RECOVERY OUTLINE
FOR SHARPNOSE SHINER AND SMALLEYE SHINER

Sharpnose Shiner (*Notropis oxyrhynchus*)

Smalleye Shiner (*Notropis buccula*)

Current Classification: Endangered

Sharpnose Shiner

Smalleye Shiner

Photos courtesy of Chad Thomas, Texas State University

U.S. Fish and Wildlife Service
Arlington, Texas, Ecological Services Field Office

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1.0 INTRODUCTION

The purpose of this recovery outline is to provide an interim strategy to guide the conservation and recovery of the sharpnose shiner and smalleye shiner (shiners) until a final recovery plan is completed. Meeting the recovery needs of the species will require cooperation among the U.S. Fish and Wildlife Service (Service), and other Federal and State agencies, Tribes, and the public. An outline of potential recovery actions for the shiners may help interested stakeholders understand how we envision shiner conservation proceeding until a recovery plan is finalized. The current outline is based on the final Species Status Assessment Report for the Sharpnose Shiner and Smalleye Shiner (SSA Report, Service 2014), as well as preliminary objectives and actions needed for recovery. This preliminary recovery strategy is based on the best available scientific and commercial information.

1.1 Species common and scientific name:

Sharpnose shiner (*Notropis oxyrhynchus*)
Smalleye shiner (*N. buccula*)

1.2 Lead Regional Office: Region 2

1.3 Lead Field Office/Cooperating Field Offices:

Arlington, Texas, Ecological Services Field Office – Lead
Austin, Texas, Ecological Services Field Office – Cooperating
San Marcos Aquatic Resource Center – Cooperating

1.4 Contact Biologist:

Omar Bocanegra 817-277-1100 ext. 2126

1.5 Listing Status and date: Endangered, August 4, 2014

1.6 Recovery Priority Number:

Sharpnose shiner: 5C
Smalleye shiner: 5C

2.0 BRIEF METHODOLOGY

Please see the SSA Report for the Sharpnose Shiner and Smalleye Shiner (Service 2014, entire), available online at *http://www.fws.gov/southwest/es/ArlingtonTexas/* for background ecological information on the shiners. The SSA Report was developed as an in-depth, all-inclusive review of the species' biology and threats to evaluate their biological status based on whether they have the resources and conditions needed to maintain long-term viability. The intent is for the SSA Report to be easily updated as new information becomes available and to support all functions of the Endangered Species Program related to each species such as consultations, permits, and recovery. The SSA Report documents biology and natural history, and assesses demographic risks (such as small population sizes), threats, and limiting factors in the context of determining viability and risk of extinction for the shiners. In the SSA Report, we compile biological data and a description of past, present, and likely future threats facing these species. Because data in these areas are limited, some uncertainties are associated with the assessment. Where we have substantial uncertainty, we made our necessary assumptions explicit in the SSA Report. We base our assumptions in these areas on the best available information.

3.0 RECOVERY STATUS ASSESSMENT

The SSA Report considers what the shiners need to ensure viability. We generally define viability as the ability of the species to persist over the long term (the next 50 years) and, conversely, to avoid extinction. We next evaluated whether the identified needs of the shiners are currently available and the repercussions to the species when fulfillment of those needs is missing or diminished. We then consider the factors that are causing these species to lack what they need, including historical, current, and future factors. Finally, considering the information reviewed, we evaluate the current status and future viability of the species in terms of resiliency, redundancy, and representation.

- **Resiliency** is defined as the ability of the species to withstand stochastic events (arising from random factors). We can measure resiliency based on metrics of population health, such as birth versus death rates, and population size. Healthy populations are more resilient and better able to withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

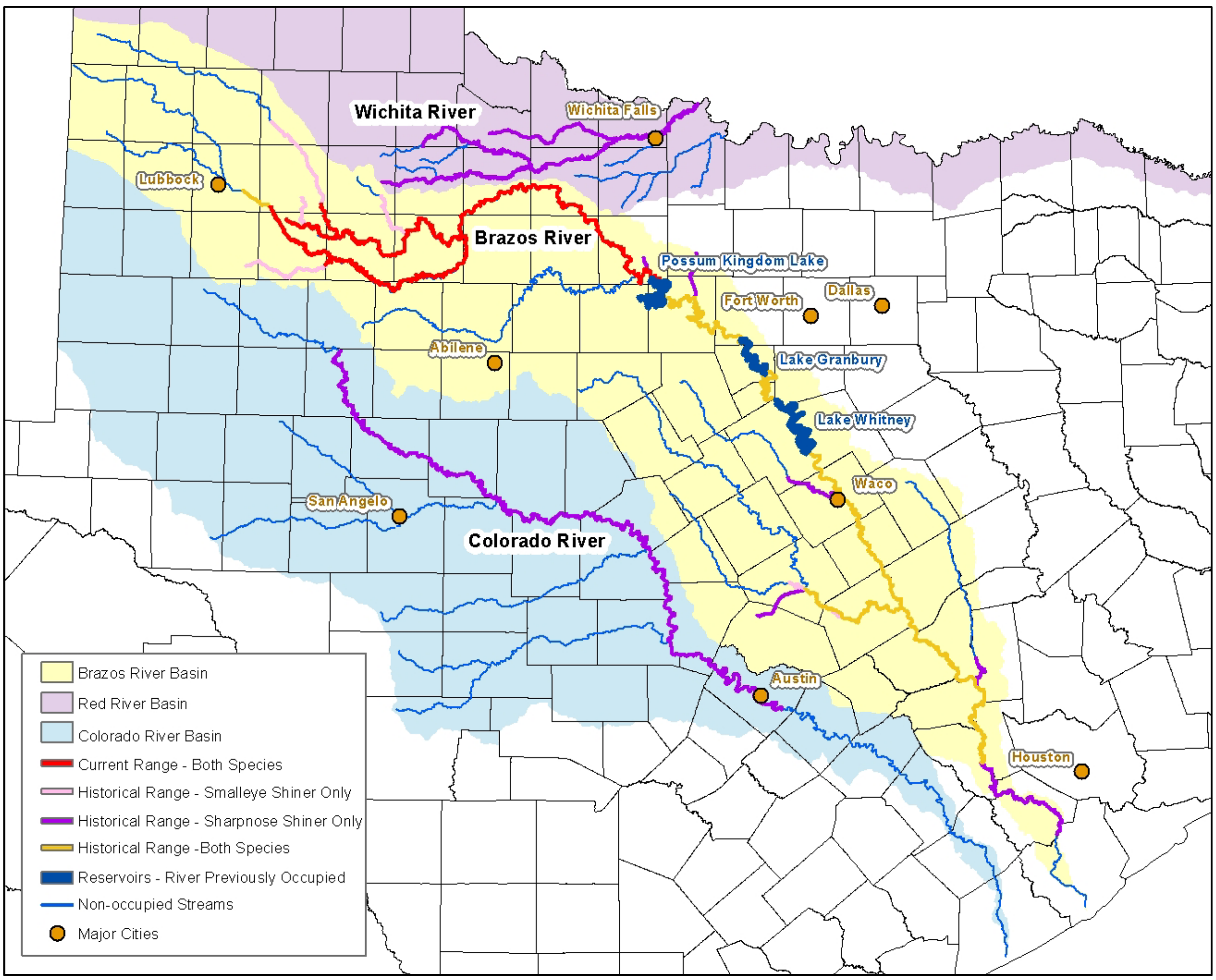
- **Redundancy** is defined as the ability of a species to withstand catastrophic events (a rare destructive natural event or episode involving many populations and occurring suddenly). Redundancy is about spreading the risk and can be measured through the duplication and distribution of resilient populations across the range of the species. The greater the number of resilient populations a species has distributed over a larger landscape, the better it is able to withstand catastrophic events.

- **Representation** is defined as the ability of a species to adapt to changing environmental conditions. Representation can be measured through the breadth of genetic diversity within and among populations and the ecological diversity (also called environmental variation or diversity) of populations across the species' range. The more representation, or diversity, a species has, the more capable it is of adapting to changes (natural or human caused) in its environment. In the absence of species-specific genetic and ecological diversity information, as is the case with the shiners, we evaluate representation based on the extent and variability of habitat characteristics within their geographical range.

3.1 Biological Assessment

Sharpnose and smalleye shiners are small minnows restricted to the contiguous river segments of the upper Brazos River basin in north-central Texas at the time of their listing. The sharpnose shiner and smalleye shiner historically occurred along most of the Brazos River and parts of its major tributaries. The sharpnose shiner also naturally occurred in the Colorado River and in the Wichita River (Service 2014, Chapter 2.D.1. Historical Range).

Shiners are generalist feeders and have a maximum lifespan of less than three years. However, it is believed most individuals survive only through one reproductive season, which generally occurs from April through September.



3.2 Species' Range-wide Population Status and Trends

The current conditions of both species indicate that they do not have the necessary resources for persistence even in the short term. These species are currently restricted to the upper Brazos River and its major tributaries, which represents a greater than 70 percent reduction in range for the sharpnose shiner and a greater than 50 percent range reduction for the smalleye shiner. As a result, sharpnose and smalleye shiners currently lack redundancy, or the ability to withstand catastrophic events, which is reducing the viability of these species as a whole. In addition, streamflows within their current range are insufficient during some years to support successful reproduction, such as occurred in 2011. These fish have been remarkably resilient to past stressors that occur over short durations and their populations appear capable of recovering naturally even under conditions that substantially limit reproductive effort. However, without human intervention, given their short lifespan and restricted range, stressors that persist for two or more reproductive seasons (such as a severe drought) severely limit these species' current viability, placing them at a high risk of extinction (Service 2014, Executive Summary).

With only one isolated population of each species remaining, these species have no redundancy, reduced resiliency due to the inability to disperse downstream, and limited representation. Therefore, these species are in danger of extinction from only one adverse event (such as lack of river flow for two consecutive years). The severe range reduction and isolation of these species to a single population in the upper Brazos River reduces the likelihood of their survival, which is exacerbated by the ongoing and intensifying effects of river fragmentation, climate change induced drought, saltcedar encroachment, water quality degradation, and commercial bait harvesting. Without substantial conservation efforts, the threats affecting these species are expected to continue or increase, causing both species to be in danger of extinction (Service 2014, Executive Summary).

3.3 Species Viability Needs

Life History Drivers: For the shiners to be considered viable, individual fish need specific vital resources for survival and completion of their life cycles. Both species broadcast spawn eggs and sperm into open water asynchronously (fish not spawning at the same time) during periods of low flow and synchronously (many fish spawning at the same time) during periods of elevated streamflow from April through September (Durham 2007, p. 24; Durham and Wilde 2008, entire; Durham and Wilde 2009a, p. 26). Based on studies of similar species, their eggs are semi-buoyant and remain suspended one or two days in flowing water as they develop into larvae (Platania and Altenbach 1998, p. 565; Moore 1944, p. 211). Similarly, larval fish remain suspended in the flowing water column an additional two to three days as they develop into free-swimming juvenile fish (Moore 1944, pp. 211–212; Perkin and Gido 2011, p. 372). In the absence of sufficient water velocities, suspended eggs and larvae sink into the substrate where the majority likely die (Platania and Altenbach 1998, p. 565; Dudley and Platania 2007, p. 2083). The reproductive strategy of these species makes them particularly vulnerable to changes in the natural conditions of occupied habitat. Given their short lifespans, most sharpnose and smalleye shiners survive through only one reproductive season (Durham 2007, p. 27).

Individual Needs: Both species need wide, shallow, flowing waters generally less than 0.5 meter (m) deep (1.6 feet [ft]) with sandy substrates, which are found in mainstem rivers in the arid prairie region of Texas (Moss and Mayes 1993, pp. 21–22; Marks 1999, p. 86; Ostrand 2000, p. 33). Microhabitat partitioning among fish species in highly fluctuating environments, such as those of arid prairie streams like the upper Brazos River basin, is probably of limited importance and fish assemblage structure is likely reliant upon physiological and chemical tolerances for abiotic limiting factors (Matthews and Hill 1980, p. 63). Additionally, the relative importance of specific abiotic microhabitat characteristics to sharpnose and smalleye shiners may vary as river conditions vary (Wilde and Durham 2013, p. 7).

Sharpnose shiners, like other native fishes of the upper Brazos River, are relatively tolerant of high temperature, high salinity, high turbidity, and low dissolved oxygen (DO) (Table 1; Service 2014, Chapter 2.B.2. Physiological Tolerances). However, abiotically induced mortality resulting from low DO in isolated pools (a natural occurrence) is known to occur, and mortality may also occur from naturally occurring salt plumes.

Table 1. Physiological tolerances of sharpnose and smalleye shiners.

Metric	Sharpnose shiner	Smalleye shiner
Acute thermal maximum	39.2°C (102.6°F)	40.6°C (105.1°F)
Acute thermal minimum	unknown	unknown
Salinity*	15‰[1]	18‰
Conductivity*	25 mS/cm[2]	30 mS/cm
DO*	2.66 mg/L[3]	2.11 mg/L
Turbidity maximum	unknown	unknown

*At 25°C

1. Parts per thousand
2. Millisiemens per centimeter
3. Milligrams per liter

The diet of sharpnose and smalleye shiners includes a variety of materials (plant material, detritus, and invertebrates), although invertebrates appear to be their primary food source (Marks *et al.* 2001, pp. 330–332). The prevalence of sand-silt and detritus in the gut of these species suggests they forage among sediments on the river bottom throughout the year (Moss and Mayes 1993, p. 33, 35; Marks *et al.* 2001, pp. 330-332).

Population Needs: Based on current life history information, population dynamics modeling estimates a mean summer water discharge of approximately 2.61 m^3s^{-1} (92 cfs) is necessary to sustain populations of sharpnose shiners (Durham 2007, p. 110), while a higher mean discharge of approximately 6.43 m^3s^{-1} (227 cfs) is necessary for smalleye shiners (Durham and Wilde 2009b, p. 670). Lack of attainment of these minimum flow requirements in any single year does not indicate that the fish populations will be driven to extinction, but rather the population will likely decrease in size. However, if river flows are further reduced such that minimum flow requirements are not met during multiple, consecutive reproductive seasons, the continual decline of population numbers will eventually lead to their extinction. The number of consecutive years failing to meet minimum flow requirements necessary to drive these species to extinction will likely be dependent on a number of factors including, but not limited to, the number, timing, and intensity of seasonal pulse flows and the level of flow deficiency from the minimum requirements.

Considering sharpnose and smalleye shiners broadcast spawn semi-buoyant eggs that remain ichthyoplanktonic (floating in the water column) for up to five days before larval fish are capable of independent swimming, there is a minimum stream reach length that can support successful reproduction in these species. Given the information available, the minimum reach for successful reproduction of the sharpnose and smalleye shiners may be similar to that of the congeneric Arkansas River shiner, which is approximately 217 km (135 mi) (Perkin and Gido 2011, p. 374). However, Perkin *et al*. (2010, p. 7) observed no extirpations of broadcast-spawning minnows in river reaches greater than 275 km (171 mi). Until more specific information is experimentally assessed for sharpnose and smalleye shiners, a reach length of greater than 275 km (171 mi) is more appropriate for long-term survival of these species. A required length of 275 km (171 mi) is further corroborated by Wilde and Urbanczyk's (2013, entire) analysis of presence/absence of sharpnose and smalleye shiners. Successful reproduction may occur in river segments shorter than 275 km (171 mi); for instance, when elevated water temperatures decrease larval development time, when flow rates are low, yet adequate to suspend eggs and larvae, or when ichthyoplanktonic life stages are entrained in slackwaters and eddies. However, under fragmented river conditions, these species are expected to lose a portion of their reproductive effort (*i.e.*, eggs and larvae) to downstream reservoirs or to the next river segment, leading to a lack of population sustainability, in river reaches shorter than 275 km (171 mi).

The best available science suggests the primary needs of sharpnose and smalleye populations include unobstructed, wide, flat-bottom, flowing river segments of greater than 275 km (171 mi) in length to support development of their early life history stages. Although sharpnose and smalleye shiners are capable of successfully producing offspring during periods of flow rapid enough to complete their life history stages, reproductive activity is increased during elevated streamflow events (such as pulse flows occurring during stormwater runoff), suggesting these elevated flows are likely important to the long term viability of these species. Downstream transport of their ichthyoplanktonic life history stages may be greater during periods of elevated flow when reproductive activity is increased.

Species Needs: Ideally, resiliency would be attained by providing additional unfragmented river length downstream of, and contiguous with, the occupied range of the upper Brazos River. The middle Brazos River is now fragmented by four large dams (two operated by the Brazos River Authority, and one each by the U.S. Army Corps of Engineers, and the City of Waco), three of which support large reservoirs. These structures are unlikely to be removed, eliminating the possibility of increasing sharpnose and smalleye shiner resiliency by permitting the downstream transport of early life history stages and the upstream migration of adults. Given the middle Brazos River does not appear restorable for the purpose of supporting sharpnose and smalleye shiner connectivity with the upper Brazos River, we suggest reduced viability be addressed by improving redundancy of these species through captive propagation and reintroduced populations.

3.4 Monitoring Needs

Sharpnose and particularly smalleye shiners can be difficult to identify in the field and require expertise with cyprinid identification. Therefore, monitoring of sharpnose and smalleye shiners should be conducted by experienced personnel. Within the occupied range of the species in the upper Brazos River basin there is little need for presence/absence surveys because these species are expected to occur when conditions are favorable (water present within their physiological tolerances). Outside of the known occupied range of the upper Brazos River basin (the Colorado River basin, the middle and lower Brazos River, and the Wichita River in the Red River basin) these species are thought to be extirpated. Additional surveys, particularly in the Colorado River basin for the sharpnose shiner, would be beneficial to confirm the loss of these species in these areas. Yearly monitoring in the upper Brazos River basin would be beneficial in determining the effects of drought on the last remaining populations of these species. Standardized survey protocols will be developed by the Service, in coordination with the State and other partners, as part of the Endangered Species Act section 10 recovery permitting process. When captive propagation is implemented, monitoring plans will be necessary to ensure success of the program and released populations.

3.5 Threats Assessment (Primary Causes and Effects from SSA)

The two primary factors affecting the current and future conditions of these shiners are river fragmentation by impoundments and alterations of the natural streamflow regime (by impoundments, drought, groundwater withdrawal, and saltcedar encroachment). Other secondary factors, such as water quality degradation and commercial harvesting for fish bait, likely also impact these species but to a lesser degree. These multiple factors are not acting independently, but are acting together as different sources (or causes), which can result in cumulative effects that reduce the overall viability of the species.

Main Stressor: Habitat Loss and Modification

Significant reduction of the amount of suitable habitat reduces carrying capacity for remaining populations and reduces habitat available for successful reproduction.

Sources of Habitat Loss and Modification:

- **River fragmentation –** fish migration barriers that lead to loss of reproductive effort or impede upstream/downstream migration. For example:
  - **Impoundments**
  - **Low-water crossings**
  - **Pipeline reinforcements**
  - **Weirs**

- **Reduction/Alteration of stream flow –** alterations in the flow regime can negatively affect shiner survivability and reproduction.

  - **Sources of reduced/altered stream flow –** impoundments, drought, groundwater withdrawal, saltcedar encroachment, in-channel projects that affect channel morphology.

Secondary Stressor: Water Quality Degradation

Significant reduction of water quality results in mortality of individuals and has the potential to affect these shiners at the population and species level during periods of drought and range restriction.

Sources of Water Quality Degradation:

- **Point source pollution –** pollution results in mortality of fish and may have sub-lethal affects (although this requires further examination). Pollution has the potential to affect these shiners at the population and species level during periods of drought and range restriction.

- **Toxic golden alga blooms –** toxic golden alga blooms result in mortality of fish and have the potential to affect these shiners at the population and species level during periods of drought and range restriction.

Secondary Stressor: Commercial Bait Harvesting

The removal of individuals from the wild to be sold as bait reduces the number of fish in the remaining populations of these species and has the potential to affect these shiners at the population and species level during periods of drought and range restriction.

3.6 Conservation Assessment

Very few recovery actions have specifically been implemented for sharpnose and smalleye shiners. However, research efforts for both species and similar congeners suggest captive breeding for sharpnose and smalleye shiners will be successful. Additionally, although not performed for the express purpose of shiner recovery, saltcedar control efforts are carried out by several conservation partners including, but not limited to, the Partners for Fish and Wildlife Program, the Natural Resource Conservation Service, and the Brazos River Authority. The Texas Environmental Flows Program is tasked with developing river flow standards to support a sound ecological environment. However, no flows have officially been adopted for the upper Brazos River and those proposed do not appear adequate to support the long-term survival and recovery of the species (BBASC 2012, p. 87). Groundwater conservation districts, agricultural producers, and water managers implement general water conservation strategies that help reduce the use of surface and groundwater for agricultural, domestic, and industrial use.

3.7 Summary Statement of Recovery Needs

Currently, without active management (water flow management and captive breeding), the sharpnose shiner and smalleye shiner exhibit:

Low Resiliency

- Fish barriers restrict their ability to migrate from drought conditions and recolonize segments upon return of favorable conditions.

- Short lifespans limit their ability to withstand stochastic events affecting reproductive ability for two or more consecutive years.

No Redundancy

- Sharpnose and smalleye shiners are each restricted to single populations within the upper Brazos River.

Low Representation

- Sharpnose and smalleye shiners lack the genetic representation necessary to overcome the impacts of habitat fragmentation and loss of river flow because it would require the complete evolution of a different reproductive strategy (away from broadcast spawning).

At the time of listing, the shiners had limited viability and increased vulnerability to extinction largely because of their stringent life history requirements of long, wide, flowing rivers to complete their reproductive cycle. With a short lifespan allowing only one or two breeding seasons and the need for long, unobstructed flowing river reaches during the summer, both species are at a high risk of extirpation when rivers are fragmented by fish barriers and flows are reduced by multiple uses and drought-enhanced water shortages. These conditions have already resulted in substantial range reduction and isolation of the one remaining population of both fish in the upper Brazos River basin. The extant population of each shiner species is located in a contiguous stretch of river long enough to support reproduction, is of adequate size, and is generally considered resilient to local or short-term environmental changes. However, with only one location, the species lack any redundancy and it is presumed these species lack the genetic and ecological representation to adapt to ongoing threats. Without human intervention, a lack of adequate flows (due to drought and other stressors) persisting for two or more consecutive reproductive seasons may lead to species extinction, given the short lifespan and restricted range of these species. With high demand for water use and ongoing regional drought, the probability of this happening in the near term (about the next 10 years) is high, putting the species at a high risk of extinction. Over the longer term (the next 11 to 50 years) these conditions may deteriorate as human water use continues, including possible construction of new dams within the extant range, and enhanced chances of drought due to ongoing climate change. In conclusion, the viability of both species is low (*i.e.*, they have a low probability of persistence) and their viability is only expected to decline into the future (Service 2014, Executive Summary).

To address the current status of the shiners and work toward long-term viability and recovery of the species, recovery efforts should preferentially focus on restoring river flow to the upper Brazos River basin, improving habitat within the upper Brazos River basin, identifying alternatives to new reservoir development, enhancing water conservation efforts, providing connectivity between the occupied range and adjacent areas by removal of existing fish barriers if feasible, and captive propagation.

4.0 PRELIMINARY RECOVERY STRATEGY

4.1 Recovery Priority Number: 5C

The recovery priority number of 5C indicates a high degree of threat, a low recovery potential, the listed entities are species, and conflict exists. The threats are high due to ongoing sources of habitat loss, degradation, and modification, including potential impoundment construction, water management and use, saltcedar encroachment, and lack of water due to drought. Additional threats include water quality degradation and commercial harvesting. The sharpnose and smalleye shiner have a low probability of recovery because the severity of future droughts is expected to increase, regional water demand is expected to increase, existing impoundments are unlikely to be removed, future impoundment construction is likely, and captive propagation efforts are still in the experimental phase. Sharpnose and smalleye shiner conservation may compete with potential reservoir development in the upper Brazos River to meet future water demand.

4.2 Recovery Vision

The main factor making the sharpnose and smalleye shiner vulnerable to extinction is the loss of suitable habitat resulting primarily from fragmentation by impoundments and other fish barriers and the alteration of the natural flow regime (*i.e.*, reduced surface flows). Secondary factors affecting shiner viability include water quality degradation and commercial bait harvesting.

Both species are limited to the main channel and certain tributaries of the upper Brazos River basin where they are blocked from moving downstream by Possum Kingdom Lake. The occupied upper Brazos River basin experiences reduced surface water flows, particularly during dry summer months. It also contains several partial fish barriers (road crossings, pipeline crossings, *etc*.), is affected by both upstream and downstream impoundments, is encroached by saltcedar capable of affecting channel morphology and reducing surface flows, experiences occasional petroleum slicks and golden alga blooms capable of causing adult fish mortality, and is subjected to commercial bait fish harvesting.

The portions of the middle Brazos River, Wichita River, and Colorado River that naturally and historically supported one or both species are now highly fragmented by flood control, water supply, and hydropower dams. These impoundments reduce the length of river segments and are unlikely to support the ichthyoplanktonic reproductive development of early life history stages of these fish. Impoundments also alter the flow regime and the riverine ecosystem in a number of ways making them less conducive to support native cyprinid species like the sharpnose and smalleye shiner associated with wide, shallow, dynamically flowing arid-prairie streams. The lower Brazos River retains an unfragmented reach of river exceeding 275 km (171 miles) in length and could theoretically support reproduction and recruitment for both species. However, the flow regime, substrate and channel morphology of the lower Brazos River is affected by upstream impoundments and is generally deeper than the wide, shallow segments these species are most commonly associated with. Both the sharpnose and smalleye shiner are believed to be extirpated from the lower Brazos River suggesting it would not support these species indefinitely (Service 2014, Chapter 4.B.3. Stream Reach Length).

Captive propagation of sharpnose and smalleye shiners and their reintroduction into currently and historically occupied stream reaches may be the only way to address the complete lack of redundancy these species currently display. Captive propagation techniques have been successfully implemented in other similar broadcast-spawning species. Research to address the requirements to sustain a genetically diverse captive bred population is also being investigated and should be completed by 2017. Fish reared in captivity can be used to supplement the last remaining populations of these species in the upper Brazos River basin following years when conditions are not favorable to successful reproduction. Reared fish can also be used to start experimental populations in historically occupied river reaches. Based on the best available science, the known historical river reaches do not meet the length requirement to indefinitely support a viable, successfully reproductive population; however, captive bred fish re-introduced into the historical range may be self-sustaining for several years and could act as an in-situ redundant population to protect against extinction events in the upper Brazos River basin. Information learned from monitoring experimental populations could also lead to better estimates of the minimum stream length and flow requirements necessary to sustain a viable population of these species.

Restoration of the upper Brazos River basin to relatively natural historical conditions will be an important aspect of recovery for these fish. Existing partial fish migration barriers such as low-water crossings, road crossings with culverts, and reinforced pipeline crossings can be repaired, removed, or replaced with sturdy, more-permanent structures that are more conducive to fish migration and the passage of flowing water. Existing impoundments that are no longer in service upstream and downstream of occupied areas would ideally be removed, if feasible, to lengthen unfragmented river segments, provide additional flow, and return the river to a more natural, historical state. Existing impoundments still in use and upstream of occupied areas may be able to provide some benefit to sharpnose and smalleye shiners by adopting water release strategies and management plans to provide some flowing water during the shiner spawning season (April – September).

Restoration of the upper Brazos River would also include saltcedar control by mechanical, chemical, and biocontrol methods to maintain a wide, shallow channel. Groundwater and surface water conservation strategies should be implemented to the greatest extent possible to maximize the potential for surface water flows. Sources of petroleum contamination and other pollutants should be identified and steps taken to reduce the likelihood of future contamination. The control of golden alga blooms may not be feasible because current information indicates salinity is a key factor in the timing and toxicity of blooms. Highly saline conditions are a natural occurrence in the upper Brazos River basin suggesting golden alga blooms will be difficult or impossible to manage.

Although the threat of commercial bait harvesting may not be substantial, Texas Parks and Wildlife Department (TPWD) is currently in the process of reviewing their nongame fish permitting process to ensure future permits will minimize negative impacts to state and federally listed species. This may include changes to nongame fishing protocols or disallowing activities within specific areas (McGarrity 2014, personal communication). We expect the threat of commercial bait harvesting to sharpnose and smalleye shiners to be effectively removed by the TPWD permit issuance changes.

4.3 Brief Action Plan

1. Establish partnerships to manage and control saltcedar encroachment along the riparian corridor of occupied areas of the upper Brazos River basin. The Service's Partners for Fish and Wildlife Program, the Natural Resource Conservation Service, and the Brazos River Authority are three examples of groups implementing saltcedar control projects in the area. Areas where saltcedar is removed should be replanted with native grasses and riparian trees to reduce the likelihood of saltcedar reestablishment. Priority areas will likely include riparian corridors along occupied river reaches, particularly the upper Brazos River, Double Mountain Fork of the Brazos River,

and North Fork Double Mountain Fork of the Brazos River, where the sharpnose and smalleye shiner appear most abundant.

2. Work with the Service's Fisheries Program, TPWD, and other knowledgeable entities to determine what types of road crossings are best designed to allow for water and fish passage and are stable in the arid prairie stream environment. Once a preferred structure is determined, work with landowners to replace existing structures with new structures (potentially through a cost-share program and the National Fish Passage Program).

3. Identify captive propagation requirements and develop a protocol for large-scale captive breeding. Once a protocol is established, find a suitable location to maintain a captive population of sharpnose and smalleye shiners.

4. Work with TPWD and the scientific community to develop a protocol for the release of captive bred individuals into occupied and historically occupied reaches for research and monitoring purposes and to provide population redundancy (even if just temporarily due to habitat unsuitability).

5. Work with stakeholders to determine the source of pollution discharges negatively affecting shiners and to take steps to avoid and minimize future surface water contamination.

6. Work with stakeholders to remove existing fish migration barriers (including impoundments) if they are no longer useful or in service.

7. Work with stakeholders to implement water release strategies to aid fish reproduction during the spawning season.

8. Work with stakeholders to implement groundwater and surface water conservation strategies in the upper Brazos River basin to maximize surface water flows.

9. Evaluate the causes of golden alga blooms, their extent, and impacts to shiners in the upper Brazos River basin.

10. Refine estimates of required stream length and required minimum stream flow for reproductive purposes.

5.0 PREPLANNING DECISIONS

A recovery plan will be prepared pursuant to section 4(f) of the Act. The recovery plan will include objective, measurable criteria, which when met, will result in a determination that the species be removed from the Federal list of Endangered and Threatened Wildlife and Plants. Recovery criteria will address all threats meaningfully impacting the species. The recovery plan will also estimate the time required and cost to carry out those measures needed to achieve the goal of recovery and delisting for both species.

Plan preparation will be under the guidance of the Arlington, Texas, Ecological Services Field Office. The Service may appoint a recovery team to undertake development of the recovery plan. Alternatively, a plan may be developed internally by the Service and presented for comment to the public and stakeholders.

Approval:

ACTING
Dr. Benjamin N. Tuggle
Regional Director
U.S. Fish and Wildlife Service, Region 2

Date: 3/4/15

6.0 LITERATURE CITED

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