United States Department of the Interior

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Memorandum

To: Superintendent, Lake Meredith National Recreation Area, NPS, Fritch, TX

From: Acting Field Supervisor, FWS, Ecological Services, Arlington, TX

Subject: Lake Meredith Off-road Vehicle Management Plan Biological Opinion

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the National Park Service's (NPS) implementation of the Lake Meredith National Recreation Area (LMNRA) Off-road Vehicle (ORV) Management Plan and its effects on the federally listed Arkansas River shiner (*Notropis girardi* [ARS]). The LMNRA encompasses approximately 44,977 acres and is located in portions of Hutchinson, Moore, and Potter Counties, Texas. Proposed actions potentially affecting federally protected resources would occur within a 275-acre area in Moore County and within a 1,740-acre area in Potter County.

This biological opinion has been prepared in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.) The biological opinion is based on the Biological Assessment (BA) and the Draft Environmental Impact Statement (DEIS) included with your letter initiating consultation, information provided by NPS staff, and other sources of information. A complete administrative record of this consultation is on file at the Service's Arlington, Texas, Ecological Services Field Office.

Consultation History

April 28, 2009: Exchange of information between LMNRA NPS staff and Daniel Fenner and Ken Collins of USFWS' Oklahoma Ecological Services Field Office (OESFO) regarding potential impacts to ARS from recreation activities. NPS staff were made aware of responsibilities under section 7 of the Act and were advised on range of alternatives.

August 2, 2010: Further exchange between LMNRA NPS staff and OESFO. LMNRA NPS requested comments on draft alternatives prior to preparing impact

	analysis. OESFO received copy of results of survey reveling ARS presence at all sampling points. Future agency coordination was discussed.
November 9, 2011:	LMNRA NPS submitted latest draft of alternatives to USFWS for review.
November 25, 2013:	LMNRA NPS provided USFWS' Arlington Texas Ecological Services Field Office (ARLESFO) with BA and DEIS for the implementation of the Lake Meredith National Recreation Area Off-Road Vehicle (ORV) Management Plan and requested formal consultation.
April 9, 2014	Draft BO sent to NPS

BIOLOGICAL OPINION

I. Description of Proposed Action

The LMNRA provides a variety of visitor experiences, including the use of ORV. ORV use has been authorized at the LMNRA since the 1970s (under CFR 7.57) in two designated areas: Blue Creek at the north end and Rosita Flats at the south end. Since this initial authorization, ORV use has changed drastically, both in intensity and in the types of ORVs used. This increased ORV use has led to detrimental effects to natural and cultural resources as well as visitor use conflicts.

Executive Order 11644, "Use of Off-road Vehicles on Public Lands" (issued in 1972 and amended by Executive Order 11989 in 1977), requires Federal agencies that allow ORV use to designate specific areas and routes on public lands where the use of ORVs may be allowed. Therefore, motorized travel off established roads would not be permitted in any areas unless designated under a special regulation. Section 3 of this executive order, as amended, authorizes the NPS to designate ORV use areas provided that the designation of such areas and trails would be based on protecting the resources of public lands, promoting the safety of all users of those lands, and minimizing conflicts among the various uses on those lands. Executive Order 11644 was issued in response to the widespread and rapidly increasing use of ORVs on public lands "often for legitimate purposes but also in frequent conflict with wise land and resource management practices, environmental values, and other types of recreational activity."

As a result of these considerations, the LMNRA proposes to implement the Lake Meredith National Recreation Area Off-road Vehicle Management Plan in order to:

- Comply with Executive Order 11644
- Provide for sustainable recreational ORV use areas
- Address the lack of an approved plan, which has led to ORV use outside authorized areas
- Address the change in numbers, power, range, and capabilities of ORVs
- Address resource impacts resulting from ORV use (including impacts to the ARS for reasons discussed in the "Effects of the Action" section of this opinion)

The NPS evaluated several project alternatives and selected "Alternative D: Management Through Use of a Zoning and Permitting System at Current Off-road Vehicle Use Areas" as their preferred alternative. Alternative D was selected as the environmentally preferable alternative and is the proposed action for section 7 consultation. NPS identified this alternative as environmentally preferable because it would establish numerous management measures that would reduce the impact of ORV use on the landscape in both the Blue Creek and Rosita Flats areas. These measures include the following:

- The establishment of ORV routes and areas in either sand bottom areas (Blue Creek) or on already disturbed trails. Routes and areas would be clearly marked so users would be better able to avoid unknowingly going off trail.
- The overlay of specified zones that would reduce the intensity of use in some areas. In these areas, restrictions on vehicle size would result in less damage to soils and provide a better opportunity for other resources, such as vegetation, to recover. Camping zones with lower ORV speed limits would be established in which camping and campfires would be allowed.
- Designated river crossings that would better protect ARS habitat in addition to restrictions that would prevent driving in isolated pools during times of drought.
- A permit system that would provide educational materials to users to keep them informed on how they can best use ORV use areas while also promoting resource protection.

The action area for the proposed project includes the anticipated extent of the direct and indirect effects. The Service has determined the action area to be approximately 2,015 acres consisting of a 275-acre area in Moore County and a 1,740-acre area in Potter County. Actions potentially impacting the ARS would only occur within the 1,740-acre area in Potter County known as Rosita Flats within and adjacent to the Canadian River (Figure 1). Therefore, the Rosita Flats area alone will be the analysis area of this biological opinion.

Minimization Measures: The proposed action also includes several conservation measures to avoid and minimize potential adverse impacts to ARSs as well as other aquatic and shoreline habitat dwelling species. These measures currently include:

- No parking or staging of vehicles of any kind adjacent to or in the Canadian River

- Access to the Canadian River would be allowed only from designated access points

- A Resource Protection Zone would be established within Rosita Flats within which only vehicles with a wheel width of 64 inches or less would be allowed

- Educational materials would be provided when a visitor obtains an ORV use permit. These materials would include information about the prohibition of driving in isolated pools or entering and leaving the Canadian River at undesignated access points, as well as other information about the ARS. This pamphlet would contain the statement, "The USFWS recommends during low water that ORV users do not drive in the Canadian River but cross the channel when needed."

- Additional information on ARS protection would be provided on the existing park bulletin boards and any boards or kiosks added at campground areas.

- The superintendent always retains the authority to close any portion of the National Recreation Area for protection of park resources.

II. Status of the Species

The current list of federally threatened (T), endangered (E), and candidate (C) species that are known to occur, or have been documented in Moore and Potter Counties consists of the following:

> Arkansas River shiner (*Notropis girardi*) – T, Moore, Potter
> whooping crane (*Grus americana*) – E, Potter
> lesser prairie-chicken (*Tympanuchus pallidicinctus)* – T, Moore

Whooping cranes have the potential to pass through the general vicinity during their annual migration, but have not been documented within or adjacent to the LMNRA in the recent past. Habitat along the shoreline is not considered preferred habitat; however, it is possible that whooping cranes could potentially utilize the shoreline briefly as a migration stopover. However, the probability of this occurrence would be minimal and could not be meaningfully measured. For this reason, the proposed action is not likely to adversely affect whooping cranes. Therefore, this species will not be discussed further in this biological opinion, and no take of this species is authorized.

The lesser prairie-chicken is currently in the federal listing process and is expected to be listed as threatened on May 12, 2014. Regardless, preferred habitat for lesser prairie-chicken does not appear to be present within the action area and adverse impacts to this species would not be expected.

The federally listed endangered species that does occur in the action area and that may be affected by the proposed action is the ARS. The ARS is a small, robust minnow with a small, dorsally flattened head, rounded snout, and small subterminal mouth (Miller and Robison 1973; Robison and Buchanan 1988). Dorsal coloration tends to be light tan, with silvery sides gradually grading to white on the belly. Adults attain a maximum length of about 2 inches. Dorsal, anal, and pelvic fins all have eight rays, and there is usually a small, black chevron present at the base of the caudal fin. The ARS was listed as a threatened species on November 23, 1998, based on reductions of the species' range and numbers due to habitat destruction and modification, stream dewatering, diversion of surface water, groundwater pumping, construction of impoundments, and water quality degradation (USFWS 1998).

On April 4, 2001, critical habitat for this species was designated (66 *FR* 18002). This critical habitat designation was vacated as a result of a September 2003 Memorandum Opinion of the U.S. District Court of the District of New Mexico, and on October 6, 2004, a new critical habitat designation for the Arkansas River basin population of the ARS was proposed (69 *FR* 59859). A final designation of critical habitat for the Arkansas River basin population of the ARS was published on October 13, 2005 (70 *FR* 59808), which does not include the portion of the Canadian River within the proposed action area.

The ARS was first reported in 1926 from the Cimarron River northwest of Kenton, Cimarron County, Oklahoma (Hubbs and Ortenburger 1929). Historically, the ARS was widespread and abundant throughout the western portion of the Arkansas River basin in Kansas, New Mexico, Oklahoma, and Texas. This species has subsequently disappeared from over 80 percent of its historical range and is now almost entirely restricted to about 508 miles of the Canadian River in New Mexico, Oklahoma, and Texas. A nonnative, introduced population of the ARS occurs in the Pecos River in New Mexico (Bestgen *et al*. 1989). That population is not protected under the Act.

The ARS is now believed to be extirpated from the entire Arkansas River. An extremely small population may still persist in the Cimarron River in Oklahoma and Kansas, based on the collection of only 22 individuals since 1985. A remnant population also may persist in the Beaver/North Canadian River of Oklahoma, based on collection of only four individuals since 1989 (Larson *et al*. 1991; Pigg 1991). However, samples collected by Wilde (2002) at 10 sites along the Beaver/North Canadian River in 2000 and 2001 found no ARS, suggesting that the ARS may be extirpated from that river. An accurate assessment of ARS populations in the Cimarron and Beaver/North Canadian Rivers is difficult because the populations are likely so small that individuals may escape detection during routine surveys.

<u>Habitat</u>

The ARS historically inhabited the main channels of wide, shallow, sandy-bottomed rivers and larger streams of the Arkansas River basin (Gilbert 1980). Adults are uncommon in quiet pools or backwaters, and almost never occur in tributaries having deep water and bottoms of mud or stone (Cross 1967). Polivka and Matthews (1997) suggested that juvenile ARS associate most strongly with current, conductivity (related to total dissolved solids), and backwater and island habitat types. Cross (1967) believed that adults preferred to orient into the current on the lee sides of transverse sand ridges and feed upon organisms washed downstream.

Matthews (1987) classified several species of fishes, including the ARS, based on their tolerance for adverse conditions and selectivity for physicochemical gradients. The ARS was described as having a high thermal and oxygen tolerance, indicating a high capacity to tolerate elevated temperatures and low dissolved oxygen concentrations (Matthews 1987). Observations from the Canadian River in New Mexico and Texas revealed that dissolved oxygen concentrations, conductivity, and pH rarely influenced habitat selection by the ARS (Wilde *et al*. 2000). ARS specimens were collected over a wide range of conditions–water temperatures from 32.7 to 98.2° Fahrenheit (0.39 to 36.78° Celsius), dissolved oxygen from 3.4 to 16.3 parts per million, conductivity (total dissolved solids) from 0.7 to 14.4 millisiemens per centimeter, and pH from 5.6 to 9.0.

In the Canadian River of central Oklahoma, Polivka and Matthews (1997) found that ARS exhibited only a weak relationship between the environmental variables they measured and the occurrence of the species within the stream channel. Water depth, current, dissolved oxygen, and sand ridge and midchannel habitats were the environmental variables most strongly associated with the distribution of ARS within the channel. Similarly, microhabitat selection by ARS in the Canadian River of New Mexico and Texas was influenced by water depth, current velocity, and, to a lesser extent, water temperature (Wilde *et al*. 2000). The ARS specimens generally occurred at mean water depths between 6.6-8.3 in (17 and 21 cm) and current velocities between 11.7 and 16.4 in (29.7 and 41.6 cm) per second. Juvenile ARS associated most strongly with current, conductivity, and backwater and island habitat types (Polivka and Matthews 1997).

Wilde *et al.* (2000) found no obvious selection for, or avoidance of, any particular habitat type (*i.e.*, main channel, side channel, backwaters, and pools) by ARS. The ARS specimens did tend to select side channels and backwaters slightly more than expected based on the availability of these habitats (Wilde *et al.* 2000). Likewise, they appeared to make no obvious selection for, or avoidance of, any particular substrate type. Substrates in the Canadian River in New Mexico and Texas were predominantly sand; however, the ARS was observed to occur over silt slightly more than expected based on the availability of this substrate (Wilde *et al.* 2000).

<u>Food Habits/Feeding Behavior</u>

The ARS is believed to be a generalized forager and feeds upon both items suspended in the water column and items lying on the substrate (Jimenez 1999, Bonner *et al.* 1997). In the Canadian River of central Oklahoma, Polivka and Matthews (1997) found that gut contents were dominated by sand/sediment and detritus (decaying organic material), with invertebrate prey being an incidental component of the diet. In the Canadian River of New Mexico and Texas, the diet of ARS was dominated by detritus, invertebrates, grass seeds, and sand and silt (Jimenez 1999). Invertebrates were the most important food item, followed by detrital material.

Terrestrial and semiaquatic invertebrates were consumed at higher levels than were aquatic invertebrates (Jimenez 1999). With the exception of the winter season, when larval flies were consumed much more frequently than other aquatic invertebrates, no particular invertebrate taxa dominated the diet (Bonner *et al.* 1997). Fly larvae, copepods, immature mayflies, insect eggs, and seeds were the dominant items in the diet of the nonnative population of the ARS inhabiting the Pecos River in New Mexico (Keith Gido, University of Oklahoma, *in litt.* 1997).

<u>Reproduction</u>

Successful reproduction by the ARS appears to be strongly correlated with streamflow. Moore (1944) believed the ARS spawned in July, usually coinciding with elevated flows following heavy rains associated with summertime thunderstorms. Bestgen *et al.* (1989) found that spawning in the nonnative population of ARS in the Pecos River of New Mexico generally occurred in conjunction with releases from Sumner Reservoir. However, recent studies by Polivka and Matthews (1997) and Wilde *et al.* (2000) neither confirmed nor rejected the hypothesis that elevated streamflow triggered spawning in the ARS.

ARS specimens are open-water, broadcast spawners that release their eggs and sperm over an unprepared substrate (Platania and Altenbach 1998, Johnston 1999). Examination of ARS gonadal development between 1996 and 1998 in the Canadian River of New Mexico and Texas demonstrated that the species undergoes multiple, asynchronous spawns in a single season (Wilde *et al.* 2000). The ARS appears to be in peak reproductive condition throughout the months of May, June, and July (Wilde *et al.* 2000, Polivka and Matthews 1997); however, spawning may occur as early as April and as late as September. ARS specimens may, on occasion, spawn in standing waters (Wilde *et al.* 2000), but it is unlikely that such events are successful.

Both Moore (1944) and Platania and Altenbach (1998) described behavior of ARS eggs. The fertilized eggs are nonadhesive and semibuoyant. Platania and Altenbach (1998) found that spawned eggs settled to the bottom of the aquaria where they quickly absorbed water and expanded. Upon absorbing water, the eggs became more buoyant, rose with the water current, and remained in suspension. The eggs would sink when water current was not maintained in the aquaria. This led Platania and Altenbach (1998) to conclude that the ARS and other plains fishes likely spawn in the upper to mid-water column during elevated flows. Spawning under these conditions would allow the eggs to remain suspended during the 10- to 30-minute period the eggs were non-buoyant. Once the egg became buoyant, it would remain suspended in the water column as long as current was present.

In the absence of sufficient streamflows, the eggs would likely settle to the channel bottom, where silt and shifting substrates would smother the eggs, hindering oxygen uptake and causing mortality of the embryos. Spawning during elevated flows appears to be an adaptation that likely increases survival of the embryo and facilitates dispersal of the young. Assuming a conservative drift rate of 3 km/hour, Platania and Altenbach (1998) estimated that the fertilized eggs could be transported 45-89 mi (72-144 km) before hatching. Developing larvae could then be transported up to an additional 134 mi (216 km) before they were capable of directed swimming movements. Bonner and Wilde (2000) speculate that 135 mi (218 km) may be the minimum length of unimpounded river that allows for the successful completion of ARS life history, based on their observations in the Canadian River in New Mexico and Texas.

Rapid hatching and development of the young is likely another adaptation in plains fishes that enhances survival in the harsh environments of plains streams. ARS eggs hatch in 24-48 hours after spawning, depending upon water temperature (Moore 1944, Platania and Altenbach 1998). The larvae are capable of swimming within 3-4 days; they then seek out low-velocity habitats, such as backwater pools and quiet water at the mouths of tributaries where food is more abundant (Moore 1944).

Evidence from Wilde *et al.* (2000) indirectly supports the speculation by Cross *et al.* (1985) that the ARS initiates an upstream spawning migration. Whether this represents a true spawning migration or just a general tendency in these fish to orient into the current and move upstream, perhaps in search of more favorable environmental conditions, is unknown (Wilde *et al.* 2000). Regardless, strong evidence suggested the presence of a directed, upstream movement by the ARS over the course of a year.

<u>Age and Growth</u>

Maximum longevity is unknown, but Moore (1944) speculated that the species' life span is likely less than 3 years in the wild. The age structure of ARS collected from the Pecos River in New Mexico included three, and possibly four, age classes (Bestgen *et al.* 1989). The majority of the fish captured were juveniles (Age-0) and first-time spawners (Age-I). Most of the fish in spawning condition were Age-I. Bestgen *et al.* (1989) thought mortality of postspawning fish was extremely high based on the absence of Age-I and older fish from collections made after the spawning period (late July and August).

Diseases, Parasites, and Predation

No studies have been conducted on the impact of disease or predation upon the ARS; therefore, the significance of these threats upon existing populations is unknown. There is no direct evidence to suggest that disease threatens the continued existence of the species. Disease is not likely to be a significant threat except in isolated instances or under certain habitat conditions, such as crowding during periods of reduced flows, or episodes of poor water quality (e.g., low dissolved oxygen or elevated nutrient levels). During these events, stress reduces resistance to pathogens and disease outbreaks may occur. Parasites and bacterial and viral agents are generally the most common causes of mortality. Lesions caused by injuries, bacterial infections, and parasites often become the sites of secondary fungal infections.

Some predation of ARS by largemouth bass *Micropterus salmoides*, green sunfish *Lepomis cyanellus*, channel catfish *Ictalurus punctatus*, and other fish species undoubtedly occurs, but the extent is unknown. Predation by aquatic birds (e.g., terns, herons, and egrets) and aquatic reptiles (e.g., snakes and turtles) also may occur. Plains fishes have evolved under adverse conditions of widely fluctuating, often intermittent flows, high summer temperatures, high rates of evaporation, and high concentrations of dissolved solids. These conditions are not favored by most large predaceous fish and tend to preclude existence of significant populations of these species. However, alteration of historic flow regimes and construction of reservoirs have created favorable conditions for some predatory species such as white bass *Morone chrysops* and striped bass *M. saxatilis*. State and Federal fish and wildlife management agencies, through cooperative efforts to develop sport fisheries in these reservoirs, have facilitated expansion of the distributions of some predatory species. The impact of predation to the species is likely to be localized and insignificant, particularly where habitat conditions upstream of mainstem reservoirs are not favorable to the long-term establishment of abundant predatory fish populations.

Factors Contributing to Decline

The ARS very likely no longer exists in the Arkansas River in Arkansas, Kansas, and Oklahoma, which is a loss of over 770 miles (1,240 kilometers) of previously occupied habitat (69 FR 59861). The decline of the shiner is primarily the result of modification of the duration and timing of streamflows, habitat loss by inundation, stream depletion due to water diversion and groundwater pumping, water quality degradation (caused by oil and gas, municipal sewage effluent, and manufacturing return flows), competition with invasive nonnative species, and the construction of impoundments (70 FR 59828; USFWS 2009). The fragmentation of streams and rivers, particularly with the construction of reservoirs, throughout the Great Plains has likely acted to increase the frequency of reproductive failure among broadcast spawning species in these systems through restricting the upstream movement of adults to spawn, leaving drifting eggs without sufficient distance to develop and hatch before being transported into lentic habitats (Durham and Wilde 2008, NPS 2013).

III. Environmental Baseline

a. Status of the species within the action area.

The LMNRA is located near the geographic center of the Texas Panhandle, about 40 miles northeast of Amarillo and 9 miles west of Borger. It is composed of approximately 45,000 acres within its boundaries (NPS 2009) and encompasses portions of Hutchinson, Moore, and Potter Counties. The Action Area consists of two separate areas within LMNRA: the 275-acre Blue Creek ORV Use Area located on the northwest side of the lake, and the 1,740-acre Rosita Flats ORV Use Area located in the southernmost section of LMNRA. The ARS occurs only within the Rosita Flats portion of the Action Area and is the primary analysis area of this biological opinion.

Within the LMNRA, the Canadian River has carved a narrow, steep walled canyon from 200 to 300 feet deep and up to two miles wide. Between this canyon and caprock, many tributary streams have caused a rough and broken topography known as the Canadian River Breaks. The completion of the Sanford Dam in 1965 between these breaks created Lake Meredith (NPS 2013). The LMNRA lies within the Canadian/Cimarron Breaks sub-ecoregion which lies within the Southwestern Tablelands ecoregion of Texas. The Southwestern Tablelands flank the High Planes with red hued canyons, mesas, and dissected river breaks. Much of this ecoregion is in sub-humid grassland and semiarid rangeland. Vegetation consists of grama-buffalograss with some mesquite-buffalograss in the southeast, juniper-scrub oak-midgrass savanna on the escarpment bluffs, and shinnery (midgrass prairie with low oak brush) along parts of the Canadian River. Soils in this ecoregion include alfisols, inceptisols, entisols, and millisols (Griffin *et al.* 2004). Soil erosion at Rosita Flats (where the ARS is present) has occurred over the last 40 years primarily due to the use of ORVs above the 3,000-foot elevation contour. On hillsides with slopes of 15 degrees or more, the soils often erode during and after rainfall events due to the presence of steep slopes combined with the removal of vegetation by ORV use (NPS 2013).

Within the LMNRA property and immediately adjacent, the ARS is known to be present in the Canadian River from Chicken Creek upstream to the U.S. Highway 287 Bridge, a large porting of this stretch running through the Rosita Flats ORV use area (NPS 2013). The ARS does not occur in the Blue Creek ORV Use Area and LMNRA staff are unaware of any historical existence of the species in this area (NPS 2013). In addition, the Blue Creek ORV use area does not contain habitat that would be conductive to support future ARS populations (NPS 2013).

The ARS is abundant in the LMNRA in the Canadian River from Chicken Creek upstream to the U.S. 287/State Highway 87 Bridge according to survey efforts of Dr. Gene Wilde (NPS 2010). Dr. Wilde and his assistants conducted quarterly surveys in this area between May 2009 and January 2010 to document the presence and abundance of the ARS at eight survey sites within the Rosita Flats ORV use area and at one survey site at the U.S. Highway 87 bridge outside the LMRA boundary. During the four quarterly sampling events, a total of 4,383 fish representing 16 species and 5 families were captured, identified, and released. During the surveys a total of 1,378 ARSs were collected, making it the most commonly captured fish, representing 31% of the collected assemblage (NPS 2010).

In the spring survey, ARS represented 16% of the fish captured and was the third most commonly collected fish. In the summer survey, ARS represented 23% of the fish captured and was the second most commonly collected fish. The ARS was the most commonly collected fish in both the fall and winter surveys, representing 47% and 58% respectively of the total number of captured fish (NPS 2010). Across all sites, ARS occurred at 18% of spring sampling sites, 63% of summer sampling sites, 38% of fall sampling sites, and 24% of winter sampling sites (NPS 2010). Upstream migration during spawning may explain the reduction in ARS abundance in the spring samples.

b. Factors affecting species environment within the action area

The damming of the Canadian River is likely the most significant adverse impact to the ARS within the action area. Impoundments function as barriers, fragmenting populations and habitat into smaller, more isolated units. As noted prior, inundation of riverine systems increases the frequency of reproductive failure among broadcast spawning species in these systems through restricting the upstream movement of adults to spawn, leaving drifting eggs without sufficient distance to develop and hatch before being transported into lentic habitats (Durham and Wilde 2008, NPS 2013). Wilde *et al.* (2000) suggested that an unimpounded stretch of the river approximately 137 miles (220.5 km) long may be necessary for the ARS to complete its life cycle. Inundation of rivers also produces increased abundance of predatory fish that feed on smaller fish like the ARS both upstream and downstream of reservoirs. Additionally, these fragmented sections are more likely to be affected by influences from external factors (*e.g.*, localized drought, water withdrawals, permitted and unpermitted wastewater discharges). Once isolated, other aggregations of ARS can no longer disperse into these reaches and help maintain or restore populations of ARS there. Due to the inundation of the Canadian River at LMNRA, suitable habitat no longer exists for the ARS downstream of Chicken Creek to the Sanford Dam. To our knowledge the ARS was last documented downstream of Sanford Dam in Texas at the intersection of the Canadian River and State Highway 152 in Hutchinson County (USFWS 2002). Since 2002, numerous USFWS surveys have failed to collect ARSs below Lake Meredith in Texas. Surveys further downstream into Oklahoma have located ARSs, however recent drought conditions have significantly lowered total ARS numbers in the South Canadian River (Daniel Fenner, personal communication, April 24, 2014).

Lack of rainfall, pumping for local use, and the spread of salt cedar (*Tamarisk* spp.) has caused a decline in water levels in the region having a direct effect on ARS habitat (NPS 2013). As water resources become scarcer, the capillary effects of increased groundwater pumping may cause isolated pools present in the Canadian River in summer to dry up. Some of these isolated pools within Rosita Flats have been documented to contain stranded ARSs (NPS 2010). Invasive nonnative salt cedar present in the area spreads quickly and uptakes large amounts of water as well. As water levels have dropped, salinity levels rise potentially causing further stress and mortality to ARSs (NPS 2013).

Gas and Oil Development activities are ongoing outside LMNRA which may impact the action area. Associated land clearing for siting and road construction may negatively affect ARS habitat through erosion and sedimentation. Also of concern is the use of water resources for gas and oil extraction as well as the potential for surface and groundwater contamination.

Implementation of the LMNRA Fire Management Plan has reduced woody vegetation possibly generating negative impacts to the ARS in the form of increases in stream temperature, leading to stress-induced mortality especially during summer conditions where shade over isolated pools might be beneficial (CRMWA 2005, NPS 2013). This decrease in woody vegetation may also have resulted in increased access to the Canadian River by ORV users and the associated adverse impacts. Burning of vegetation may have resulted in increased levels of eroded materials entering the Canadian River, which may result in adverse impacts to ARS through the loss of instream habitat, loss of spawning substrate, channel incision, and increased/altered instream velocities (CRMWA 2005, NPS 2013).

The 1973 Lake Meredith National Recreation Area Master Plan was developed to ensure that the aesthetic and biological qualities would be maintained at a standard which would serve its users most effectively. This Master Plan also designated the Rosita Flats portion of the study area for recreational use (including ORVs), likely contributing to the historical degradation of ARS habitat well before the present ORV Management Plan was proposed. However, the development of resource management objectives and the establishment of natural environment areas within the 1973 Master Plan likely contributed to portions of Rosita Flats being less degraded than if the Plan had not been implemented (NPS 2013).

Surveying to monitor the ARS population at LMNRA could have adverse impacts on individual fish due to the stress associated with capture by seine and the handling required to sex, weigh, and mark fishes. However, the adverse impacts to individuals are expected to be outweighed by the benefits to the species from the information gained from the monitoring studies, which may be used to direct future species management efforts. Information gained from monitoring the ARS population at LMNRA may result in increased management actions, such as further ARS habitat protection and enhancement efforts, which may benefit the ARS.

Primary potential sources of adverse impact to the ARS from recreational activities within the action area include ORV use, camping, picnicking, and hunting (NPS 2013), which have contributed to habitat depletion and destruction. In addition to the direct impacts to ARS habitat as a result of these activities, indirect impacts, such as impacts to water quality from vehicles and trash, have also caused impacts as a result of visitor use (NPS 2013).

In the LMNRA, it is common for the Canadian River and inflow streams to dry up during summer conditions, leaving fish congregated in small to large isolated pools. ORVs driven through these isolated pools pose a threat to the congregated fish species, including the ARS (Arlene Wimer, Paul Jones, and Jeremy Stevens, personal communications). Dr. Gene Wilde added that ARS specimens sampled from the Canadian River in isolated pools during summer drought showed higher levels of stress indicators, such as parasites and poor nutrition, than those sampled in more favorable habitat conditions. These stranded individuals therefore may be more likely to be harmed or killed by added disturbances such as being trampled or splashed out of the pools by repeated ORV traffic, and/or by the resulting degradation of habitat quality from increased turbidity, loss of vegetation along margins, and accelerated water loss (Dr. Gene Wilde, personal communication, March 24, 2014). Appendix A contains several photographs provided by Dr. Wilde which illustrate fish stranded in shrinking pools in the Canadian River and some of the apparent effects of ORVs driven through these pools. Additionally, appendix B contains the preliminary results of an April 2014 field experiment conducted within the Canadian River by Dr. Wilde illustrating the direct mortality of fish stranded in pools resulting from a motor vehicle passing through.

IV. Effects of the Action

The proposed action consists of the implementation of the Lake Meredith Off-road Vehicle Management Plan for recreational use. Implementation of the Lake Meredith Off-road Vehicle Management Plan would designate specific routes and areas for ORV use in the Blue Creek and Rosita Flats areas of LMNRA. A fee-based permit system would also allow the NPS to provide additional amenities and increased enforcement in the action area. The Biological Assessment for the Lake Meredith Off-road Vehicle Management Plan / Environmental Impact Statement provided descriptions of proposed actions likely to adversely affect the ARS (NPS 2013). Quantitative measurements of length and area of proposed actions and property perimeters were calculated using shapefiles provided by NPS and utilizing ArcGIS software (version 10.1). The Service anticipates that direct and indirect adverse effects to the ARS would result from the action as discussed below.

ORVs cause long-lasting damage to land and aquatic ecosystems, wildlife, soils, and hydrologic flows and this is expected to occur in the action area. Even if all ORV users stayed in designated routes and areas, their activities may contribute to erosion and stream sedimentation, transport invasive species, disrupt and damage wildlife, and reduce habitat quality (Taylor n.d., NPS 2013). Motorized road and trail crossings through aquatic habitats degrade water quality, affect bank stability, damage riparian vegetation, and increase stream deposition, thus reducing habitat quality for aquatic species, including fish and their aquatic insect food sources (New Mexico EMNRD *et al.* 2008, NPS 2013). Soils classified as having moderate or high erosion potential are present along the edges of the Rosita Flats ORV use area. Sedimentation of surface waters of the LMNRA would continue to result from the ongoing erosion of soils due to ORV use. Incremental contributions to existing surface water quality impairments would also result from increased sediment runoff as well as runoff of gasoline or oil that may be leaked from ORVS (CRMWA 2005; Taylor n.d.; NPS 2013).

The individual elements of the Off-road Vehicle Management Plan necessitating section 7 consultation, and their corresponding direct and indirect impacts to the ARS, are as follows:

1. Designated Vehicle Routes/Areas

Direct Effects

The continued use of ORVs at Rosita Flats would likely result in additional habitat disturbance and disruption of the reproductive cycle due to the potential for injury and direct mortality during all life stages, leading to adverse impacts to ARSs. Implementing designated ORV access pointes at the riverbed and resource protection zones may likely have a beneficial effect on ARS by limiting ORVs from driving through riparian habitat and localizing impacts to certain areas. However, long-term adverse impacts to ARSs would persist from the continued presence of

ORVs in the riverbed. Sign posting and the use of post and cable fencing along ORV routes and indicating ORV use boundaries may help mitigate some of the adverse impacts of ORV use by preventing ORVs from driving through isolated pools possibly containing congregated ARSs.

Indirect Effects

ORV use at Rosita Flats would result in continued habitat/channel degradation due to erosion and aggradation due to sedimentation. Soil erosion may be increased by the compaction and rutting caused by vehicle tracks (Taylor n.d.), which in turn can lead to more sediment entering streams. This may result in turbidity, loss of instream habitat, loss of spawning substrate, channel incision, and increased stream velocities in ARS habitat (CRMWA 2005). These habitat changes may reduce the foraging and reproductive success of ARSs. Prohibiting ORV outside specified routes/areas as specified in the ORV Management Plan may reduce these erosion impacts by decreasing the overall footprint of ORV traffic and by maintaining the soil stabilizing effects of plant roots recolonizing untraveled areas. Continued ORV use at Rosita Flats may also result in the continued occurrence of trash entering streams, contributing to the degradation of ARS habitat. The ORV Management Plan includes efforts to minimize these waste disposal impacts through education and outreach provided to visitors. ORV use occurs off of LMNRA property upstream of Rosita Flats which can also contribute to reduced habitat quality for ARS both off and on LMNRA property by introducing additional turbidity and sedimentation. Identification of Sensitive Resource Areas through signage and fencing may have the indirect, and unintended, effect of encouraging vandalism or intentional destruction of these areas by identifying their locations.

2. Zone System

Direct Effects

Establishing 1,040 acres of Resource Protection Zones, where ORVs with a wheel width greater than 64 inches would not be permitted, would be intended to reduce the size and volume of ORV traffic in these areas. Additional measures are expected to minimize, but not eliminate the potential incidental take of ARSs by restricting the number of locations to four where ORVs can access the river, and limiting the number of ORVs overall, potentially reducing ORVs that come into contact with ARSs.

Indirect Effects

Establishing designated ORV use zones in already degraded areas of Rosita Flats and prohibiting the use of ORVs in vegetated resource protection zones is expected to limit increases in soil erosion, sedimentation, and water quality degradation in ARS habitat. By keeping ORVs in designated non-vegetated zones, preservation of existing vegetation is expected to help maintain water quality by controlling erosion in these areas due to root structure and the wind diffusing effects of the vegetation. Improvements to the road and designated camping zone at Rosita Flats are expected to reduce the impacts of erosion, sedimentation, and water quality degradation resulting from use of this area. Establishment of a hunting zone may result in a decrease of recreational ORV use during rifle season (up to two months) because ORV use in these areas would be restricted to hunters. Additionally, the establishment of camping-only zones may reduce impacts to water quality due to the prohibition of ORV use in these areas.

3. Permit Requirements

Direct Effects

Temporary closures of the ORV use areas if evidence of ORV use is found outside designated routes, as well as the implementation of a permit system could reduce impacts of ORV use on ARSs by encouraging ORV users to stay on designated routes. This action could help to preserve ARS habitat and reduce the incidence of direct mortality. The fee-based permit would also include an ORV user education component informing permit holders about resource protection.

Indirect Effects

Considering that only permitted ORV users would be allowed access to Rosita Flats, it is hopeful that these "informed" persons would follow the rules learned through the permitting process, in turn potentially reducing impacts to ARSs and their habitats. This would be in the form of reduced trash and leakage of fluids from ORVs in the water, and reducing the use of ORVs outside of designated areas. Repeat offenders would face revocation of permits, possibly eliminating the presence of users who may impact ARSs most severely.

4. Vehicle Requirements

Underage ORV users would be required to be accompanied by an adult, hopefully leading to greater compliance with LMNRA rules including those that contribute to resource protection.

Indirect Effects

The requirement of spark arresters on ORVs would decrease the possibility of wildfires thereby reducing the likelihood of impacts to water quality associated with fire-induced erosion and loss of vegetation.

5. Speed Limits

Direct Effects

None.

Indirect Effects

Speed limits may increase compliance with avoiding areas closed to ORV use (such as ARS inhabited pools) because operators may be more likely to maneuver around these areas while traveling at reduced speeds.

6. Education and Outreach

Direct Effects

Along with education provided within the ORV use permitting process, additional visitor education would inform users of LMNRA about the habitat and status of the ARS. This would hopefully result in greater compliance with rules designed to reduce impacts to ARSs and their habitats.

Indirect Effects

Increased education may result in increased compliance with ORV regulations, reducing impacts to water quality from erosion, loss of vegetation, and chemical leakage.

7. Camping, Campfires, and Other Amenities

Direct Effects

During construction activities for various future amenities, the resulting erosion and sedimentation may impact ARS habitat. Erosion and runoff from these construction sites would be minimized by following best management practices.

Indirect Effects

Construction of new visitor amenities may result in adverse indirect impacts related to increased visitor usage of the area. LMNRA will make efforts to locate amenities away from ARS habitats.

8. Enforcement

Direct Effects

Increased law enforcement may likely result in greater compliance with ORV regulations. This may result in benefits to ARS habitats when compared to current management practices.

Indirect Effects

Increased compliance with ORV regulations could result in less trash and less erosion and sedimentation entering ARS habitats resulting in beneficial indirect impacts to water quality, when compared to current management practices.

V. Cumulative Effects

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

Activities potentially resulting in cumulative effects to the ARS and/or its habitat in the action area are as follows:

1. **Revised Texas Wildlife Action Plan** – The goal of this plan is to conserve and improve the status of species of greatest conservation need and the habitats upon which they rely to prevent listings under the Act. This plan is the natural resources conservation plan for all of Texas (TPWD 2012, NPS 2013). This plan could have potential beneficial impacts to ARSs within the action area if the recommended monitoring is conducted and the data are used to identify needs and direct future resource management.

2. **Continued Hunting** – Hunting activities occur at various times during the year increasing the recreational use of the area and the associated strain on natural resources potentially negatively affecting the ARS.

3. **Continued Invasive Species Removal** – This may involve hand application of herbicides and some minor mechanical removal within the action area. This could potentially negatively affect the ARS if herbicides reach the water. Removal may also produce negative effects associated with increased stream temperature, increased erosion if replanting does not take place, and increased access to the stream from ORVs. Beneficial impacts may include increasing base flows in the Canadian and reducing salinity. Salt cedar is a target species known to uptake large amounts of water and to draw salts to the surface from deep within the ground.

4. **Future Mesquite Spraying on Adjacent Lands** – Past land use practices on adjacent lands have included the spraying of mesquite. This could negatively impact water quality for the ARS if aerial overspray and overland runoff reach the Canadian River including the portion of the action area.

5. **Lowering Lake Levels** – Water levels at Lake Meredith have been steadily decreasing over the past decade. This has been due to many factors including lack of rainfall, groundwater pumping for local use, and the spread of salt cedar which spreads quickly and removes large amounts of water. As water resources become more scarce, the capillary effects of increased groundwater pumping may cause isolated pools present in the Canadian River in the summer (some documented to contain stranded ARSs), to dry up. As water levels drop, salinity levels rise potentially causing further stress and mortality to ARSs (NPS 2013). A decline in the number of cottonwood trees (*Populus deltoids*) in the region has also been attributed to a reduction in available water. This decline in cottonwoods bordering the Canadian River has the potential to alter ARS habitat through increased stream temperatures, loss of shading, increased erosion, and potential increased access by ORV users to the riverbanks.

V. Conclusion

After reviewing the current status of the ARS, the environmental baseline for the action area, the effects of the proposed ORV Management Plan, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to *jeopardize* the continued existence of the ARS. No critical habitat for the ARS exists in the action area, therefore none will be affected. However, implementation of the ORV Management Plan may result in the incidental take of ARS.

As stated previously, principal effects of the action may involve unintended degradation of instream habitat and possible mortality of individuals during recreation activities. The project could impact ARSs within approximately 5.5 rivermiles of habitat within Rosita Flats which is only a small fraction of available ARS habitat in the Canadian River. Implementation of the Minimization Measures associated with the proposed ORV Management Plan may reduce the level of incidental take of ARS, when compared to existing resource management practices at LMNRA.

INCIDENTAL TAKE STATEMENT

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

The measures described below are non-discretionary, and must be undertaken by NPS so that they become binding conditions for any action, grant, or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. NPS has a continuing duty to regulate the activity covered by this incidental take statement. If NPS (1) fails to assume and implement the terms and conditions or (2) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, NPS must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement. [50 CFR §402.14(i)(3)].

Amount or Extent of Take Anticipated

Several factors may make detection of incidental take under field conditions difficult. For example, finding a dead or impaired specimen is unlikely because the species has a small body size and is difficult to detect under most conditions. Even when detected under these conditions, capture of such individuals may be unlikely. In some instances, sublethal physiological effects may be delayed or not readily apparent in captured individuals. Despite these constraints, the Service is obligated to describe the amount or extent of such anticipated incidental take based on the amount of occupied habitat that may be disturbed.

Incidental take is expected to result from the effects of recreational activities producing erosion, sedimentation, and ORV associated contaminants being introduced into the Canadian River, and ORVs driven into water where the ARS is present. Accordingly, incidental take is expected to occur in the form of harm, wounding, and/or killing. The Service anticipates that any ARS residing within the action area (Rosita Flats) could be taken as a result of the proposed action; however, the extent of take is difficult to accurately assess due to the nature of the take and the unknown abundance of the species within the action area. Therefore, take will be determined based on the description of activities expected to affect the species as described in the Biological Assessment and using habitat area as a surrogate for the species.

The ever-changing nature of the Canadian River within Rosita Flats further complicates quantifying habitat area potentially affected. The Canadian River is typically not a single, well-defined channel, but instead is comprised of a braided system of flows when enough rainfall is present. During dryer conditions, only isolated pools remain containing water. All of these conditions may vary annually depending on rainfall. Therefore, the Service estimates take may occur within a linear distance of approximately 5.5 rivermiles from the furthest upstream boundary of Rosita Flats to the Canadian River's confluence with Chicken Creek, beyond which the ARS is no longer present. The ARS has been documented downstream of 8.5 rivermiles downstream Sanford Dam but the implementation of the ORV Management Plan would not be expected to adversely affect the ARS downstream of Rosita Flats.

Effect of the take

In the accompanying biological opinion, the Service determined that the level of anticipated take is not likely to result in jeopardy to the ARS.

Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of ARS within the Action Area.

1) NPS shall develop and implement an appropriate monitoring plan for reporting progress in development of the property and implementation of the reasonable and prudent measures. Population monitoring for ARS will occur every 3-5 years, as funding permits. The content, schedule, and format of the monitoring plan will be at the discretion of the NPS, but would take place no less than once every 5 years.

2) NPS shall provide sufficient guidance to its employees and contracted employees to minimize incidental take and to ensure compliance with the Terms and Conditions in this opinion.

Terms and conditions

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

1. Parking or Staging of vehicles of any kind will be confined to areas outside the wetted channel of the Canadian River.

2. ORV use with park boundaries will be restricted to designated routes. Access to the Canadian River will be allowed only from designated access points.

3. ORV use zones will be established in Rosita Flats in two areas currently devoid of vegetation. One is south of the Canadian River and the other will be east of Bull Taco Hill. Outside these areas, ORVs would permitted only on designated, marked routes. ORVs may access the riverbed area only from marked and designated access points off the designated ORV routes.

4. A resource protection zone of approximately 1,040 acres would be established north and east of the Bull Taco Hill ORV use area to protect vegetation and reduce soil erosion. This zone would permit only vehicles with a wheel width of 64 inches or less.

5. Every two to four years, aerial photography will be used to determine if use is occurring outside of designated routes and areas.

6. Educational materials will be provided when a visitor receives an ORV use permit. These materials would include information about the prohibition of driving in isolated pools or entering and leaving the river at undesignated access points. These materials could also contain the statement "The U.S. Fish and Wildlife Service recommends during low water that ORV users do not drive in the river or isolated pools but may cross the channel when needed."

7. Four to six times per week, on-the-ground NPS law enforcement will patrol and monitor for prohibited driving in isolated pools and the wetted channel, as well as other ORV area violations. Monitoring for incidental take of ARS will occur at this time. Additional law enforcement patrols may occur as funding from ORV permits becomes available.

The Service anticipates that no more than 5.5 rivermiles of ARS habitat may be adversely affected as a result of the proposed action. These adverse effects could potentially happen annually dependent up numerous natural and human-caused elements. Reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, reinitiation of consultation will be required. NPS must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations

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

The Service recommends that NPS make efforts to ensure that instream survey monitoring for ARS within Rosita Flats continue at a frequency that would continue to provide valuable information to the scientific community, but not overly stress the local population. This information could be used to direct resource management decisions at LMNRA, as well as recovery efforts for the entire ARS population. As funding is available, efforts should be made to survey areas upstream of Rosita Flats (with landowner permission) which might be more adversely impacted in the absence of resource protections. Information on habitat conditions within this area might be useful in explaining fluctuations in ARS populations downstream in Rosita Flats.

Additional educational materials concerning ARS protection might also be provided on existing park bulletin boards and any boards or kiosks added to campground areas to further awareness of ARS conservation.

Reinitiation Notice

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

The Service appreciates the cooperation extended by NPS staff and participating parties during this consultation. If further assistance or information is required, please contact Mr. Sean Edwards or myself at the above address or telephone (817) 277-1100.

Sincerely,

Debra Bills
Field Supervisor

cc: Regional Director, FWS, Albuquerque, NM

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PERSONAL COMMUNICATIONS

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Jones, Paul. 2014. Chief Ranger – National Park Service, Lake Meredith National Recreation Area. March 20, 2014.

Jeremy Stevens. 2014. Chief Ranger – National Park Service, Lake Meredith National Recreation Area. March 20, 2014.

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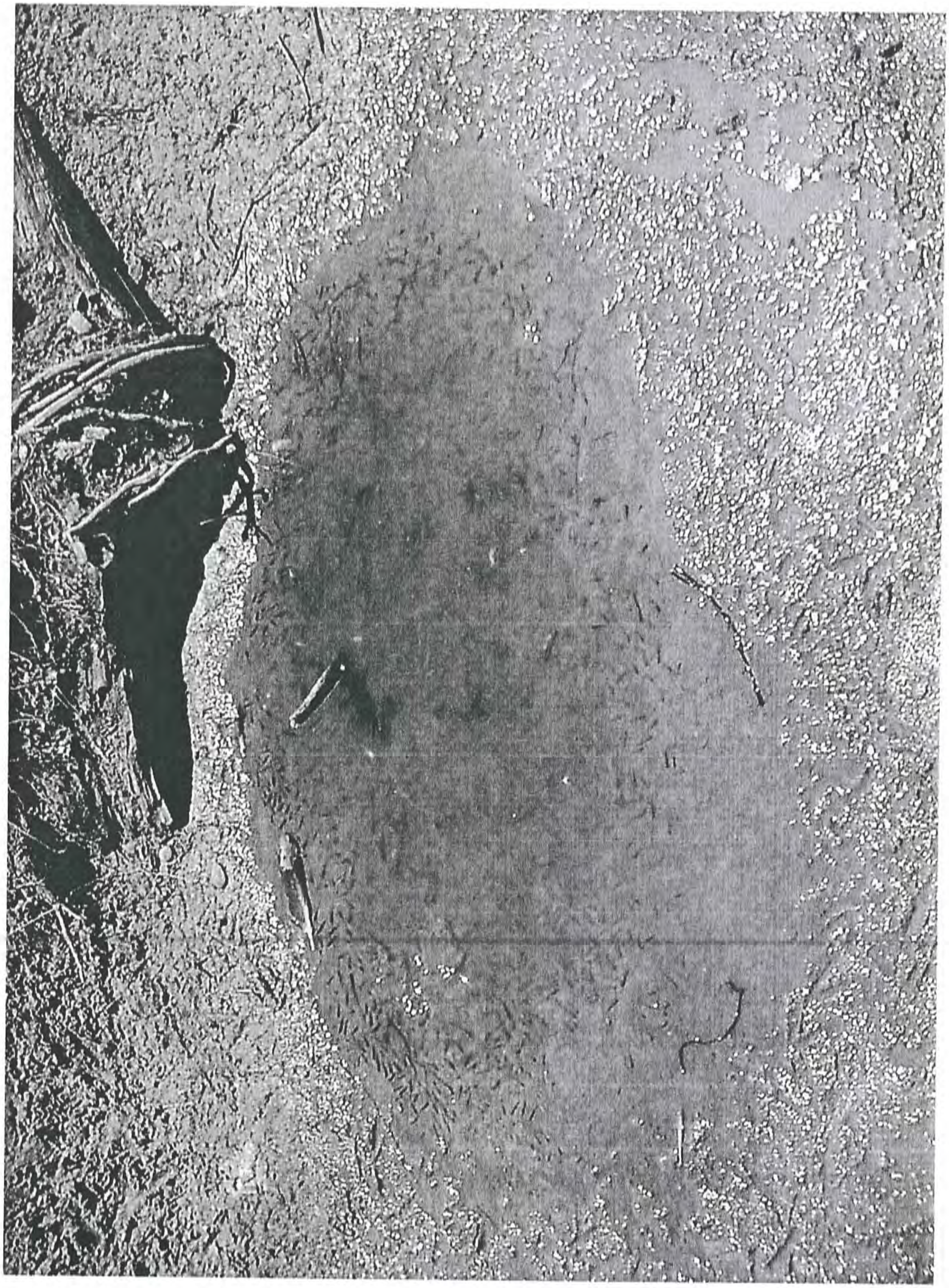
Wimer, Arlene. 2014. Chief of Resources Management – National Park Service, Lake Meredith National Recreation Area. March 19, 2014.

Appendix A

Photos of fish stranded in pools at Rosita Flats and evidence of ORV disturbances

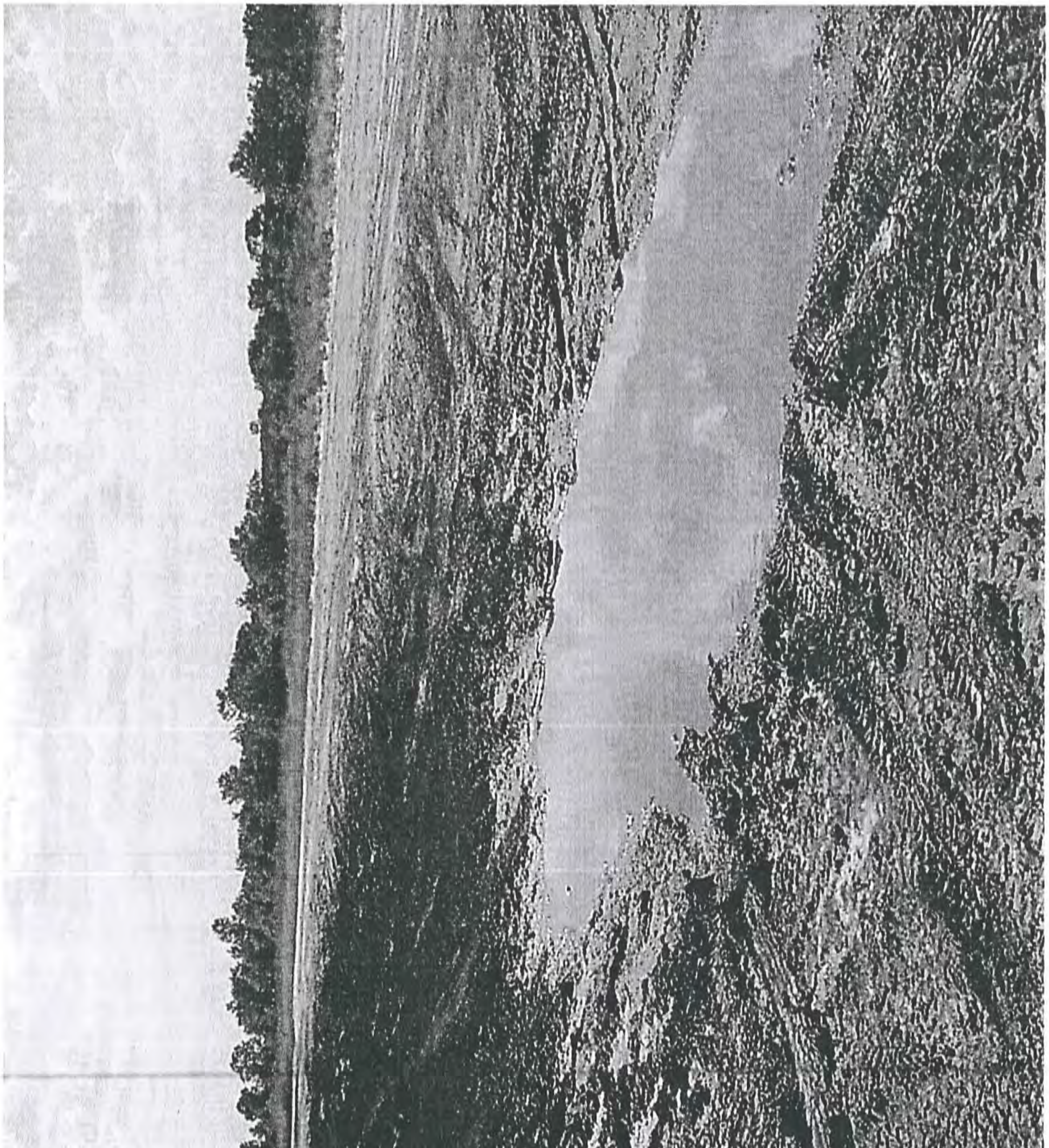
Isolated pool at Canadian River



Evidence of fish stranded in isolated pool at Canadian River

Evidence of fish stranded in isolated pool at Canadian River

Evidence of ORV traffic though isolated pool at Canadian River



Evidence of ORV traffic through isolated pool at Canadian River

Appendix B

Preliminary results of Dr. Gene Wilde's field experiment involving ORVs entering isolated pools containing fish

TEXAS TECH UNIVERSITY
Department *of*
Biological Sciences

Daniel B. Fenner
U.S. Fish and Wildlife Service
Oklahoma Ecological Services Field Office
9014 East 21st Street
Tulsa, Oklahoma 74129

5 April 2014

Dear Daniel:

We have had several discussions over the years about whether off road vehicles injure or kill fishes in the Canadian River, Texas, specifically in isolated pools in the river bed during periods of no flow. I have always believed there was a possibility that fish in pools might be affected, but didn't believe motor vehicles posed much of a hazard to fish in the flowing river. In either case, this was just an opinion.

Now, however, I have field observations and results of a quick experiment that better inform my opinion. I now believe off road vehicles, when operated in the river, do injure and kill fish. Also, I now am convinced that off road vehicles represent an important source of mortality for fishes, including Arkansas River shiner, trapped in isolated pools during periods of no flow.

In the attachment to this letter I present a few photographs and narrative that support my views.

Sincerely,

Gene R. Wilde
Professor of Fish Ecology

att.

cc: Sean Edwards
Lindsay Gillham
Arlene Wimer
Tim Birdsong

Box 43131, Lubbock, Texas 79409-3131 | T 806.742.2710 | F 806.742.2963 | **gene.wilde@ttu.edu**

Tire tracks on a sand bar, which give some indication of recent motor vehicle activity. Most of these tracks lead into or out of the river. Canadian River, upstream from US Hwy 287 bridge, north of Amarillo, Potter County, Texas. 31 March 2014.

Common carp captured while seining showing extensive bruising and loss of scales on rear half of the fish (right side). In all likelihood, these injuries are the resulted of the fish being run over by an off road vehicle. The fish was released alive. Canadian River, upstream from US Hwy 287 bridge, north of Amarillo, Potter County, Texas. 31 March 2014.

Same fish, showing injury to the left side of its body. Canadian River, upstream from US Hwy 287 bridge, north of Amarillo, Potter County, Texas. 31 March 2014.

Recently killed plains minnows picked up from the water. The injuries sustained by these fish are consistent with their being run over by an off road vehicle. Canadian River, upstream from US Hwy 287 bridge, north of Amarillo, Potter County, Texas. 31 March 2014.

Recently killed plains killifish picked up from the water. (Red arrow points to a portion of the injured area of the fish.) The fish was in relatively good condition, but its body posterior to the head and gills was crushed, presumably after being run over by an off road vehicle. Canadian River, upstream from US Hwy 287 bridge, north of Amarillo, Potter County, Texas. 31 March 2014.

I have always suspected that motor vehicles driven through pools in the river bed result in fish deaths. I had an opportunity to test this hypothesis by conducting a field experiment with Aaron Urbanczyk on 2 April 2014 on the Canadian River, upstream from US Hwy 287 bridge, north of Amarillo, Potter County, Texas.

We found a small, isolated pool (10.5-m long, 1.5-m wide, 5-cm deep) approximately 3 km upstream from the US Hwy 287 bridge. We removed, by seining, a number of small (< 30 mm TL) plains killifish and plains minnow and relocated them to another pool. We then introduced 80 large (> 35 mm TL) plains killifish, two red shiner, one plains minnow, and one western mosquitofish. We drove a truck through the pool five times, at 8 km per hour (5 mph).

After repeatedly seining the pool, we recovered 70 live plains killifish, plus all other fishes released into the pool.

Two dead plains killifish were collected by seining, one was crushed and other had internal injuries that were evidenced externally by hemorrhaging of the eye. Three plains killifish were displaced onto the bank by the outwash from the truck. Thus, we confirmed 5 fatalities due to the truck. We assume the five missing fish were crushed into the sand substrate. We estimate the mortality due to vehicular activity to be 11.8% (10/85 fish). A very conservative estimate would be 5.9% (5/85 fish). We observed mortality only among plains killifish. We believe this is because they represented 94% of fishes introduced into the pool, rather than being due to peculiarities of their behavior or biology.

Pool used in our experiment. (Note the pre-existing tire tracks through the pool.) Canadian River, 3 km upstream from the US Hwy 287 bridge. 2 April 2014.

Truck driven through pool at 8 km per hour. Canadian River, 3 km upstream from the US Hwy 287 bridge. 2 April 2014.