- Water demands stabilize, resulting in no changes to future flows
- Current rate of emissions is mitigated – assuming no future effect to flows
- Water conservation is implemented
- Species targeted conservation actions are implemented

We applied each of these scenarios independently to the Arkansas River shiner to characterize future species resiliency, representation, and redundancy. A brief summary of the results of our SSA analysis is provided in the sections below.

Scenario 1 - Continuation of Existing Trends - Under this Scenario, we expect resiliency of both occupied river systems to decline from Moderate to Low by 2039 and

would expect resiliency to continue to be low at 2069 and that the species will be more vulnerable to demographic and environmental stochasticity (Table 2).

Table 2. Summary results of habitat, flow and demographic factors and future resiliency under Scenario 1 - Continuation of Existing Trends. Bold arrow before score indicates a change in score from current condition. Smaller arrow in parenthesis after score indicates a change in that condition, but not rising to the level of a score change. See Chapter 5 of the SSA report for more information on our future condition analysis.

SCENARIO 1 - Continuation of Existing Trends *Arkansas River Shiner*											
	CURRENT RESILIENCY	Demographic Factors				Habitat/Flow Factors					*FUTURE RESILIENCY*
		Capture Ratio	Probability of Capture Trend	Relative Abundance	Relative Abundance Trend	Stream Fragment Length	Channel Narrowing	Flood Frequency	Hydroperiod	Low Flow	
		20 Years (to 2039)									
Lower Arkansas	Ø	Ø	Ø	Ø	Ø	.	.	.	.	.	Ø
Upper Arkansas	Ø	Ø	Ø	Ø	Ø	.	.	.	.	.	Ø
Cimarron	Ø	Ø	Ø	Ø	Ø	.	.	.	.	.	Ø
North Canadian	Ø	Ø	Ø	Ø	Ø	.	.	.	.	.	Ø
Lower South Canadian	MODERATE	**↓**Good to Ø	**↓**Good to Ø	**↓**Poor to Ø	**↓**Poor to Ø	Good	**↓**Poor to Null	Fair	Poor (↓)	Fair	LOW
Upper South Canadian	MODERATE	**↓**Fair	**↓**Fair	**↓**Fair	**↓**Fair	Fair (↓)	**↓**Poor to Null	Poor	Poor (↓)	Fair	LOW
		50 Years (to 2069)									
South Ninnescah	Ø	Ø	Ø	Ø	Ø	.	.	.	.	.	Ø
Arkansas/Salt Fork	Ø	Ø	Ø	Ø	Ø	.	.	.	.	.	Ø
Cimarron	Ø	Ø	Ø	Ø	Ø	.	.	.	.	.	Ø
Lower South Canadian	MODERATE	Poor to Ø	Poor to Ø	Poor to Ø	Poor to Ø	Fair to Poor	Poor to Nul (↓)	Fair	Poor (↓)	Fair	LOW/Ø
Upper South Canadian	MODERATE	**↓**Poor	**↓**Poor	**↓**Poor	**↓**Poor	**↓**Poor	**↓**Poor to Null	Poor	Poor (↓)	Fair	LOW

The current level of representation may be maintained through 2039, although overall population size in the Upper and Lower South Canadian River units could decline, potentially affecting genetic diversity. By 2069 it is possible that the Lower South Canadian River could be functionally extirpated, leaving only the Upper South Canadian River and non-listed Pecos River population to provide species representation.

Current redundancy of only two populations (Upper and Lower South Canadian River) would generally be maintained by 2039, although with a low resiliency in both units. These populations will be even more vulnerable to extirpation, as compare to current condition. By 2069, it is possible that the lower South Canadian River could become functionally extirpated, leaving only the Upper South Canadian River population, with low resiliency.

Scenario 2 - Water Conservation and Flow Trends Stabilizing - This scenario assumes current condition of the species continues into the future (Table 1). We expect that both occupied river systems would maintain a moderate level of resiliency into the future under this scenario. The current level of representation may be maintained through 2069 for the Arkansas River shiner. We presume that a population could be functionally extirpated in the future due to a catastrophic event, however moderately resilient populations (as compare to low resiliency) would provide some buffer from that potential result. With the potential loss of a population in the future, a lower level of redundancy is possible under this scenario. As such, the species as a whole could be at higher risk of future extinction from an unusually rare and destructive drought.

Scenario 3 – Species Conservation and Continuation of Existing Trends - Currently, there are two occupied resiliency units in the range of Arkansas River shiner. In Scenario 3, with introductions and other conservation efforts assumed to be successful, there may be up to four occupied Resiliency Units (Table 3). Under this scenario, by 2039, the resiliency units in the South Canadian River will have low to moderate resiliency and that any reestablished populations in the Salt Fork or Cimarron Resiliency Units will have low resiliency. By 2069 one resiliency unit may have low to moderate resiliency and the other three units may have low levels of resiliency with one unit being low to extirpated. Under Scenario 3, the Arkansas River shiner would have representation in the form of genetic diversity in five areas (four in the historic range and one introduced Pecos River population). Because fish for reintroductions will come from either the South Canadian River or Pecos River, genetic variation is not necessarily improved for the species. But over time, if one or more new populations becomes established it could potentially provide for increased ecological adaptability in the future. Under Scenario 3, redundancy of four populations of Arkansas River shiner would be maintained: Upper and Lower South Canadian River, Cimarron River and Arkansas River. With all four units possibly exhibiting low resiliency, these populations would be vulnerable to catastrophic events, reducing redundancy in the future.

Table 3. Summary of Arkansas River shiner resiliency under the Species Conservation and Continuation of Existing Trends scenario.

SCENARIO 3 - Species Conservation with Continuation of Existing Trends *Arkansas River Shiner*				
	CURRENT RESILIENCY	**Demographic Factors**	**Habitat/Flow Factors**	***FUTURE RESILIENCY***
		20 Years (to 2039)		
South Ninnescah	**Ø**	No Arkansas River shiner management	N/A	**Ø**
Arkansas/Salt Fork	**Ø**	Re-establishment of Arkansas River shiner	Kaw Releases	**LOW**
Cimarron	**Ø**	Re-establishment of Arkansas River shiner	Riparian & floodplain restoration	**LOW**
Lower South Canadian	**MODERATE**	Improved reproduction	Riparian & floodplain restoration	**LOW / MODERATE**
Upper South Canadian	**MODERATE**	Improved reproduction and fish movement	Ute Releases; Riparian and floodplain restoration	**LOW / MODERATE**
		50 Years (to 2069)		
South Ninnescah	**Ø**	No Arkansas River shiner management	N/A	**Ø**
Arkansas/Salt Fork	**Ø**	Re-establishment of Arkansas River shiner	Kaw Releases	**LOW**
Cimarron	**Ø**	Re-establishment of Arkansas River shiner	Riparian & floodplain restoration	**LOW**
Lower South Canadian	**MODERATE**	Improved reproduction	Riparian & floodplain restoration	**LOW / Ø**
Upper South Canadian	**MODERATE**	Improved reproduction and fish movement	Ute Releases; Riparian and floodplain restoration	**LOW / MODERATE**

Scenario 4 – Species and Water Conservation with Flow Trends Stabilizing - With the reintroduction of Arkansas River shiner into two resiliency units and the conservation efforts considered in future Scenario 4, two Resiliency Units would have low resiliency, one unit to maintain moderate resiliency, and one unit to increase from moderate to high resiliency by 2039 and to maintain this level of resiliency in each unit through 2069 (Table 4). Under Scenario 4, the Arkansas River shiner has representation in the form of genetic diversity in five areas (the four units in its historical range and the introduced Pecos River population). Because broodstock for fish reintroductions will come from the either South Canadian River or Pecos River, genetic variation is not necessarily improved for the species. But over time, if one or more new populations becomes established they could potentially provide for increased ecological adaptability in the future. Redundancy increases by 2039 by establishing Arkansas River shiner in two additional Resiliency Units compared to current condition. We would anticipate redundancy of four populations of Arkansas River shiner would be maintained after 2039. However, with two of the four units exhibiting low resiliency, these units would be vulnerable to catastrophic events, possibly reducing redundancy in the future.

Table 4. Resiliency summary for the Arkansas River shiner under the Species Conservation with Flow Trends Stabilizing scenario.

SCENARIO 4 - Species Conservation with Flow Trends Stabilizing *Arkansas River Shiner*				
	CURRENT RESILIENCY	**Demographic Factors**	**Habitat/Flow Factors**	***FUTURE RESILIENCY***
		20 Years (to 2039)		
South Ninnescah	**Ø**	No Arkansas River shiner management	N/A	**Ø**
Arkansas/Salt Fork	**Ø**	Re-establishment of Arkansas River shiner	Kaw Releases; maintain existing flows	**LOW**
Cimarron	**Ø**	Re-establishment of Arkansas River shiner	Riparian & floodplain restoration; maintain existing flows	**LOW**
Lower South Canadian	**MODERATE**	Improved reproduction	Riparian & floodplain restoration; maintain existing flows	**MODERATE**
Upper South Canadian	**MODERATE**	Improved reproduction and fish movement	Ute Releases; Riparian and floodplain restoration; maintain existing flows	**HIGH**
		50 Years (to 2069)		
South Ninnescah	**Ø**	No Arkansas River shiner management	N/A	**Ø**
Arkansas/Salt Fork	**Ø**	Re-establishment of Arkansas River shiner	Kaw Releases; maintain existing flows	**LOW**
Cimarron	**Ø**	Re-establishment of Arkansas River shiner	Riparian & floodplain restoration; maintain existing flows	**LOW**
Lower South Canadian	**MODERATE**	Improved reproduction	Riparian & floodplain restoration; maintain existing flows	**MODERATE**
Upper South Canadian	**MODERATE**	Improved reproduction and fish movement	Ute Releases; Riparian and floodplain restoration; maintain existing flows	**HIGH**

2.5 Synthesis

After evaluating threats to the species and assessing the cumulative effects of the threats under the section 4(a)(1) factors, we find that the species' resiliency, representation, and redundancy are at levels that currently allow the Arkansas River shiner to persist in the Arkansas River basin as two self-sustaining populations; one in the upper South Canadian River and one in the lower South Canadian River. The resiliency of each population is currently considered to be at moderate level, making it less vulnerable to a catastrophic event as compare to a population with low resiliency. Thus, after assessing the best available information, we conclude that the Arkansas River shiner does not meet the definition of an endangered species.

However, given current downward trends of the species and its habitat we expect that population resiliency for Arkansas River basin populations of the Arkansas River shiner will be further reduced from current condition. This reduction could lead to low resiliency of both remaining populations within 20 years, with potential extirpation of one of those two populations within 50 years. Future species and water conservation efforts could provide more population resiliency and add redundancy through the successful re-introduction and management of new populations, but those efforts are only in their planning stages. Given that redundancy is currently limited (only two remaining populations) and with future anticipated declines in population resiliency, the remaining populations of Arkansas River shiner will be more vulnerable to extirpations as compared to current condition. Therefore, we have determined that the Arkansas River basin population could become an endangered species within the foreseeable future throughout all of its range, meeting the definition of a threatened species.

3.0 RESULTS

3.1 Recommended Classification

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist** (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *The species is extinct*
____ *The species does not meet the definition of an endangered species or a threatened species (i.e., is recovered, or new information on status and threats indicate species does not meet definitions)*
____ *The listed entity does not meet the statutory definition of a species.*
__X__ **No change is needed**

3.2 New Recovery Priority Number

No change in the current Recovery Priority Number (5C) is recommended at this time.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Develop and implement a recovery plan for the Arkansas River shiner. Broad actions within the plan may include the following:

1. **Restore and conserve habitats to support Arkansas River shiner life history requirements into the future -** As described in the SSA report, flows and corresponding physical habitat such as channel complexity and channel width are declining. To ensure survival of the species, it will be necessary to restore and protect habitats with an ecosystem perspective, as well as develop and implement water management strategies that support suitable habitat characteristics into the future. Continue to work with State agencies, Canadian River Municipal Water Authority, landowners, and other parties to ensure adequate flow conditions for native fishes.

2. **Maintain viable populations of Arkansas River shiner** - Viability of the Arkansas River shiner into the future will benefit from at least three resilient populations across the species' range that represents the species breadth of genetic diversity and habitat types. Existing populations will be monitored to assess resiliency and captive propagation will be necessary to increase representation and redundancy of the species.

3. **Further scientific understanding and develop a comprehensive and structured adaptive management program for Arkansas River shiner recovery** - Southern Great Plains rivers and their associated aquatic and riparian habitats are complex and dynamic. There is uncertainty regarding the potential effects of various recovery actions on the Arkansas River shiner, water users, and the existing infrastructure. As our understanding of these systems increases, it may be necessary to adjust and refine the recovery strategy. This is the essence of adaptive management, which may be defined as management in the face of uncertainty, with a focus on reduction of uncertainty over time.

4. **Design and implement a public awareness and information program** – Continue to work with State agencies, Tribes, land owners, and other partners to develop public awareness of conservation opportunities and the issues and conditions that led to the Arkansas River shiners decline. Such a program should seek to inform the public on the issues and the rationale for management actions, encourage river and riparian conservation, and solicit their support for the Arkansas River shiner recovery program. An information and education program that actively involves all stakeholders and interested parties, and makes use of several means to reach and inform people should be developed.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

Arkansas River shiner (*Notropis girardi*)

Current Classification: Threatened; Distinct Population Segment (Arkansas River basin population).

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable: 5C

FIELD OFFICE APPROVAL:

Field Supervisor, Fish and Wildlife Service, Oklahoma Ecological Services Field Office

Approve JONNA POLK Digitally signed by JONNA POLK Date: 2020.09.29 09:31:39 -05'00'