United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
9014 East 21st Street
Tulsa, Oklahoma 74129
918/581-7458 / (FAX) 918/581-7467

In Reply Refer To:
FWS/R2/OKES/
FWS-R2-ES-2014-F-1021

May 12, 2015

Memorandum

To: Chief, Wildlife and Sportfish Restoration Program, U. S. Fish and Wildlife Service, Albuquerque, New Mexico

From: Field Supervisor, Oklahoma Ecological Services, Tulsa, Oklahoma

Subject: Intra-Service Section 7 Biological Opinion (2014-F-1021) on the Funding of a State Wildlife Grant Regarding "An Assessment of Impacts of Bighead Carp on Species of Greatest Conservation Need in the Neosho and Spring Rivers"

This memorandum provides the U. S. Fish and Wildlife Service's (Service) intra-Service biological opinion, pursuant to section 7 of the Endangered Species Act of 1973 (16 USC 1531 et seq.), as amended (Act), on the proposed funding of a State Wildlife Grant submitted by the Oklahoma Department of Wildlife Conservation (ODWC). The Wildlife and Sportfish Restoration Program has proposed funding a research study through the State Wildlife Grants Program on the impacts of bighead carp (*Hypophthalmichthys nobilis*; previously *Aristichthys nobilis*) within Grand Lake O' The Cherokees (Grand Lake) and associated tributaries, primarily the Neosho and Spring rivers, in northeastern Oklahoma. Work also would be conducted in the Elk River provided time allows. We received your March 11, 2014, request on March 14, 2014.

The bighead carp is a non-native fish species now known to occur in Grand Lake and its major tributaries. This fish was first introduced into the United States in 1972. The impacts of this exotic species on the native fish and invertebrate fauna of northeastern Oklahoma are largely undocumented. The proposed study would attempt to document the impacts of bighead carp on these aquatic systems and seek to eradicate, or effectively control, the impacts of bighead carp. As proposed, the study would be conducted in multiple phases. The first phase would involve collection of bighead carp in the lower Neosho River primarily using fish harvest by anglers and boat mounted electrofishing technology. The fish captured would be implanted with ultrasonic tracking devices to facilitate location of bighead carp aggregations in the reservoir. The second phase of the project would involve an extensive survey of the upper Neosho and Spring rivers for aquatic species, primarily fish and mussels, of greatest conservation need. During this second phase, information on the presence, distribution, and basic population status of these fish and mussel species would be collected. Principal collection techniques would involve seining, including kick sets, underwater observation and capture using self-contained underwater breathing apparatus (SCUBA), and electrofishing. The third phase of the project will include an analysis of bighead carp movements throughout the system above Grand Lake and attempted eradication of the bighead carp from the system. Collection and eradication efforts will concentrate in areas where bighead carp are determined to congregate.

This biological opinion is based on information contained in the March 11, 2014, memorandum transmitting the request for initiation of formal consultation and the Project Statement, the Service's relevant proposed and final rules, information contained in the scientific literature, information in the Service's files and other sources of information. A complete administrative record of this consultation is on file in the Service's Oklahoma Ecological Services Field Office in Tulsa, Oklahoma. Should you have any questions regarding this consultation, please contact Ken Collins of the Oklahoma Ecological Services Field Office at (918) 382-4510.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed Federal action consists of providing federal funding to conduct a multi-stage fisheries research project in Grand Lake and the Neosho and Spring rivers above the reservoir in Oklahoma. A primary objective of the study would be to document the abundance and distribution of the bighead carp in Grand Lake and its principal tributaries. The bighead carp is an exotic, invasive fish species native to Asia (Schofield *et al.* 2005) that potentially may be impacting native aquatic Species of Greatest Conservation Need (SGCN) in the Neosho and Spring rivers and their tributaries (ODWC 2005). Bighead carp are sexually dimorphic and may reach sizes that exceed 1 meter total length and over 50 kilograms in weight (Schofield *et al.* 2005). Establishment of invasive, exotic species, such as bighead carp and zebra mussels, is an important conservation concern, particularly where they may impact native freshwater mussel, fish, and plant populations (ODWC 2005). Management of the bighead carp is specifically addressed in the Oklahoma Aquatic Nuisance Species Management Plan (Foster *et al.* 2009).

Adult bighead carp are opportunistic filter feeders that primarily consume phytoplankton (Schofield *et al.* 2005) but the larvae are zooplanktivorous and have the potential to directly compete with specific life stages of many aquatic SGCN. For example, all life stages of paddlefish (*Polyodon spathula*; tier III species; ODWC 2005, Schrank *et al.* 2003) and rare freshwater mussels such as the butterfly (*Ellipsaria lineolata*), Ouachita kidneyshell (*Ptychobranchus occidentalis*), rabbitsfoot, Neosho mucket and western fanshell (*Cyprogenia aberti*) (tier I species; ODWC 2005) may be impacted. Additionally, juvenile life stages of fish species that rely on planktonic algae for food, such as the cardinal shiner (*Luxilus cardinalis*), redspot chub (*Nocomis asper*), Ozark minnow (*Notropis nubilis*), and wedgespot shiner (*Notropis greenei*) (tier I & II species; ODWC 2005) also may be impacted by the presence of bighead carp.

Bighead carp were first documented from Grand Lake in 1992 (Pigg *et al.* 1993) and, according to ODWC, limited numbers of individuals are routinely snagged by anglers during the annual paddlefish spawning migrations. Bighead carp now are detected annually and the population appears to be expanding. Based on age estimates of large specimens (*e.g.*, Long and Nealis 2011) and habitat suitability assessments (Long *et al.* 2012), bighead carp are likely to be reproducing in the Grand Lake system, but specific occurrences have not been documented. The proposed study would provide needed detail on the distribution, abundance and ecology of the bighead carp in the Grand Lake system and assist biologists in efforts to eradicate bighead carp.

The third stage of this project will consist of an analysis of bighead carp movements throughout the system and an attempted eradication effort which will be conducted to remove bighead carp. Removal of the bighead carp is expected to reduce stresses that may exist on native SGCN from this invasive species. The third stage would consist of electrofishing and gill-netting in unidentified portions of the Neosho or Spring rivers or possibly Grand Lake. The precise locations will depend on results from ongoing research, particularly data obtained during tracking of bighead carp throughout the system. If a consistent movement pattern can be documented and these fish are congregating at a particular location or season, eradication efforts will be targeted at those locations or within that season. Eradication efforts will include electrofishing and gill-netting surveys at targeted bighead carp spawning locations throughout the Neosho and Spring river systems in Oklahoma. After studying the biology and gathering a better understanding of the annual movement, abundance, and spawning nature of this population in the Grand River system, conservation actions will take place as an end result to this project.

Field work is anticipated to conclude by December of 2017. Annual and final performance reports will be prepared and include location data for all individual bighead carp that were tracked (approximately N = 10) according to month and year, as well as data on catch (number, summaries of size (length and weight) and age frequencies, sex ratios, catch-per-unit-effort) for fish captured. The final report will be compiled during the last 6-month portion of the study period.

Action Area

The action area encompasses portions of Grand Lake and its two major tributaries, the Neosho and Spring rivers, in Oklahoma. Below the confluence of the Neosho and Spring rivers, which has been inundated by impoundment of Grand Lake, the two rivers merge to form the Grand River which flows into the Arkansas River near Muskogee, Oklahoma. Pensacola Dam impounds Grand Lake at rkm 124 (rmi 77.0), which extends about 88 km (55 mi) up the Grand (Neosho) River. The total drainage area, as measured at Pensacola Dam is 26,671.7 km^2 (10,298 mi^2). The reservoir has been in operation since 1941. The 18,817-surface hectare (46,500-acre) reservoir covers portions of four Oklahoma counties: Mayes, Delaware, Craig, and Ottawa, and is owned and operated by the Grand River Dam Authority (GRDA). Grand Lake provides hydropower generation from six 20,000-horsepower Francis Turbines and has a mean depth of 10.9 m (35.9 ft). The GRDA owns title to a line representing the 750-foot Pensacola Datum (PD) or 748.93 feet National Geodetic Vertical Datum (NGVD) contour. The Tulsa District Corps of Engineers (USACE) has authority over the Grand Lake flood control operation. The USACE has flowage easements up to 757 feet PD (755.93 feet NGVD) for much of the shoreline and higher in the upper reaches of the reservoir. Most of the remaining lakeshore property above these elevations was sold and developed into commercial, recreational, and residential sites.

Grand Lake is one of the most popular recreational areas in northeastern Oklahoma, and most of the shoreline above GRDA control is in private ownership. Consequently, numerous residences and businesses have been constructed adjacent to the reservoir. Nonpoint runoff containing lawn and agricultural chemicals (pesticides and fertilizers) and from agricultural activities (feedlots and poultry houses) and septic tanks influence water quality in the reservoir. Average annual precipitation in the Neosho Basin varies from about 89 centimeters (cm; 35 inches (in)) near John Redmond Reservoir to 109 cm (43 in) near Miami, Oklahoma. Most of the precipitation falls during the late spring through early summer (USACE 2013).

early as 1875 (Juracek 1999b). The primary purpose of these low-head dams is to provide water supply to local municipalities. Information on water withdrawals/diversions, evapotranspiration and return flows from municipal sources in the upper Neosho River drainage, as of December 1980, was summarized in Carswell and Hart (1985). The presence of these low-head dams likely impedes movements by Neosho madtoms, at least during certain times of the year.

Several smaller public impoundments also exist within the Neosho basin: Lake Council Grove (434 acres), Lake Kahola (203 acres), Olpe City Lake (90 acres), Iola City Lake (19 acres), Gridley Lake (30 acres), Bartlett City Lake (13 acres), Altamont City Lake #1 (17 acres), Altamont City Lake #2 (27 acres), Thayer City Lake (30 acres), Lake Parsons (825 acres), Yates Center Old Reservoir (South Owl Lake (115 acres)) and Neosho Falls City Lake (4 acres). Within the Cottonwood River subbasin public impounments include: Marion County Lake (153 acres) and Cottonwood Park Ponds (16 acres).

The Kansas Department of Wildlife, Parks and Tourism administers four public aquatic areas in the basin: Chase County State Fishing Lake (109 acres), Neosho State Fishing Lake (92 acres), Neosho Waterfowl Management Area (1,390 acres), and the Cherokee County Strip Pits (3,000 acres cumulatively). Additionally, the entire Neosho River Basin contains at least 13,838 private agricultural ponds, totaling 8,459 ha (20,902 acres) (Service 2013a).

A 6,400-km^2 (2,500-mi^2) portion of the watershed above Grand Lake, predominantly in the Spring River drainage, is within an area known as the Tri-State Mining District (Pope 2005, Angelo *et al.* 2007). This area was designated as a superfund hazardous waste site (EPA National Priorities List for clean-up), pursuant to the Comprehensive Environmental Response, Compensation and Liability Act, in 1983 (Pope 2005). The Tri-State Mining District superfund site encompasses portions of southeastern Kansas, southwestern Missouri and northeastern Oklahoma (Spruill 1987). Commercial mining and ore processing in the area began after the Civil War, and from 1918 to 1945 the Tri-state Mining District was the leading producer of lead and zinc in the United States. Mining and ore processing in the area ceased about 1970 (Spruill 1987) but numerous mine shafts and many hundreds of miles of underground tunnels, along with several million tons of mine tailings remained. During active mining of the region, water was pumped from mined areas but pumping ceased when active mining ceased (Spruill 1987, Pope 2005). Discharge of metals-laden, acidic mine (subsurface) water into adjacent surface streams was first documented in 1979 but contamination of surface waters from mine wastes (tailings and other sources) likely occurred during much of the commercially active mining period (Spruill 1987, Pope 2005).

As a result of the mining operations, portions of the Neosho and Spring rivers and their tributaries have been contaminated by heavy metals (*e.g.*, zinc, lead, cadmium) from discarded mine tailings within the Tri-State Mining District (Spruill 1987, Wildhaber *et al.* 2000b). Cadmium and zinc are known to be highly toxic to many freshwater organisms. The Neosho madtom recovery plan (Service 1991) identified the need to assess the impacts of mine wastes entering the Spring River through land surface runoff. The range of the Neosho madtom in the Spring River watershed is coincident with areas subject to historical lead and zinc mining (Allen *et al.* 2001, Kiner *et al.* 1997, Schmitt 2013). Metal concentrations, primarily lead and zinc, in the Neosho River are much lower than those found in the Spring River and its tributaries (Center and Turkey creeks), that receive runoff from mining areas (Smith 1988, Allen *et al.* 2001). Other studies documented that fishes of the Spring River, including the Neosho madtom, are limited by

Distribution

The Neosho madtom occurs primarily in the mainstems of the Cottonwood, Neosho and Spring rivers in Kansas, Missouri, and Oklahoma. Historically, the Neosho madtom was reported from the mainstem Neosho River and several of its larger tributaries, including the Illinois River in Oklahoma. The irreversible loss of up to one-third of the Neosho madtom's former range, particularly the Grand and Illinois rivers in Oklahoma, due to habitat alteration (impoundment) in Oklahoma was cited as a primary factor in listing the species (Service 1990).

This fish presently occurs throughout most of the mainstem Cottonwood and Neosho rivers in Kansas, with fewer records from the Neosho River in northern Oklahoma, as far downstream as Miami (Moss 1981, Wagner *et al.* 1984). A scarcity of uncompacted gravel substrates, preferred habitat of Neosho madtoms, appears to limit abundance and distribution of Neosho madtoms in Oklahoma (Luttrell *et al.* 1992). Records of the Neosho madtom from smaller tributaries of the Neosho and Spring rivers are rare. Ernsting *et al.* (1989) documented the occurrence of the Neosho madtom from Lightning Creek, a small tributary of the Neosho River in Cherokee County, Kansas. In 1996, the species was discovered in the South Fork of the Cottonwood River as a small but apparently reproducing population (Wilkinson and Fuselier 1997). Surveys by Luttrell *et al.* (1992) did not observe Neosho madtoms from any of the eight smaller Neosho River tributaries in Oklahoma.

The Neosho madtom also occurs in the Spring River in Kansas, Missouri, and Oklahoma although historical records are scarce (Branson *et al.* 1969, Pflieger 1975, Moss 1981, Wagner *et al.* 1984, Wilkinson *et al.* 1996). Branson *et al.* (1969) did reportedly capture two individuals from Spring River tributaries; one individual was collected in Shoal Creek northeast of Baxter Springs and another individual was captured in a tributary that cannot be positively identified, based on information contained in Branson (1966). More recent extensive surveys of 106 sites in the Spring River captured Neosho madtoms from 24 locations in Kansas and Missouri (Wilkinson *et al.* 1996). Although Neosho madtoms were captured from the Spring River downstream of Empire Lake, no Neosho madtoms were captured in Oklahoma. Fifteen of the sites represented new collection localities for the species (Wilkinson *et al.* 1996). In 2006, the Peoria Tribe of Indians captured a single Neosho madtom from the Spring River near Quapaw, Oklahoma. The following year, the Service collected a single individual from the same general area. Another single individual was collected by the Service and Peoria Tribe from the same area in 2012, perhaps indicating a persistent but extremely low density population in the upper Spring River in Oklahoma. Schmitt (2013) concluded that the Neosho madtom was likely more widespread in the Spring River drainage prior to initiation of mining within the Tri-State Mining district. The present limited geographic distribution of Neosho madtoms leaves the species susceptible to a widespread catastrophic impact that could cause a rangewide reduction in population size.

Life History

In the wild, the Neosho madtom is a very short-lived fish, likely reproducing only once (*i.e.*, semelparous) during its short life span; however, known-age fish have lived up to eight years in the laboratory (Fuselier and Edds 1994, Bulger and Edds 2001, Bryan *et al.* 2006, Davis and Paukert 2008,Wildhaber 2011). Fuselier and Edds (1994, 1995) and Bulger and Edds (2001) documented the occurrence of two age classes during late summer: young-of-the-year and age-1 adequate assessment of breeding biology in the field is not feasible. Recent efforts to spawn Neosho madtoms in captivity have expanded our understanding of the reproductive cycle of the species.

Moss (1981) and Wildhaber *et al.* (2000a) reported that reproduction likely takes place during May and June high flow events, possibly during the largest floods. Capture of gravid females typically occurs in May, with young-of-the-year fish evident in August, suggesting reproduction may be coincident with these early summer peak flows. Similarly, Albers and Wildhaber (2002) believed Neosho madtoms likely spawn from May through July when water temperatures approach 25°C (77°F). Fuselier and Edds (1994) hypothesized that Neosho madtoms utilize the head or crest of riffles for spawning where presence of larger substrates provides ample opportunities for excavation of spawning cavities. Cochran (1996) identified cavity utilization during spawning as a common characteristic of several madtom species. Laboratory studies have confirmed that Neosho madtoms excavate nest cavities within the gravel substrates under large objects and that spawning occurs at temperatures between 21 and 28 °C (Bulger *et al.* 2002a, Bryan *et al.* 2005, Bryan *et al.* 2006). Both sexes play a role in cavity enhancement/nest building but males participate substantially more than females (Bryan *et al.* 2006). In other madtoms, the eggs and young are often guarded by a parent. Bulger *et al.* (2002a) observed that males guarded the eggs for 8-9 days post-spawning and appeared to tend to the young for another 8-10 days. They also observed that Neosho madtoms may limit or refrain from feeding during the spawning period.

Pfingsten and Edds (1994) reported on the first attempts to spawn Neosho madtoms in captivity. They observed a single clutch of 63 eggs, the water hardened eggs having an average diameter of 3.1 mm. Individual egg size varied from 2.9 to 3.5 mm in diameter (Pfingsten and Edds 1994). None of these eggs hatched, likely because they were never fertilized. The eggs became infected with a white fungus and by the third day, the fungus had infected about 75 percent of the eggs. Bulger *et al.* (2002a) reported observing clutches of 60, 32 and 30 eggs. Bryan *et al.* (2005) used ultrasound techniques to estimate fecundity (number of eggs) in Neosho madtoms. Although mean egg diameter did not vary significantly between years or individual fish, fecundity increased each year as fish grew in total length, a common relationship in longer lived ictalurid species. Average estimated fecundity over the study period increased from 121 in the first year, to 210 in the second, and 234 in the third year (Bryan *et al.* 2005). Average clutch size in the summer of 2001 was 230 eggs and average estimated fecundity was 246 eggs. Average egg diameter was 3.5 mm. However, the fish used in that study were larger than have ever been observed in the wild so the reported fecundities are likely higher than typically would be expected (Bryan *et al.* 2005).

Bulger *et al.* (2002a) reported on two instances of successful hatching of Neosho madtom eggs in captivity. The eggs hatched after about 8-9 days and the yolk sacs were absorbed after another 8-10 days. Mean length of the larvae at hatching was 6.82 mm in 1996 and 8.8 mm in 1998. Neosho madtoms appear capable of producing multiple clutches in a single season but the incidence of multiple clutches is unknown. The possibility of multiple clutches may indicate that the Neosho madtom has a polyandrous mating strategy, as observed in other species of madtoms, but this mating strategy has not been confirmed for the Neosho madtom (Bulger *et al.* 2002a).

Bulger *et al.* (2002b) specifically examined the importance of day length as a cue in triggering reproduction of Neosho madtoms. Bulger *et al.* (2002b) demonstrated the importance of

Dams and associated reservoirs are known to alter stream hydrology and flows, impact channel geomorphology and trap bedload, alter water quality, alter fish communities and impede movements of stream fishes, and destroy habitat (*i.e.*, riffles) by inundation. Observations by Wildhaber *et al.* (2000a) suggest that many such alterations have occurred in the Neosho River post-construction of John Redmond Dam. Additionally, no individual Neosho madtoms have been captured from a reservoir, and inundation of habitat is presumed to have caused local extirpations (Moss 1981, Wagner *et al.* 1984). All three of the main stem reservoirs in Kansas exert a direct control over the flow regime in their respective rivers, with a combined effect downstream of John Redmond dam. Because flood control is a primary function of these reservoirs, peak instream flows are reduced or eliminated following precipitation events, and there is a prolonged period of higher flows as the additional stored water is released over several weeks, rather than a few days (Studley 1996). However, Juracek (1999a) determined that overall physical channel response to the altered stream flow regime and sediment load introduced below John Redmond Dam was minor. There was some localized channel widening, but little post-dam change in bank-full channel width. In-stream habitat alterations caused by the operation of John Redmond Dam, as documented by Wildhaber *et al.* (2000a) likely exert a negative influence on Neosho madtom reproduction, population growth, habitat creation, and colonization of new areas.

Tiemann *et al.* (2004a) examined the effects of existing low-head dams on Neosho madtoms. Generally areas above the dams were deeper and had lower water velocities than reference sites and areas below the dams were generally shallower and had higher velocities than reference sites. Substrates were more compact both above and below the dams than at the reference sites. Neosho madtoms tended to have lower abundance (*i.e.*, density) directly above and below the dam sites than at the reference sites, with densities downstream of the dams more reduced than that measured at other sites. Macroinvertebrate density, an indication of the abundance of food items used by Neosho madtoms, was lowest immediately downstream of the dams primarily due to presence of greater abundance of bedrock substrates below the dams (Tiemann *et al.* 2004a). In particular, the abundance of mayflies, caddisflies and stoneflies was influenced by the presence of low-head dams (Tiemann *et al.* 2005).

Wolf Creek Lake, a 2059-ha (5,090-acre) man-made impoundment on a direct tributary to the Neosho River in Coffey County near John Redmond Reservoir is owned and operated by the Wolf Creek Nuclear Operating Corporation. This lake is used as a source of cooling water for the Wolf Creek Generating Station, a nuclear electric generating facility. The confluence of Wolf Creek with the Neosho River occurs approximately 10 river miles downstream from John Redmond Reservoir dam. Direct transfers of water from John Redmond Reservoir to Wolf Creek Lake, and subsequent discharges of water from Wolf Creek Lake, are subject to the cooling needs of the facility. The main threat from plant operations is the timing of the withdrawals of water from the Neosho River for plant cooling operations, and their combined effects with possible future drought conditions (Service 2013b).

Several substantive bank stabilization projects have been completed within the Neosho River basin in Allen, Lyon, and Neosho Counties, Kansas. These projects impacted Neosho madtom habitat (Service 2013a) and any future bank stabilization projects in the Neosho or Spring rivers would be expected to have similar impacts.

in combination with existing habitat fragmentation could exacerbate the known effects of drought on Neosho madtoms.

Historically, removal of river gravel for commercial uses was an ongoing activity in the Neosho and Cottonwood basins, and this activity has the potential for removing usable madtom habitat as well as harming individual fish directly. Responding to these concerns, the Kansas Department of Wildlife and Parks (now Kansas Department of Wildlife, Parks and Tourism; KDWPT) in 1991 enacted a moratorium on issuing State permits for this activity in Neosho madtom habitat. The State rescinded its moratorium in 1995, contingent upon permit applicants also acquiring necessary Clean Water Act section 404 permits and receiving Service approval. Mining of river gravel by "scalping" is an ongoing activity in the Neosho River drainage although no significant differences in Neosho madtom density were detected between mined (scalped) and non-mined sites (Davis and Paukert 2008). Scalping involves removal of gravel from portions of bars exposed above the water line. Average annual gravel mining over the 11 years of their study was 557 m^3 (19,670 ft^3) (Davis and Paukert 2008). In-channel gravel mining/dredging likely degrades or eliminates habitat used by madtoms and other stream fishes (Forshage and Carter 1973, Kanehl and Lyons 1992, Brown *et al.* 1998). Additionally gravel scalping may impact Neosho madtoms and other fishes where gravel removal causes a reduction in the transport of bedload material such that downstream habitat conditions are altered. The action of removal of gravel from bank-side deposits (scalping) without disruption of gravel within the wetted area of the stream is presently an unregulated activity by the USACE, and occurs throughout the basin at varying intensities (Davis and Paukert 2008).

Competition with other benthic stream fishes does not appear to limit abundance of Neosho madtoms (Wildhaber *et al.* 1999a, Tiemann *et al.* 2004b). Because Neosho madtoms are nocturnal, they likely are not in direct competition for food items with fishes that are primarily active during the day (Burr and Stoeckel 1999). Predation and disease are not currently known to have contributed to the decline of Neosho madtoms.

Densities (number per unit area) of Neosho madtoms are highly variable but are likely to be highest during the late summer/early fall period when young-of-the-year fish are recruited into the population. Bryan *et al.* (2010; see their Table 1) reported on trends in average madtom densities within the Cottonwood, Neosho and Spring rivers based on data collections from 1991 to 2008, including data collected by the Service and others. Several other studies have provided estimates of Neosho madtom dens[illegible] literature is summarized below.

Table 2
Bryan not
table 1

In the Spring River, Wilkinson *et* [illegible] timates from several sites. Allert *et al.* (1997) also estimated Neosh[illegible]) in the Spring River. Bryan *et al.* (2010) reported on trends in av[illegible] the Cottonwood, Neosho and Spring rivers based on data collect[illegible]ding data collected by the Service. A continuing decline in [illegible]ach of Neosho River downstream of Redmond Dam from 1999 to 2[illegible]ensities since 2007. Overall, Neosho madtom density tends to be highest in the Neosho and Cottonwood rivers above John Redmond Reservoir (0.198/m^2) and lowest in the Spring River (0.033/m^2) upstream of the Turkey Creek confluence (Wildhaber *et al.* 2000a, 2000b).

Additional estimates of density are provided in Wenke *et al.* (1992) for late winter (0.021 to 0.125/m^2), Wildhaber *et al.* (1999a) in late summer/early fall (0.033/m^2) and in Tiemann *et al.*

Spring River is considered stable and viable, based on the presence of a large number of individuals and evidence of recent recruitment.

Life History

Neosho mucket life history is generally similar to that of many other freshwater mussels. Freshwater mussels are relatively sedentary animals and typically live embedded in the bottom substrate of rivers and other water bodies. They siphon water into their shells and across four gills that are specialized for respiration and food collection. Food items include detritus, bacteria, algae, and microscopic animals. Juveniles typically burrow completely below the substrate surface and use their foot to bring food particles into the shell for digestion until the structures used in filter feeding become more developed. During breeding, the males release sperm into the water column. The sperm is then drawn in by females through their siphons during feeding and respiration. Fertilization occurs inside the shell. The fertilized eggs are brooded in a pouch (marsupium) formed by the gills of the female until they develop into mature larvae. Once mature, the larvae, called glochidia, are released into the water column. The glochidia are parasitic and must attach (encyst) to the gills, fins or skin of a specific host fish until they transform into a juvenile mussel. When transformation is complete, the juveniles will drop from their fish host and sink to the bottom where they will grow and mature into adults. Once encysted, the duration of the parasitic stage varies by mussel species, water temperature and host species. Mussels tend to grow rapidly for the first few years of life but growth slows considerably as the individuals mature. Heavy-shelled species, such as the Neosho mucket, typically grow more slowly than do thin-shelled species. Freshwater mussels prefer areas of stable substrates where they may persist in the same location over their life span.

Habitat and Food Habits- the Neosho mucket is an obligate riverine species preferring clean, shallow (< 1 meter; 3.3 feet) riffles and runs comprised of fine to medium sized gravel substrate and moderate to swift currents. In portions of its range (*e.g.*, the Illinois River), the species is most successful in certain near-shore areas and areas out of the main current. Although little is known of the specific habitat requirements for the Neosho mucket, they are known to require relatively clean flowing water over much of their annual cycle, geomorphically stable river channels and banks with suitable substrate, adequate food, the presence and abundance of fish hosts, adequate water and sediment quality, and few or no competitive or predaceous invasive (nonnative) species.

Reproduction- The Neosho mucket is a bradytictic breeder, spawning in late April through May with brooding occurring in May through August. The females use a mantle lure to attract potential fish hosts. Neosho mucket glochidia are obligate parasites on smallmouth (*Micropterus dolomieu*), largemouth (*M. salmoides*) and spotted bass (*M. punctulatus*).

Status of the Species

Based on historical and current data, the Neosho mucket has been extirpated from approximately 1,342 rkm (834 rmi) of its historical range (62 percent). The compilation of current distribution, abundance, and status trend information demonstrates that the Neosho mucket has experienced range reductions and population declines throughout its range.

Critical Habitat

Approximately 777 river kilometers (rkm) (483 river miles (rmi)) of critical habitat has been designated for the Neosho mucket in the Elk, Fall, Illinois, Neosho, Shoal, Spring, North Fork Spring, and Verdigris rivers in Arkansas, Kansas, Missouri, and Oklahoma (80 FR 24693). Specifically critical habitat has been designated in Benton and Washington counties, Arkansas; Allen, Cherokee, Coffey, Elk, Greenwood, Labette, Montgomery, Neosho, Wilson, and Woodson counties, Kansas; Jasper, Lawrence, McDonald, and Newton counties, Missouri; and Adair, Cherokee, and Delaware counties, Oklahoma. In Oklahoma, critical habitat is designated in the Illinois River (Unit NM1) and the Elk River (Unit NM 2).

The primary constituent elements associated with Neosho mucket critical habitat, as provided by Service (2013c) in 80 FR 24693, are:

(1) Geomorphically stable river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as, stable riffles, sometimes with runs, and mid-channel island habitats that provide flow refuges consisting of gravel and sand substrates with low to moderate amounts of fine sediment and attached filamentous algae).

(2) A hydrologic flow regime (the severity, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussel's and fish host's habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.

(3) Water and sediment quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.

(4) The occurrence of natural fish assemblages, reflected by fish species richness, relative abundance, and community composition, for each inhabited river or creek that will serve as an indication of appropriate presence and abundance of fish hosts necessary for recruitment of the Neosho mucket and rabbitsfoot. Suitable fish hosts for Neosho mucket glochidia include smallmouth bass, largemouth bass and spotted bass.

(5) Competitive or predaceous invasive (nonnative) species in quantities low enough to have minimal effect on survival of freshwater mussels.

ENVIRONMENTAL BASELINE

The environmental baseline, as defined in 50 CFR 402.02, focuses on the action area and includes past and present impacts of all Federal, state, or private actions in the action area; the anticipated impacts of all proposed Federal actions in the action area that have already undergone formal or early section 7 consultation; and the impact of state and private actions within the action area which are contemporaneous with the consultation in progress. The environmental

In November 2004, a "no jeopardy" biological opinion was issued to the Federal Emergency Management Agency for the funding of a large bank stabilization project on the Neosho River in Neosho County, Kansas. The amount of incidental take that was anticipated was not quantifiable.

In August 2007, a "no jeopardy" biological opinion with incidental take was issued to the Service regarding funding of a fish and aquatic habitat survey in eastern Oklahoma through the Sport Fish Restoration Program of the Division of Federal Aid. The Service estimated that up to 36 Neosho madtoms could be taken annually over the 5 year duration of the project. The Neosho River portion of this project was completed in 2009 and no Neosho madtoms were observed. All of the sampling sites were located downstream of Miami, Oklahoma in unfavorable habitat.

A "no jeopardy" biological opinion was issued to the EPA for funding a large-scale bank stabilization project on the Neosho River upstream of John Redmond Reservoir in January 2010.

In July 2011, two separate "no jeopardy" biological opinions were issued. One involved USACE authorization for a small bank stabilization project on the Cottonwood River in Chase County, Kansas; and the other to the FHWA for the construction of a new bridge over the Neosho River in Neosho County, Kansas.

On January 25, 2012, the Service issued a "no jeopardy" biological opinion to the FHWA regarding replacement of a county road bridge (EW-60) over the Neosho River near Commerce, Oklahoma. This project involved replacement of an existing bridge on a new alignment in the vicinity of Stepp's Ford. The old bridge was deemed structurally deficient and now has largely been removed in accordance with project plans. Incidental take associated with the project was estimated to be 104 individual madtoms. The consultation was later amended to address changes in the design of the proposed structure and anticipated impacts to the Neosho mucket. The project is currently underway with completion expected in the fall of 2015.

In September 2013, a "no jeopardy" biological opinion with incidental take (unquantified) was issued to the USACE for a stream bank rehabilitation project authorized under a Clean Water Act section 404 permit. The project involved stabilization and rehabilitation of approximately 4.8 km (3 miles) of actively eroding streambank, consisting of 25 sites of active erosion (hotspots), along a 32.2 km (20 mile) reach of the Cottonwood River in Lyon County, Kansas.

Although not a formal consultation, the Nuclear Regulatory Commission (NRC) and the Service recently (2012) concluded informal section 7 consultation regarding relicensing of the Wolf Creek generating facility. The main threat from plant operations is the timing of the withdrawals of water from the Neosho River for plant cooling operations, and their combined effects with possible future drought conditions. As a result of the consultation, the plant operator and the NRC have agreed to withdraw water during periods of high stream flow and maintain the plant's cooling lake at high levels to avoid withdrawing water during low flow or drought conditions.

Conservation Efforts

Various conservation efforts currently are ongoing for the benefit of the Neosho madtom and Neosho mucket and are briefly summarized below. Joint efforts that are ongoing in multiple States also are summarized.

The Neosho madtom and Neosho mucket mussel do not occur in the impounded portions of Grand Lake and proposed activites in Grand Lake are not expected to have an impact on these species. Reservoirs alter the habitat used by these species by creating deeper water conditions, changing flow regimes and facilitating sediment deposition on the gravel substrates preferred by these species. Currently the distributions of these species are limited to the flowing, unimpounded portions of the Neosho and Spring rivers above Grand Lake.

Neosho madtom

In Oklahoma, the Neosho madtom is known to occur in suitable habitat throughout the unimpounded reaches of the Neosho River above Grand Lake and a small portion of the Spring River from near Quapaw, Oklahoma, upstream to the Kansas State line. The species had not been captured from the Spring River downstream of Empire Lake in Cherokee County, Kansas, until 1994 when several individuals were captured near Baxter Springs, Kansas. Wilkinson *et al.* (1996) reported on Neosho madtom distribution and abundance in the Spring River, including at 14 sites in Oklahoma. They failed to collect Neosho madtoms from any of the sites in Oklahoma. Then in 2007, a single Neosho madtom was captured in the Spring River from near Quapaw, Oklahoma, by biologists representing the Peoria Tribe. Another single Neosho madtom was captured later that year by Service biologists near the same site. Then in 2012, during nighttime sampling by the Service and Peoria Tribe another single individual was captured at the same general location. Repeated surveys in the Spring River have not documented Neosho madtoms downstream of the Quapaw area although they may still persist in much reduced numbers. Substrate particle size in the Spring River tends to be coarser than that in the Neosho River (Wildhaber *et al.* 1999b).

Luttrell *et al.* (1992) reported Neosho madtoms at several sites in the Neosho River in Oklahoma, including several sites downstream of Stepps Ford. However no Neosho madtoms were found in any of the main tributaries to the Neosho River above Grand Lake in Oklahoma. Luttrell *et al.* (1992) concluded that a lack of preferred habitat limited Neosho madtom distribution and abundance in the Oklahoma portions of the Neosho River.

Surveys by the Service, Peoria Tribe and USACE in the lower reaches of the Neosho River (between the fairgrounds in Miami upstream to Stepps Ford) during 2010 observed Neosho madtoms on almost every gravel bar (17) within the sampled reach (Ken Collins, Service, unpublished data). Although no adults were captured, juveniles (young-of-the-year) were present in the shallow water habitat adjacent (1-2 m offshore) to gravel bars, as described in Moss (1981).

Neosho mucket

The Neosho mucket is extremely rare in the Oklahoma portions of the Neosho and Spring rivers. The Service has found relict shells of the species, in low densities, at Oklahoma sites of both rivers, during the period of 1993 to 2012 (Oklahoma ESFO, unpublished data). In 2014, surveyors from the Peoria Tribe found a single living Neosho mucket in the Neosho River at Stepp's Ford (Peoria Tribe 2014). To avoid adverse effects from future bridge construction at the ford, the Neosho mucket found was relocated to a suitable site approximately one mile upstream. Also, in 2011, surveyors from the Oklahoma Biological Survey found one living Neosho mucket in the Spring River upstream of the State Highway 10 bridge (Atkinson 2011).

portions of the lower Neosho and Spring River drainages. Gravel mining is not a significant activity within the action area but does occur in limited amounts. Gravel mining is a more significant concern upstream of the action area. However, gravel mining can result in elimination of mussel populations under certain conditions.

Oil and gas development in the action area is relatively minor although there is at least one pipeline crossing within the Neosho River just downstream of Stepp's Ford and another within the Spring River immediately upstream of the confluence of Warren Branch. Neither species are commercially valuable and collections, other than for scientific purposes, are not expected to occur. Muskrats (*Ondatra zibethicus*), river otters (*Lontra canadensis*), and raccoons (*Procyon lotor*) are expected to exert a small, localized and perhaps only seasonal predation pressure on both species. Additionally some predation of the Neosho madtom by other fishes undoubtedly occurs but the extent is not known. Neither species are expected to be significantly impacted by predation within the action area.

EFFECTS OF THE ACTION

"Effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). Direct effects are considered immediate effects of the project on the species or its habitat. Indirect effects are those caused by the proposed action and are later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consultation. The effects of the action are added to the environmental baseline to determine the future baseline and to form the basis for the determination in this opinion.

The proposed project is anticipated to result in only minor, temporary impacts to the affected species. The only long-term or permanent impacts which may be expected relate to the possible eradication of the bighead carp from the Neosho and Spring rivers. If eradication is not successful, then this impact is expected to be short-term in duration as well. However, the eradication of bighead carp is likely to be neutral or slightly beneficial for the Neosho madtom and entirely beneficial for the Neosho mucket.

Temporary impacts would consist of minor, localized disturbance of the stream-bed during collection efforts that may lead to some localized releases of deposited sediment. Additionally some capture and handling of the target organisms would occur that my cause harm, injury and perhaps occasionally death of madtoms and mussels. Measures to minimize these impacts have been proposed as a part of this project and are described below. Collection activities that occur during the spawning season may alter or destroy nests, eggs or young Neosho madtoms.

No stream flow alteration is anticipated as a part of this action. Habitat alteration is expected to be confined to the relatively small area sampled and likely would be a very small percentage of the available habitat. The physical damage expected during collection efforts would likely only disturb the upper 0.1 m (6 in) of the substrate. This disturbance is expected to be of short duration. However, application of electrical current during collection efforts in the Elk River, should that occur, may cause mortality or physical damage to target organisms. Physical damage to fishes from electrofishing can include respiratory arrest, fractured vertebrae, curvature of the within the occupied range of these species in Oklahoma are in private ownership, future land use decisions related to agriculture will have the greatest impact on the habitats used by the Neosho madtom and Neosho mucket. Land uses in these areas are primarily livestock grazing, crop production for soybeans, wheat, and sorghum and harvest of pecans from orchards. Implementation of these private actions will be influenced by economic and climatic factors, primarily drought and fluctuating crop commodity prices. However, we do not anticipate that land use in the region will be altered by the proposed action. Considering many of these activities do not have a federal nexus, we do not currently have access to planning information which would provide the scope and location of these activities such that we could accurately predict the magnitude of impact of these non-federal actions on these species.

We anticipate that the Peoria Tribe will continue to participate in conservation of the Neosho madtom and Neosho mucket. However, we do not anticipate any significant adverse impacts to either species associated with tribal activities because the Peoria Tribe has a strong cultural desire to facilitate conservation of both species.

CONCLUSION

After reviewing the current status of the Neosho madtom and Neosho mucket, the environmental baseline for the action area, the effects of the proposed project, and the cumulative effects, it is the Service's biological opinion that funding and implementation of this research project, as proposed, is not expected to reduce appreciably the likelihood of both the survival and recovery of the Neosho madtom or Neosho mucket in the wild by reducing the reproduction, numbers, or distribution of the species. No critical habitat has been designated for the Neosho madtom; therefore, none will be affected. Critical habitat has been designated for the Neosho mucket; however, only a small portion in the Elk River occurs in the project action area and any physical impacts to critical habitat are expected to be insignificant. Although some electrofishing impacts are expected to the fish hosts for the Neosho mucket, primarily in the Elk River, and impacts to this primary constituent element of critical habitat could occur, the impacts are expected to be minor. Therefore we do not anticipate that this project would result in the destruction or adverse modification of proposed critical habitat. Thus, we conclude that the proposed action is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of critical habitat. We base this conclusion on the following:

- The proportion of occupied range encompassed by the action area is very small compared to the entire occupied range and the abundance of both species, while unknown, is believed to be very low based on past collecting efforts by the Service and others.

- The conservation measures included in the project will help minimize lasting impacts to the species.

- No significant, lasting adverse impacts to stream flow, amount or configuration of available habitat, or change in water quality are expected from project implementation. However, if the project is successful some neutral to beneficial impacts to the Neosho madtom and Neosho mucket could occur.

implementation of the project despite use of non-lethal sampling gear. However, timing of the survey will substantially reduce, if not eliminate, the likelihood of take of madtom nests or eggs. Some glochidia of the Neosho mucket may be killed if host fishes are harmed during sampling efforts.

The actual take that would occur is impossible to determine with the information available to the Service. We have no information on the number of sites that would be surveyed, their location or the extent of habitat that would be sampled. No intentional lethal take is planned as a part of this project. However some unintended take is expected to occur.

The estimated anticipated level of incidental take associated with the project is directly related to the abundance of Neosho madtoms and Neosho muckets in the action area. However, we do not currently know the abundance of either species in the action area. Information on the density of Neosho madtoms are available for specific sites within the occupied range including one site in the action area (Table 1 in Bryan *et al.* 2010). However, we do not have comparable information for the Neosho mucket, particularly with respect to the glochidia. We also lack information on the extent of habitat that would be sampled during collection efforts.

Despite the lack of information, the Service is obligated to estimate the amount of take that would occur during project implementation. We can attempt to estimate take using the number of gravel bars present in the Neosho River. Surveys by the Service in 2010 observed 17 gravel bars in the lower Neosho River downstream of Stepps Ford. If we assume a similar number of bars occur above Stepps Ford, the ODWC has the potential to collect fishes at a total of 35 gravel bars. During this sampling effort, the Service did not observe any mortality of Neosho madtoms from capture or handling of the fish. However, personal observation of Service biologists over the 20 years spent capturing Neosho madtoms indicates that some mortality during capture and handling does occur. If we assume a maximum of 1 Neosho madtom per bar is killed, the total lethal take that could occur over the entire action area would be 35 fish per collecting event. Considering collections of SCGN are limited to a 3-month period annually and only one SGCN sampling period is expected for each river over the life of the project, we would expect no more than 35 Neosho madtoms would be taken from the Neosho River over the life of the project.

Determining the take of Neosho madtoms in the Spring River is considerably more difficult considering their populations are believed to be much smaller than those in the Neosho River and only three Neosho madtoms have ever been captured from the Spring River within the action area. Considering the available information, we do not believe any take would occur in the Spring River, due to scarcity of the fish. Additionally, if appropriate care is taken in capturing and handling fishes, lethal take would be extremely unlikely in this instance. However, based on our professional judgement and years of experience capturing imperiled fishes, the unexpected often happens. Therefore, we estimate that no more than 1 Neosho madtom would be taken in the Spring River.

Estimating take of the Neosho mucket is equally, if not significantly more, difficult. Considering mussels are more capable of coping with the environmental effects of capture and handling—they simply close their shells—than freshwater fishes, capture and handling of freshwater mussels such as the Neosho mucket should not result in the mortality of even a single individual, particularly if appropriate care is given during capture and handling. Although some harm and harassment from capture stress is expected, we do not anticipate that such take would result in

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of incidental take of the Neosho madtom and Neosho mucket:

1) All basses (*Micropterus* spp.) captured shall be processed quickly and returned to the water unharmed to ensure any glochidia are protected. Similarly all Neosho madtoms and Neosho muckets captured shall be processed quickly and with the utmost care to ensure they are returned to the collection site unharmed.

2) Conservation measures proposed as a part of project implementation shall be strictly applied, as stipulated.

3) Electrofishing gear shall not be used in the Neosho or Spring rivers to capture SGCN except at those sites where its use is absolutely necessary. If boat mounted electrofishers are used, care should be taken to ensure current is not applied to the water in riffles or shallow water (<1 m in depth) over gravel where Neosho madtoms may be present. Use of boat electrofishers in deeper standing water to capture bighead carp is allowed.

Terms and Conditions

The following terms and conditions, which implement the reasonable and prudent measures described above, must be undertaken by the Service for the exemptions from the prohibitions of section 9 of the Act to apply. These terms and conditions are non-discretionary.

1) Monitoring and enumeration of any incidental take must be conducted to ensure take is not exceeded.

2) Within 2 months of completion of SGCN surveys in each river, the Grantee will provide the Oklahoma Ecological Services Field Office (OKESFO) with written summarization of SGCN captured, including any Neosho madtoms or Neosho muckets. Upon completion of final report providing results of investigation, provide a copy of the approved report to the OKESFO.

3) The Reasonable and Prudent Measures shall be included in the funding agreement to ensure that identified measures are implemented as a part of the project.

Reporting Requirements

The ODWC will be responsible for providing subject reports as identified in the above terms and conditions. Upon completion of the project, the ODWC will meet with appropriate Service staff, including the Oklahoma Ecological Service Field Office to discuss the results of the sampling efforts and success of eradication efforts. Reports will be due as stipulated or no later than December 31st of each year, whichever comes first.

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.

LITERATURE CITED

Albers, J. L. and M. L. Wildhaber. 2002. Neosho madtom spawning. USGS, Biological Science Report 2002-0002. CERC, Columbia, MO.

Ahlstedt, S.A. and J.D. Tuberville. 1997. Quantitative reassessment of the freshwater mussel fauna in the Clinch and Powell Rivers, Tennessee and Virginia. Pp. 72-97 *in* K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo, eds. Conservation and management of freshwater mussels II: initiatives for the future. Proceedings of a UMRCC symposium, October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Allen, G.T., S.H. Blackford, V. Tabor, and M.S. Cringan. 2001. Metals, boron, and selenium in Neosho madtom habitats in the Neosho River in Kansas, U.S.A. Environmental Monitoring and Assessment 61:1-21.

Allert, A.L., M.L. Wildhaber, C.J. Schmitt, D. Chapman, and E. Callahan. 1997. Toxicity of sediments and pore-waters and their potential impact on Neosho madtom, *Noturus placidus*, in the Spring River system affected by historic zinc-lead mining and related activities in Jasper and Newton counties, Missouri; and Cherokee County, Kansas. Final Report to the U.S. Fish and Wildlife Service, Columbia, Missouri.

Angelo, R.T., M.S. Cringan, D.L. Chamberlain, A.J. Stahl, S.G. Haslouer, and C.A. Goodrich. 2007. Residual effects of lead and zinc mining on freshwater mussels in the Spring River basin (Kansas, Missouri, and Oklahoma, USA). Science of the Total Environment 384: 467-496.

Atkinson, C. 2011. Mussel survey report for the Welling Road bridge on Baron Fork Creek near Tahlequah, Oklahoma, and the State Highway 10 bridge on the Spring River near Miami, Oklahoma. Report prepared by the Oklahoma Biological Survey for the Oklahoma Department of Transportation, Oklahoma City, OK. 3 p.

Bajer, P.G., C.J. Chizinski, and P.W. Sorensen. 2011. Using the Judas technique to locate and remove wintertime aggregations of invasive common carp. Fisheries Management and Ecology 18:497-505.

Bajer, P.G. and P.W. Sorensen. 2012. Using boat electrofishing to estimate the abundance of invasive common carp in small Midwestern lakes. North American Journal of Fisheries Management 32:817-822.

Carswell, Jr., W.J. and R.J. Hart. 1985. Transit losses and traveltimes for reservoir releases during drought conditions along the Neosho River from Council Grove Lake to Iola, east-central Kansas. USGS Water-Resources Investigations Report 85-4003. Lawrence, KS. 40 pp.

Cochran. P .A. 1996. Cavity enhancement by madtoms (genus Noturus). Journal of Freshwater Ecology 11 :521 -522.

Cross, F.B., and M. Braasch. 1969. Qualitative changes in the fish-fauna of the upper Neosho River system, 1952-1967. Transactions of the Kansas Academy of Science 71: 350-360.

Davis, N., and C. Paukert. 2008. Impacts of gravel bar scalping on Neosho madtom (*Noturus placidus*) populations from the lower Neosho River, Kansas. Journal of Freshwater Ecology 23: 501-511.

Deacon, J.E. 1961. Fish populations, following a drought, in the Neosho and Marais des Cygnes Rivers in Kansas. University of Kansas Museum of Natural History, Miscellaneous Publication 13: 359-427, Lawrence, Kansas.

Deacon, J.E., G. Kobetich, J.D. Williams, and S. Contreras. 1979. Fishes of North America, endangered, threatened, or of special concern. Fisheries 4(2):29-44.

Dean, J., D. Edds, D. Gillette, J. Howard, S. Sherraden, and J. Tiemann. 2002. Effects of lowhead dams on freshwater mussels in the Neosho River. Kansas. Transactions of the Kansas Acad. of Science 105(3-4):232-240.

Dieffenbach, W. and F. Ryck, Jr. 1976. Water quality survey of the Elk, James, and Spring River basins of Missouri , 1964-1 965. Missouri Department of Conservation, Aquatic Series No. 15. 24 pp.

Ernsting, G. W., M.E. Eberle, and T.L. Wenke. 1989. Range extensions for three species of madtoms (*Noturus*: Ictaluridae) in Kansas. Transactions of the Kansas Academy of Science 92: 206-207.

Forshage, A., and N.E. Carter. 1973. Effect of gravel dredging on the Brazos River. Southeastern Association of Fish and Game Commissioners 24: 695-708.

Foster, A., J. Boxrucker, G. Gilliland, B. Wentroth, and C. Tackett. 2009. Oklahoma aquatic nuisance species management plan (updated). Final report T-44-P-1, Oklahoma Department of Wildlife Conservation, Oklahoma City.

Fuselier, L., and D. Edds. 1994. Seasonal-variation in habitat use by the Neosho madtom (Teleostei, Ictaluridae, *Noturus placidus*). Southwestern Naturalist 39: 217-223.

Fuselier L. and D. Edds. 1995. Management Briefs: An artificial riffle as restored habitat for the threatened Neosho Madtom. North American Journal of Fisheries Management, 15:499-503.

Kiner, L.K., C. Vitello, and K. Hash. 1997. Spring River basin inventory and monitoring plan. Missouri Department of Conservation, Jefferson City.

Leff, L.G., J.L. Burch, and J.V. McArthur. 1990. Spatial distribution, seston removal, and potential competitive interactions of the bivalves *Corbicula fluminea* and *Elliptio complanata* in a coastal plain stream. Freshwater Biology 24:409-416.

Long, J.M. and A. Nealis. 2011. Age estimation of a large bighead carp from Grand Lake, Oklahoma. Proceedings of the Oklahoma Academy of Science 91:15-18.

Long, J.M., D.E. Shoup, J.R. Bidwell, A.R. Dzialowski, and Y. Liang. 2012. Assessing the risk of invasion of Oklahoma reservoirs by bighead carp and zebra mussels. Final Report N-2-R-1, Oklahoma Department of Wildlife Conservation, Oklahoma City.

Luttrell, G.R., R.D. Larson, W.J. Stark, N.A. Ashbaugh, A.A. Echelle and A.V. Zale. 1992. Status and distribution of the Neosho madtom *(Noturus placidus)* in Oklahoma. Proceedings of the Oklahoma Academy Of Science 72:5-6.

Moss, R. 1981. Life history information for the Neosho madtom (*Noturus placidus*). Kansas Nongame Wildlife Improvement Program, Contract No. 38. 32 pp.

Naimo, T. J. 1995. A Review of the Effects of Heavy Metals on Freshwater Mussels. Ecotoxicology 4(6): 341-362.

Neves, R.J., and J.C. Widlak. 1987. Habitat ecology of juvenile freshwater mussels (Bivalvia: Unionidae) in a headwater stream in Virginia. American Malacological Union Bulletin 5(1):1-7.

Oklahoma Department of Wildlife Conservation. 2005. Comprehensive Wildlife Conservation Strategy. Final Report T-2-P-1, Oklahoma Department of Wildlife Conservation. Oklahoma City.

Peoria Tribe. 2014. 2014 mussel survey of the Ottawa County, Stepp's Ford bridge construction project area/Neosho River, for the endangered Neosho mucket and rabbitsfoot mussels, and other mussel species. Report prepared by the Peoria Tribe of Indians of Oklahoma, Environmental Department, for the Oklahoma Department of Transportation, Oklahoma City, OK. 25 p.

Pfingsten, D.G., and D.R. Edds. 1994. Reproductive traits of Neosho madtom, *Noturus placidus* (Pisces: Ictaluridae). Transactions of the Kansas Academy of Science 97: 82-87.

Pflieger, W.L. 1975. The fishes of Missouri. Missouri Dept. of Conservation. Jefferson City, MO. 343 pp.

Pigg, J., J. Stahl, M. Ambler, and J. Smith. 1993. Two potential sources of exotic fishes in Oklahoma. Proceedings of the Oklahoma Academy of Science 73:67.

Tiemann, J.S., D.P. Gillette, M.L. Wildhaber, and D.R. Edds. 2004b. Correlations among densities of stream fishes in the upper Neosho River, with focus on the federally threatened Neosho madtom *Noturus placidus*. Transactions of the Kansas Academy of Science 107:17-24.

USACE. 2004. Tulsa District Pertinent Data Book. Tulsa District Corps of Engineers. Tulsa, OK. 167 pp.

USACE. 2013. Final supplement to the final environmental statement volume one—storage reallocation: John Redmond Dam and Reservoir, Kansas. Tulsa District Corps of Engineers. Tulsa, OK.

U.S. Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; Neosho madtom determined to be threatened. Federal Register 55(99): 21148-21153.

U.S. Fish and Wildlife Service. 1991. Neosho madtom recovery plan. USFWS, Denver, Colorado.

U.S. Fish and Wildlife Service. 2013a. Letter dated September 13, 2013, from USFWS, Manhattan, Kansas to U.S. Army Corps of Engineers, El Dorado, Kansas regarding Cottonwood River Streambank Rehabilitation Project.

U.S. Fish and Wildlife Service. 2013b. Neosho madtom 5-year review. Manhattan, KS.

U.S. Fish and Wildlife Service. 2013c. Endangered and threatened wildlife and plants; endangered status for the Neosho mucket and threatened status for the rabbitsfoot. Federal Register 78(180):57076-57097.

Valenti, T.W., D.S. Cherry, R.J. Neves, and J. Schmerfeld. 2005. Acute and chronic toxicity of mercury to early life stages of the rainbow mussel, Villosa iris (Bivalvia: Unionidae). Environmental Toxicology and Chemistry 24(5):1242-1246.

Vaughn, C.C. 1997. Determination of the status and habitat preference of the Neosho mucket in Oklahoma. Annual Performance Report submitted to Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma.

Vaughn C.C. and C.M. Taylor. 1999. Impoundments and the decline of freshwater mussels: a case study of an extinction gradient. Conservation Biol. 13(4):912-920.

Wagner, B.A., A. Echelle, and O.E. Maughan. 1984. Status of three Oklahoma fishes (*Notropis perpallidus, Noturus placidus, Percina nasuta*). Contract No. 14-16-0009-1513-W02-MI. Final Report to U.S. Fish and Wildlife Service, Oklahoma Cooperative FisheryResearch Unit, Stillwater, OK. 30 pp.

Wang, N., C.G. Ingersoll, C.D. Ivey, D.K. Hardesty, T.W. May, T. Augspurger, A.D. Roberts, E. Van Genderen, and M.C. Barnhart. 2010. Sensitivity of early lifestages of freshwater mussels (Unionidae) to acute and chronic toxicity of lead, cadmium, and zinc in water. Environmental Toxicology and Chemistry 29(9):2053-2063.

Yeager, M.M., R.J. Neves, and D.S. Cherry. 2000. Competitive interactions between early life stages of *Villosa iris* (Bivalvia: Unionidae) and adult Asian clams (*Corbicula fluminea*). Pp. 253-259 in: P.D. Johnson and R.S. Butler, eds. Freshwater Mollusk Symposium Proceedings--Part II: Proceedings of the First Symposium of the Freshwater Mollusk Conservation Society, March 1999, Chattanooga, Tennessee. Ohio Biological Survey, Columbus.

the Arkansas darter may occasionally occur in the mainstem Spring River, habitats typically inhabited by this species are very uncommon there.

The Arkansas darter feeds on a variety of aquatic insects such as isopods, snails, mayflies, and midges. Spawning occurs throughout spring and summer. Females may spawn more than once per year (Miller and Robinson 2004).

Conclusion

The proposed action would occur in the Spring River where Arkansas darters may occasionally be found. However suitable habitat is rare there. The proposed project would not implement any activities that would remove ground water or cause drying of surface water or springs used by this species. While the Arkansas darter may occasionally be encountered, the number of Arkansas darters that would be encountered would be low. Therefore, we do not anticipate that the proposed action would jeopardize the continued existence of this species.

Gray bat *Myotis grisescens*

Large maternity colonies (around 5,000 bats or more) are known from caves in Adair, Cherokee, Delaware, and Ottawa counties. The most important gray bat caves in the Grand Lake area are Beaver Dam, Twin Cave and Boy Scout Cave. Beaver Dam Cave is located in Delaware County, along Drowning Creek, a tributary to Grand Lake. The cave is privately owned, but contains a flowage easement by Grand River Dam Authority. The cave entrance is directly adjacent to Drowning Creek and this cave currently serves as a maternity site for a gray bat colony (one of the five known maternity colonies in Oklahoma). Approximately 20 percent of the known Oklahoma gray bat maternity population and about 0.8% of the total gray bat population may occur in Beaver Dam cave. Twin Cave is a well-known cave located about a mile from Grand Lake and approximately 1.5 miles from Beaver Dam Cave in Delaware County. Records indicate that gray bats historically used Twin Cave as a maternity colony. In 1981 approximately 13,300 gray bats were estimated to use Twin Cave. A new gate was installed in 1982, and no bats have used Twin Cave since 1982. Gray bats are believed to have abandoned Twin Cave after 1982 because of the new gate. Banded gray bats from Twin Cave were later discovered in Beaver Dam Cave. Experts believe that the maternity colony in Beaver Dam Cave consists of all or a portion of the bats that left Twin Cave. Currently Twin Cave is serving as a transient site and night roost for gray bats which may be bats from Beaver Dam Cave. In 1991 roughly 5,000 gray bats used Twin Cave as a transient site. Boy Scout Cave is located in Ottawa County about 5 miles from Grand Lake.

Gray bats feed on flying insects over bodies of water including rivers, streams, lakes and reservoirs. Mayflies, caddisflies, and stoneflies comprise the majority of their diet, but beetles and moths also are consumed (Harvey, 1994; Tuttle and Kennedy, 2005). Gray bats are known to travel up to 35 kilometers from caves to prime feeding areas (LaVal *et al.,* 1977; Tuttle and Kennedy, 2005). However, most foraging areas are within 1-4 km (0.6 – 2.5 miles) of caves (Tuttle, 1976).

Northern long-eared bat *Myotis septentrionalis*

The northern long-eared bat is a wide-ranging species, occurring in 38 states, Washington D.C., and Canada (Service 2014). Data on the extent of the species' range in Oklahoma is limited. Occurrence records, based on summer mist-netting and winter cave surveys, exist for seven counties in eastern Oklahoma: Adair, Cherokee, Choctaw, Delaware, LeFlore, McCurtain, and Sequoyah. Suitable winter habitat (hibernacula) for the northern long-eared bat includes underground caves and cave-like structures (e.g. abandoned or active mines, railroad tunnels). These hibernacula typically have large passages with significant cracks and crevices for roosting; relatively constant, cool temperatures (0-9 degrees Celsius), with high humidity and minimal air currents (Caceres and Barclay 2000; Raesly and Gates 1987; Service 2013 and 2014). Spring migration between winter hibernacula and summer sites typically occurs between April 1 and mid-May (Service 2014). Suitable summer habitat consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures (Service 2014). During summer, northern long-eared bats roost alone or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags that typically are ≥3 in dbh (Carter and Feldhammer 2005; Foster and Kurta 1999; Lacki *et al.* 2009; Service 2014). The species appears to select roost sites opportunistically, using tree species based on presence of cavities or crevices or presence of peeling bark (Carter and Feldhammer 2005; Lacki *et al.* 2009; Timpone *et al.* 2010; Service 2014). Males and non-reproductive females also may roost in cooler places, like caves and mines. The northern long-eared bat occasionally has been found roosting in structures like barns and sheds, possibly when suitable roost trees are unavailable. Most foraging occurs on forested hillsides and ridges, rather than along riparian areas (Brack and Whitaker 2001; LaVal *et al.* 1977).

Conclusion

The northern long-eared bat is likely to occur in the project area. However, this bat uses caves for winter hibernacula and roosts in trees during the summer, habitats that would not be affected by the proposed action. The northern long-eared bat primarily forages in forest understory but also may glean motionless insects from water surfaces. Considering this bat forages primarily from sunset to sunrise and that no nocturnal sampling is anticipated as a part of this project, the proposed action is not likely to impact foraging activities. Additionally, habitats known to be utilized by this species will not be entered or sampled as a part of this project. Therefore we do not anticipate any impacts to this species.

Ozark cavefish *Amblyopsis rosae*

Ozark cavefish are small fish reaching a total length of about two inches. The fish are true troglobites or obligatory cave inhabitants, and live most of their life in total darkness. They have only rudimentary eyes and no optic nerve. They also lack pigment, but appear pinkish-white because their translucent skin reveals blood and organs. The Ozark cavefish was listed as threatened on November 1, 1984, due to habitat alteration and over-collecting for scientific purposes and the aquaria trade. Habitat degradation and pollution due to agricultural activities and development currently are considered primary threats to the Ozark cavefish. In Oklahoma, Ozark cavefish primarily occur within the Spavinaw Creek watershed which is outside of the action area for this project.

modification of riverine habitat through channelization and the construction of dams, and predation (Service 2009).

The breeding range of the piping plover includes the Atlantic Coast, the Northern Great Plains of the United States and Canada, and around the Great Lakes (Andrews and Righter 1992, Service 2009). Breeding habitat consists of sparsely vegetated, sandy shores of lakes, ponds, and rivers and coastal beaches. The plover winters along the southern Atlantic and Gulf coasts, and in the Bahamas and West Indies (Service 2009). Non-breeding habitats include ocean beaches and sand, mud, and algal flats. Piping plovers use sandy rivers, reservoir beaches and mudflats during migration (Haig 1992, Haig and Plisnner 1993, Service 2009). The threatened northern Great Plains population migrates through the action area in Oklahoma each spring and fall.

Conclusion

The piping plover is a shorebird that utilizes aquatic and shoreline habitats. They migrate through Oklahoma each spring and fall and largely are considered a transient species in the state. Any piping plovers that occur in the action area are anticipated to be migrating individuals. Although the piping plover may migrate through the affected counties, we are not aware of any records that indicate piping plovers would occur in the action area (Wood and Schnell 1984). Therefore, the piping plover is not expected to be affected by the proposed action.

Rufa Red Knot *Calidris canutus rufa*

The red knot was listed as threatened on December 11, 2014 (79 FR 73706). Critical habitat has not been proposed at this time. Primary threats include habitat destruction and modification, principally related to climate change and its effects, such as sea level rise, and coastal development, hunting, primarily outside of the United States, and in some instances predation, particularly at key stopover sites during migration. Other factors such as reduced food availability, ocean acidification, altered migratory patterns and wind energy development also may impact the species.

Oklahoma is within the interior migration pathway used by rufa red knots, where they may occur during the spring and fall. However major stopover areas are not known from Oklahoma and reported observations consist of only a few individuals, primarily west of Interstate 35 (Wood and Schnell 1984). No records exist for the red knot from the counties encompassed by the action area.

Conclusion

The red knot is a shorebird that utilizes aquatic and shoreline habitats, primarily sandy beaches, during migration. They migrate through Oklahoma each spring and fall and largely are considered a transient species in the state. Any red knots that occur in the action area are anticipated to be migrating individuals and in low abundance. Although precise information on migratory habitat in Oklahoma is not available, available information indicates the species is not likely to occur in the action area (Wood and Schnell 1984). Therefore, the rufa red knot is not expected to be affected by the proposed action.

Cross, F.B. 1967. Handbook of fishes of Kansas. University of Kansas Museum of Natural History, Misc. Publ. 45:1-357.

Davis, S.K. 2004. Area sensitivity in grassland passerines: effects of patch size, patch shape, and vegetation structure on bird abundance and occurrence in southern Saskatchewan. Auk 121:1130-1145.

Ericksson, M.O.G. 1985. Prey detectability for fish eating birds in relation to fish density and water transparency. Ornis Scandinavica 16:1-7.

Foster, R.W., and A. Kurta. 1999. Roosting ecology of the northern bat (Myotis septentrionalis) and comparisons with the endangered Indiana bat (Myotis sodalis). Journal of Mammalogy 80: 659-672.

Haig, S.M. 1992. Piping Plover (*Charadrius melodus*). No. 2 in A. Poole, P. Stettenheim, and F. Gill, editors. The Birds of North of America. The Academy of Natural Sciences, Philadelphia, and The North American Ornithologists Union, Washington, D.C.

_____ and J.H. Plissner. 1993. Distribution and abundance of piping plovers: results and implications of the 1991 international census. Condor 95:145-146.

Harvey, M.J. 1994. Status of summer colonies of the endangered gray bat, *Myotis grisescens* in Tennessee. Unpub. Rept. to the Tennessee Wildlife Resources Agency. Tennessee Technological University, Cookeville, TN. 44 pp.

Jones, S.L. 2010. Sprague's Pipit (*Anthus spragueii*) conservation plan. U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C.

Lacki, M.J., D.R. Cox, and M.B. Dickinson. 2009. Meta-analysis of summer roosting characteristics of two species of Myotis bats. American Midland Naturalist 162:318-326.

LaVal, R. K., R. L. Clawson, M. L. LaVal and W. Caire. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis*. Journal of Mammalogy 58(4):592-599.

Martinez, D., A.A. Echelle, and W.L. Fisher. 1994. Status of threatened and endangered fishes in Oklahoma—status survey of the Arkansas darter in Eastern Oklahoma. Final section 6 report, Federal Aid Project E-28, Oklahoma Department of Wildlife Conservation. Oklahoma City. 54 pp.

Miller, R.J., and H.W. Robison. 2004. Fishes of Oklahoma. University of Oklahoma Press, Norman, OK. 450 pp.

Raesly, R.L., and J.E. Gates. 1987. Winter habitat selection by north temperate cave bats. American Midland Naturalist 118:15–31.