United States Department of the Interior

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November 29, 2018

Raegan Ball
U.S. Department of Transportation
Federal Highway Administration
3220 W. Edgewood, Suite H
Jefferson City, Missouri 65109

Dear Ms. Ball:

Pursuant to section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*), the enclosed document transmits the U.S. Fish and Wildlife Service's (Service) final biological opinion (BO) for the Federal Highway Administration's (FHWA) proposed replacement of the Route T bridge in Gasconade County, Missouri. Your request for formal consultation was received on November 1, 2018.

The enclosed Biological Opinion addresses effects of the project on the federally endangered Snuffbox mussel (*Epioblasma triquetra*). It includes an incidental take statement with nondiscretionary reasonable and prudent measures and terms and conditions that are necessary and appropriate to minimize incidental take associated with this project. We have also included a brief list of discretionary conservation recommendations that could contribute to the recovery of the species. As discussed in the BO, the Service concludes that the proposed action will not jeopardize the continued existence of the Snuffbox and no critical habitat will be affected.

The enclosed BO is based on information provided in the November 1, 2018 Biological Assessment, meetings, field investigations, available literature, personal communications with species experts, and other sources of information regarding the status of the species. A complete administrative record of this consultation is on file in our office.

We appreciate your cooperation in working to protect federally listed species. If you have any questions or concerns regarding this consultation, please contact Andy Roberts at 573/234-2132, extension 110.

Sincerely,

Karen Herrington
Field Supervisor

Enclosure

BIOLOGICAL OPINION

for the

Effects of the replacement of Route T bridge on the Federally Endangered Snuffbox mussel (*Epioblasma triquetra*) in Gasconade County, Missouri.

Prepared by:

U.S. Fish and Wildlife Service
Ecological Services
Missouri Field Office

November 29, 2018

INTRODUCTION

This document is the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the Federal Highway Administration's (FHWA) proposed replacement of the Route T bridge in Gasconade County, Missouri. This BO evaluates the effects of project activities on the Snuffbox mussel (*Epioblasma triquetra*) in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). No other federally listed, proposed, or candidate species or designated or proposed critical habitat are expected to be affected by project activities.

As stated in the Biological Assessment (BA), the purpose of the project is to demolish the existing bridge and replace it with a new bridge over the Bourbeuse River. Preliminary coordination for this project occurred in early 2018 between the Service and the Missouri Department of Transportation (MoDOT), FHWA's non-federal Section 7 representative. Formal consultation was initiated on November 1, 2018, via a letter from the FHWA to the Service's Missouri Ecological Services Field Office. Section 7(a)(2) of Act requires that Federal agencies shall insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any threatened or endangered species, or result in the destruction or adverse modification of critical habitat.

This BO is based on: information provided in the November 1, 2018 BA; available literature; personal communications with species experts; information provided by MoDOT; site visits; and other sources of information.

CONSULTATION HISTORY

April 26, 2018 – telephone conversation between MoDOT and the Service to discuss the Route T project and preliminary design.

August 22, 2018 – on site project meeting and mussel survey conducted by the Service and MoDOT personnel.

September 24, 2018 – Conference call between the Service and MoDOT to discuss project design, impacts, avoidance measures, and measures to reduce impacts.

November 1, 2018 – Email with attached letter from the FHWA to the Service providing a BA and requesting formal consultation and concurrence with a "likely to adversely affect" determination.

November 14, 2018 – Email with attached letter from the Service to the FHWA acknowledging that information with the submitted Biological Assessment is complete.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The FHWA has proposed to demolish the existing Route T bridge over the Bourbeuse River in Gasconade County, Missouri and replaced it with a new bridge (Figure 1). The existing bridge was constructed in 1958 and has one main steel truss span and six approach spans. The main span is a ten-panel, 120' riveted Warren pony truss with polygonal top chord. All six approach spans are 47' I-beam spans. The total length of the bridge is 406'. The bridge is posted for weight limit of 36 tons. The bridge deck will be removed by cutting the concrete and removing it in slabs. The slabs will not be allowed to drop in the water below. After deck removal, the steel superstructure will be cut and dropped into the river channel below. Steel pieces will be immediately removed from the River and hauled away. The existing piers will be demolished and removed to at least ground level. The existing bridge has no piers in the water at the river's normal base flow, and the new piers will be located adjacent to the existing piers.

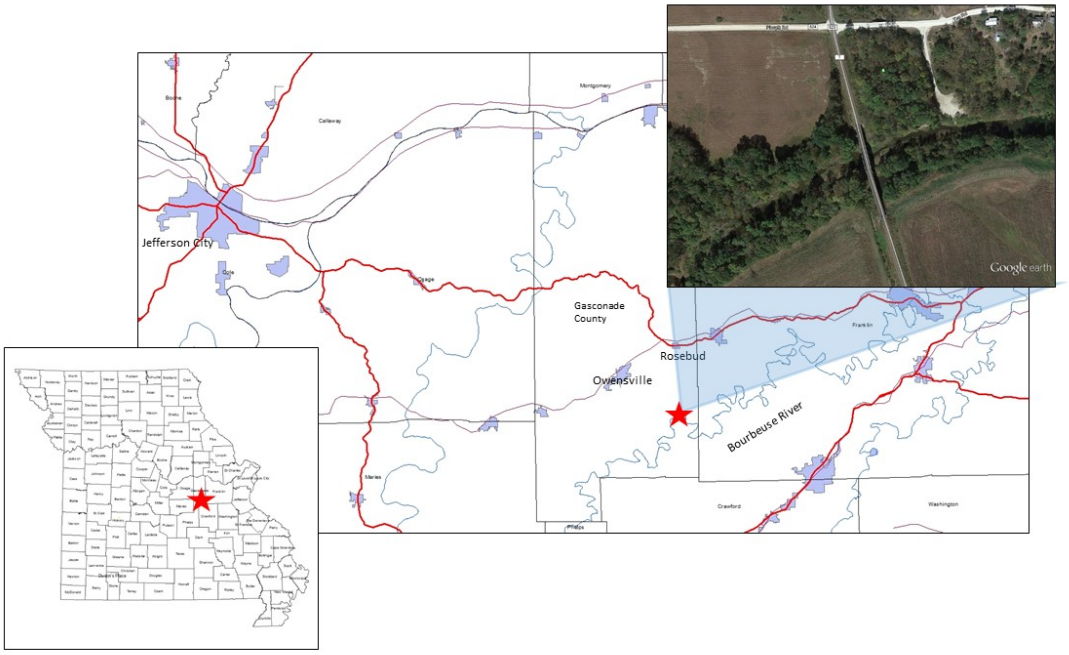

Figure 1. Location of the proposed Route T Bridge replacement.

The new bridge structure will consist of one 96' girder on each end and two 114' intermediate girders made of 43" NU-Girder pre-stressed concrete spans, 3 girders wide. The bridge will be 420' in length, 14' longer than the existing structure. The grade of the new bridge will be approximately 3' higher in the center and 2' higher at the ends than the existing structure. Demolition of the existing bridge and construction of the new bridge will require a temporary

causeway in the river channel. The causeway will span the entire river just upstream of the existing bridge. Placing the causeway upstream avoids a large scour hole in the southeast quadrant and greatly reduces the amount of rock needed. Placement of the causeway upstream also minimizes the amount of suitable mussel habitat impacted because the substrate there consists largely of exposed bedrock and unstable gravel and sand. The causeway will be constructed after June 15 (the end of the fish spawning restriction period) and will be removed by November 15, 2019.

The causeway will be approximately 20' wide on top with 1.5:1 slopes and a 40' wide footprint. It will be approximately 7' tall (697' elevation) in order to provide the necessary clearance for the equipment needed to drill the shafts for the new piers. The contractor will determine whether flow will be maintained by pipes or some other means (trench box, short span). However, the contractor shall be required to design the causeway so that it shall have a minimum of 100 square feet of hydraulic opening placed in the natural stream channel. The opening shall be set to the bottom of the channel so that it operates effectively at low flows.

Conservation Measures

Conservation measures are actions that benefit or promote the recovery of a listed species that a Federal agency includes as an integral part of its proposed action and that are intended to avoid, minimize or compensate for potential adverse effects of the action on the listed species. As such, these measures are mandatory. FHWA has proposed to implement conservation measures in order to minimize potential impacts to the Snuffbox mussel and contribute to its recovery. The following is a list of potential adverse effects of the project on the Snuffbox mussel and the conservation measures that will be employed to minimize adverse effects.

1) Demolition of existing bridge will impact occupied habitat
   a) MoDOT will relocate all mussels within the causeway and bridge demolition footprint into suitable habitat upstream.
   b) MoDOT will ensure the contractor removes the bridge deck before the steel superstructure is dropped into the water. This will prevent concrete slabs and most concrete rubble from falling into the water.
   c) MoDOT will ensure the contractor cuts the steel superstructure before dropping into river channel.
   d) MoDOT will ensure the contractor removes the steel super structure pieces immediately from the river after it is dropped.
2) Temporary causeway construction and removal will impact occupied habitat
   a) The causeway will be placed upstream of bridge where pockets of unsuitable habitat (bedrock and unstable sand/gravel) is present.
   b) All mussels will be relocated from direct and indirect impact areas.
   c) The causeway will be constructed after June 15outside of host fish spawning dates (March 15th to June 15th) and outside the peak of Snuffbox host fish infestation period (May and June).
   d) Deconstruction will occur between September 1 and November 15, outside of probable Missouri Snuffbox spawning dates.
   e) MoDOT will ensure the contractor designs the causeway designed for minimum of 100 sq. ft. of effective hydraulic opening in the natural stream channel.

3) Cement/gray water seeping from new pier forms could impact water quality and disturb mussels downstream.
   a) MoDOT will ensure the contractor seals the forms used for the piers.
   b) MoDOT will ensure the contractor surrounds the pier work areas with rock causeway/work pad.
   c) MoDOT will ensure the contractor pumps the water from drilled shaft construction and prevent it from entering the river.
4) Altered hydraulics from new pier placement could impact existing habitat and mussels present
   a) The bridge is on same alignment, with new piers outside the main channel during base flows.
5) Water runoff from the general construction site may contribute to turbidity and sedimentation downstream of the work site.
   a) MoDOT will ensure the contractor follows all standard erosion control practices during the duration of the project and upon final stabilization of the project area (70% vegetative growth over the entire project area).
6) Any mussels missed in the relocation efforts will be subject to injury or mortality from the construction activities (i.e. bridge demolition, causeway construction and removal, sedimentation and scour while causeway is in place). Relocated mussels may not establish themselves in the new location.
   a) Relocation will be conducted as thoroughly as possible
   b) Mussels will be relocated upstream of bridge, to an area known to support suitable habitat and other mussels
   c) To help offset the loss of habitat and mussels from the construction area, MoDOT will contribute to ongoing mussel habitat restoration efforts in the Meramec River Basin with a one-time payment into the mitigation fund for mussels. A post-construction assessment of impacts on mussel habitat and mussel survey will be completed by MoDOT and the Service. The post-construction assessment will determine the extent of the habitat damage and an estimate of take. MoDOT's payment into the mitigation fund for mussels will be determined by the results from the post-construction mussel habitat survey and by calculating habitat loss by using the Service's habitat equivalency assessment method for mussels. The payment will be sent to the Missouri Conservation Heritage Foundation at 230 Commerce Drive Ste. 301, Jefferson City, Missouri 65109 by MoDOT.

Action Area

Service regulations define "Action Area" as all areas affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR §402.02). Because there may be indirect effects from the Federal actions included in the consultation that occur outside of the geographic area of the proposed action as described by the action agency, the Action Area of the biological opinion may not be the same as the actual geographic area of the proposed action.

The action area for the proposed bridge replacement project includes the length of the suitable mussel habitat that extends upstream and downstream of the project area. This includes the length of channel from 100 meters upstream to 175 meters downstream of the existing bridge.

STATUS OF THE SPECIES

This section presents the biological or ecological information relevant to formulating this BO. Appropriate information for the Snuffbox (including life history, habitat and distribution, and

other data on factors necessary to their survival) are either included or referenced to provide background for analysis in later sections. This analysis documents the effects of past human and natural activities or events that have led to the current range-wide status of the species.

Species Description

The Snuffbox is a freshwater mussel that was listed as federally endangered in 2012 (USFWS 2012). The following description of the Snuffbox is summarized from Simpson (1914), Oesch (1995), and Parmalee and Bogan (1998). The Snuffbox is a small to medium-sized mussel that reaches at least 3.5 inches in length. Sexual dimorphism is pronounced with males achieving greater lengths. The shape of the shell is somewhat triangular (females), oblong, or ovate (males) with the valves solid, thick, and very inflated. The beaks are located somewhat anterior of the middle, swollen, turned forward and inward, and extended above the hingeline. Beak sculpture consists of three or four faint double-looped bars. The anterior end of the shell is rounded and the posterior end is truncated, highly so in females. The posterior ridge is prominent, being high and rounded, while the posterior slope is widely flattened. The posterior ridge and slope in females is covered with fine ridges and grooves, and the posterioventral shell edge is finely toothed. When females are viewed from a dorsal or ventral perspective, the convergence of the two valves on the posterior slope is nearly straight due to being highly inflated. This gives the female Snuffbox a unique broadly lanceolate or cordate perspective when viewed at the substrate/water column interface (Ortmann 1919, van der Schalie 1932). The ventral margin is slightly rounded in males and nearly straight in females. The periostracum (external shell surface) is generally smooth and yellowish or yellowish-green in young individuals becoming darker with age. Green squarish, triangular, or chevron-shaped marks cover the umbone but become poorly delineated stripes with age. Internally, the left valve has two high, thin triangular, emarginate pseudocardinal teeth (the front tooth being thinner than the back tooth) and two short, strong, slightly curved, and finely striated lateral teeth. The right valve has a high, triangular pseudocardinal tooth with a single short, erect, and heavy lateral tooth. The interdentum is absent and the beak cavity is wide and deep. The color of the nacre (mother-of-pearl) is white, often with a silvery luster, and a gray-blue or gray-green tinge in the beak cavity. The soft anatomy was described by Lea (1863), Ortmann (1911, 1912), Simpson (1914), Utterback (1916), Baker (1928), Oesch (1984), and Williams et al. (2007).

Life History

Relatively little is known of the specific life history of the Snuffbox mussel. Its general biology is believed to be similar to other bivalve mollusks belonging to the family Unionidae. Adults are suspension feeders, using their gills to remove suspended particles in the water column. While the diet of unionids is a subject of debate, it is believed to include phytoplankton, zooplankton, diatoms, bacteria, and fine organic detritus (Fuller 1974, Haag 2012). The extent of selectivity exhibited by mussels feeding on each of these food groups and species within these food groups is poorly understood and is likely to vary by species. Recent evidence suggests that detritus and bacteria may be an important food source (Silverman *et al.* 1997, Nichols and Garling 2000). Even less is known of the feeding behaviors of juvenile mussels. Juvenile mussels are believed to employ foot (pedal) feeding to some degree for the first several months of their lives, feeding on depositional materials in interstitial water, including bacteria, algae, and detritus (Yeager *et al.*

1994). Pedal feeding in juveniles is accomplished by movements of microscopic cilia lining the foot that carry food particles into the mantle cavity and into the mouth. Juveniles also use the foot in a sweeping motion to draw particles toward the mantle cavity (Reid *et al.* 1992).

Adult unionids spend their entire lives partially or completely buried in the stream bottom (Murray and Leonard 1962). The depth to which they bury themselves may depend on the species, season, and environmental conditions (Parmalee and Bogan 1998). The posterior margin of the shell is usually partially spread, and the siphons extended to facilitate feeding and respiration. During periods of activity, movement is accomplished by extending and contracting a single muscular foot between the valves. Extension of the foot also enables the mussel to wedge itself into the river bottom.

Unionids have an unusual and complex mode of reproduction, which includes a brief, obligatory parasitic stage on fish. Most species typically have separate sexes, and spawning occurs in the spring, summer, or early fall (depending on the species). First, females lay eggs and brood them in specialized chambers in the gills (marsupia). Then males release sperm into the water column that are drawn into the female's incurrent siphon. Fertilization takes place internally within the marsupium. Within the marsupium, fertilized eggs develop into microscopic larvae (glochidia), which only have embryonic stages of a mouth, intestines, heart, and foot. The female may brood glochidia until the following year (long-term brooders) or release glochidia the same year it is fertilized (short-term brooder). Once glochidia are expelled by the female, they must quickly attach to the gills or the fins of an appropriate fish host to complete development. Glochidia that fail to attach to a suitable host will die. Host fish specificity varies among unionids. While some mussel species appear to require a single host species, other species can transform their glochidia into juvenile mussels on several fish species. The glochidia parasitize a fish host for a variable length of time, likely depending upon water temperature, fish species and other factors.

The Snuffbox is bradytictic or a long-term brooder (Ortmann 1912, 1919). The glochidia measure 0.0083 inches in both length and height (Ortmann 1911, Hoggarth 1988) and are brooded from September to May (Ortmann 1912, 1919; Baker 1928). Reproduction and glochidial release in the Clinton River, Michigan, was reported by Sherman (1993, 1994). Fertilized eggs were found in marsupial pouches from 26-30 July at water temperatures of 64-81° F. Spawning and fertilization occurred from mid-July to August when water levels were low, facilitating sperm transfer to female mussels (Zale and Neves 1982). Females with swollen marsupia and developing glochidia were found from early December to late July (Sherman 1994). Glochidia are individually released from pores opening at the distal ends of the watertubes. Glochidial release (from drift samples) began on 17 May (water temperature = 62° F), peaked on 11 June (74° F), and ended by 15 July (84° F) (Sherman 1994). The seasonal timing of reproductive events for Snuffbox are likely different for Missouri because of the difference in latitude between Michigan and Missouri. Many reproductive events are controlled by water temperature, and presumably, these events would occur earlier in Missouri because of the warmer climate. In the absence of additional data, it is difficult to determine how much of a shift in the timing of these events there would be between Missouri populations and the Michigan data set above.

Juvenile Snuffbox have successfully transformed on the following fish in laboratory tests: logperch (*Percina caprodes*), blackside darter (*P. maculata*), rainbow darter (*Etheostoma caeruleum*), Iowa darter (*E. exile*), blackspotted topminnow (*Fundulus olivaceous*), mottled sculpin (*Cottus bairdi*), banded sculpin (*C. carolinae*), Ozark sculpin (*C. hypselurus*), largemouth bass (*Micropterus salmoides*), and brook stickleback (*Culaea inconstans*) (Sherman 1993, 1994; Yeager 1986; Yeager and Saylor 1995; Hillegass and Hove 1997; Barnhart 1998; Barnhart et al. 1998; Hove et al. 2000; McNichols and Mackie 2002, 2003, 2004; Sherman Mulcrone 2004). Hornyhead chub (*Nocomis biguttatus*) is a potential host (Sherman 1994). Logperch is widely considered to be the best host for the Snuffbox (Sherman 1994, McNichols and Mackie 2004, Sherman Mulcrone 2004). There was a statistically significant correlation between Snuffbox and logperch when analyzing both density and relative abundance data for mussels and fishes (Sherman Mulcrone 2004).

The successful transfer of mature glochidia to a suitable host constitutes one of the critical events in the life cycle of freshwater mussels, and various adaptations to facilitate this process have evolved. The method of host infection greatly varies among species. While some species simply release glochidia into the water where they must haphazardly come into contact with the appropriate host, the process is more intricate and direct in other species. For example, females in the genus *Lampsilis* (including *L. abrupta*) have an extension of the mantle tissue that strikingly resembles a small fish. This structure is displayed outside the shell from between the valves and is twitched repetitively to attract its predaceous fish host. The host is infested by the female mussel when the fish attempts to eat the lure (Kraemer 1970, Barnhart and Roberts 1997). Other unionid species release conglutinates (small structures made up of gelatinous material that enclose large numbers of glochidia) freely into the water. These structures resemble prey items of the mussel's host fish; the host fish are infested when they attempt to eat them (Chamberlain 1934, Barnhart and Roberts 1997).

The Snuffbox employs a unique behavior to infest its host fish called host trapping. Gravid females gape their valves open at the surface of the substrate. Foraging darters (i.e. logperch), which commonly probe among rocks or flip rocks with their snout, may poke their snout into the gape of a Snuffbox. This elicits a "snapping" response from the female mussel, and the mussel holds the fish by the head with the recurved denticles on the posterior edge of the valves. Once caught, the mussel inflates her specialized mantle margins (cymapallia) to form a seal around the fishes' snout and dispels glochidia into its buccal cavity with rhythmic pulses (Jones 2004, Barnhart 2008).

Once attached to its host fish, the developing glochidia will disperse with the fish for a period of weeks while they must successfully transform. This phase is another major bottleneck in the life cycle of unionids as not all glochidia that attach to a suitable host successfully transform into juveniles. Glochidia generally spend from two to six weeks as parasites, the duration of encystment being dependent on the species and water temperature (Zimmerman and Neves 2002). Transformation rates reported for Snuffbox glochidia to juveniles on logperch are as follows: southeastern Michigan, 9 days (no temperature recorded) (Sherman 1994); Powell River, Tennessee and Virginia, 24-33 days at 62.8 °F (Yeager and Saylor 1995); Bourbeuse River, Missouri, 21-27 days (peak 24 days) at 68.0 °F (Barnhart 1998, Barnhart et al. 1998); and St. Croix River, Minnesota and Wisconsin, 26-51 days (no temperature recorded) (Hove et al.

2000).

Newly-metamorphosed juveniles drop off to begin a free-living existence on the stream bottom, and will die if they settle in unsuitable habitat (Isely 1911). Thus, complex life histories of unionids has many weak links that may prevent successful reproduction and/or recruitment (e.g., spatial aggregation of adults too dispersed for successful fertilization, flows not conducive for successful fertilization, host-fish densities too low during glochidial release period, newly-metamorphosed juveniles drop off host fish in unsuitable habitat, and low juvenile survival rates to adult (Neves 1993).

Growth and Longevity

Many freshwater mussel species are long-lived. Individuals of many species live more than 10 years, and some have been reported to live over 100 years (Cummings and Mayer 1992, Ziuganov et al. 2000). Mortality rates tend to be highest in young juveniles then decline until advanced age gradually depletes older cohorts (Hastie 2006). Growth rates vary among species. Heavy shelled species grow slowly relative to thin shelled species (Stansbery 1961, Coon et al. 1977, Hove and Neves 1994). Snuffbox was found to grow 0.55 inches in one year and another 0.75 inches after two years in Wisconsin (Dunn et al. 2000).

Freshwater mussels exhibit distinct lines on the surface of their shells that are hypothesized to form annually (Isely 1911, Vaughn and Pyron 1995). However, enumeration of these rings to estimate age is problematic due to shell erosion, false annuli formation, difficulty of reading growth rings in older individuals, and age underestimation (Downing et al. 1992, Veinott and Cornett 1996, Anthony et al. 2001, Rogers et al. 2001, Jones and Neves 2002). Little information on the longevity of Snuffbox is available. Ages estimates of 18-20 years were observed by counting external growth rings from the Wolf River, Wisconsin (J. Lee, Ecological Specialists, Inc., personal communication [pers. comm.], 2003) and a Cumberland River, Tennessee, specimen was estimated to be 27 years (Koch 1983).

Habitat

The Snuffbox is found in small to medium streams to larger rivers and large lakes in northern portions of its range (Parmalee and Bogan 1998). It occurs in swift currents of riffles and shoals and wave-washed lakeshores over gravel and sand with occasional cobble and boulders, and generally burrows deep into the substrate except when spawning or attracting a host (Parmalee and Bogan 1998,). They are typically found in stable stream channels in “mussel beds”, where a diversity of other mussel species are concentrated (Roberts and Brunderman 2000). These areas of suitable habitat naturally occur in relatively small patches separated by longer reaches of unsuitable habitat (Vaughn and Pyron 1995). Roberts and Bruenderman (2000) collected the Snuffbox primarily from mussel beds with stable, gravel substrates in the Meramec and Bourbeuse rivers. Mussels occur chiefly in flow refuges, which are relatively stable areas that display little movement of substrate particles during flood events and where shear stress is low (Vannote and Minshall 1982, Layzer and Madison 1995, Strayer 1999, Johnson and Brown 2000, Hastie et al. 2001). Flow refuges conceivably allow relatively immobile mussels to remain in the same general location their entire lives.

Distribution and Population Status

The Snuffbox historically occurred in 210 streams and lakes in 18 States and 1 Canadian province including Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Missouri, New York, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin; and Ontario, Canada. The major watersheds of historical streams and lakes of occurrence include the upper Great Lakes sub-basin (Lake Michigan drainage), lower Great Lakes sub-basin (Lakes Huron, Erie, and Ontario drainages), upper Mississippi River subbasin, lower Missouri River system, Ohio River system, Cumberland River system, Tennessee River system, lower Mississippi River sub-basin, and White River system (USFWS 2012).

Currently, extant populations of the Snuffbox are known from 79 streams in 14 States and 1 Canadian province including: Alabama (Tennessee River, Paint Rock River, and Elk River), Arkansas (Buffalo River, Spring River, and Strawberry River), Illinois (Kankakee River and Embarras River), Indiana (Pigeon River, Salamonie River, Tippecanoe River, Sugar Creek, Buck Creek, Muscatatuck River, and Graham Creek), Kentucky (Tygarts Creek, Kinniconick Creek, Licking River, Slate Creek, Middle Fork Kentucky River, Red Bird River, Red River, Rolling Fork Salt River, Green River, and Buck Creek), Michigan (Grand River, Flat River, Maple River, Pine River, Belle River, Clinton River, Huron River, Davis Creek, South Ore Creek, and Portage River), Minnesota (Mississippi River, St. Croix River), Missouri (Meramec River, Bourbeuse River, St. Francis River, and Black River), Ohio (Grand River, Ohio River, Muskingum River, Walhonding River, Killbuck Creek, Olentangy River, Big Darby Creek, Little Darby Creek, Salt Creek, Scioto Brush Creek, South Fork Scioto Brush Creek, Little Miami River, and Stillwater River), Pennsylvania (Allegheny River, French Creek, West Branch French Creek, Le Boeuf Creek, Woodcock Creek, Muddy Creek, Conneaut Outlet, Little Mahoning Creek, Shenango River, and Little Shenango River), Tennessee (Clinch River, Powell River, Elk River, and Duck River), Virginia (Clinch River and Powell River), West Virginia (Ohio River, Middle Island Creek, McElroy Creek, Little Kanawha River, Hughes River, North Fork Hughes River, and Elk River), and Wisconsin (St. Croix River, Wolf River, Embarrass River, Little Wolf River, and Willow Creek); and Ontario, Canada (Ausable River and Sydenham River). It is probable that the species persists in some of the 132 streams or lakes where it is now considered extirpated (Butler 2007); however, if extant, these populations are likely to be small and not viable.

Based on historical and current data, the Snuffbox has declined significantly range-wide and is now known only from 79 streams (down from 210 historically), representing a 62 percent decline in occupied streams. Because multiple streams may comprise a single Snuffbox population, the actual number of extant populations is fewer than 79. Extant populations, with few exceptions, are highly fragmented and restricted to short reaches. Available records indicate that 25 of 79, or 32 percent, of streams considered to harbor extant populations of the Snuffbox are represented by only one or two recent live or fresh dead individuals (Little Wolf, Maple, Pigeon, Kankakee, Meramec, Ohio, Muskingum, Olentangy, Stillwater, Hughes, Green, Powell, Duck, and Black Rivers; and Little Mahoning, Woodcock, McElroy, Big Darby, Little Darby, Salt, South Fork, Scioto Brush, Slate, and Buck (Indiana), Graham, and Buck (Kentucky) Creeks

(USFWS 2012).

Threats to the Species

In general, the decline of the Snuffbox parallels the decline and elimination of freshwater mussels from many big river systems in the United States. The Snuffbox was listed as endangered for similar reasons largely because of its extirpation from many river systems and significant reduction in range (USFWS 2012). Habitat destruction and degradation as a result of physical, chemical, and biological alterations, has and continues to threaten populations throughout their current ranges. The major causes of such alterations are impoundments, water pollution, sedimentation, river alterations (channelization and dredging), mining activities, and invasive species. Presented below is a brief description of the threats; additional information, including a description of all potential threats, may be found in the final listing rule for the Snuffbox and rayed bean mussels (USFWS 2012).

Impoundments

Impoundments negatively affect mussels both upstream and downstream by inducing bank and channel scouring, altering water temperature regimes, and altering habitat, food, and fish host availability (Neves *et al*. 1997, Watters 2000). Impoundments permanently flood stream channels and eliminate flowing water that is essential habitat for most unionids (Fuller 1974, Oesch 1995). Scouring is a major cause of mussel mortality below dams (Layzer *et al.* 1993). Most detrimental, however, is the disruption of reproductive processes. Impoundments interfere with movement of host fishes, alter fish host assemblages, and isolate mussel beds from each other and from host fishes (Stansbery 1973, Fuller 1974, Vaughn 1993, Williams *et al.* 1993). The result is diminished recruitment (Layzer *et al.* 1993).

Water Quality Degradation

Mussel biologists generally agree that contaminants are partially responsible for the decline of mussels (Havlik and Marking 1987, Bogan 1993, Williams *et al.* 1993, Neves et al. 1997, The National Native Mussel Conservation Committee 1998). Mussels are sedentary filter feeders and are vulnerable to contaminants that are dissolved in water, associated with suspended particles, or deposited in bottom sediments (Naimo *et al.* 1992). Mussels appear to be among the most sensitive organisms to heavy metals (e.g. cadmium, chromium, copper, mercury, zinc) some of which are lethal even at low levels (Havlik and Marking 1987, Keller and Zam 1991, Wang *et al*. 2007*a*, Wang *et al*. 2007*b*, Wang *et al*. 2010). Heavy metals can enter streams from various mining activities like metal and coal mining, which can also affect other water quality parameters such as pH (USFWS 2012). Mussels are also sensitive to ammonia (Augspurger *et al*. 2003, Wang *et al*. 2007*a*, Wang *et al*. 2007*b,* Wang *et al.* 2010), which is a common pollutant in streams associated with animal feedlots, nitrogenous fertilizers, and the effluents of municipal wastewater treatment plants (Goudreau *et al*. 1993). Contaminants enter streams from point and nonpoint sources. Point source pollution is the entry of material from a discrete, identifiable source such as industrial effluents, sewage treatment plants, solid waste disposal sites, and accidental chemical spills. Industrial and municipal effluents often contain heavy metals, ammonia, chlorine, phosphorus, and numerous organic compounds. Direct freshwater mussel mortality from toxic spills and polluted water is well documented (Ortmann 1909, Baker 1928,

Cairns *et al.* 1971, Goudreau *et al.* 1988). Decline and elimination of populations may be due to acute and chronic toxic effects that result in direct mortality, reduced reproductive success, or compromised health of the animal or host fish.

Nonpoint source pollution is the entry of material into the environment from a diffuse source such as runoff from urban areas, cultivated fields, pastures, private wastewater effluents, agricultural feed lots and poultry houses, active and abandoned mines, construction, and highway and road drainage. Stream discharge from these sources may accelerate eutrophication (i.e., organic enrichment), decrease oxygen concentration, increase acidity and conductivity, and cause other changes in water chemistry that are detrimental to the survival of unionids and may impact host fishes (Fuller 1974, Dance 1981, Goudreau *et al.* 1988). Eutrophication generally occurs when nutrients are added in concentrations that cannot be assimilated as a result of runoff of organic wastewater contaminants from livestock farms and fertilizers used on row crops. Excessive growths of filamentous algae alter the surface of the stream bottom and may cause shifts in algal communities, disrupting food supplies for mussels. Juvenile mussels, utilizing interstitial habitats, are particularly affected by excessive levels of oxygen-consuming algae during nocturnal respiration (Sparks and Strayer 1998). Pesticides from row crops are a major source of agricultural contaminants, and are known to have direct affect on mussels (Havlik and Marking 1987).

Sedimentation

Sediment is material that is suspended in the water, and is being transported, or has been moved, as the result of erosion [U.S. Soil and Conservation Service (USSCS) 1988]. Although sedimentation is a natural process, intensive agricultural practices, channelization, impoundments, timber harvesting within riparian zones, heavy recreational use, urbanization, and other land use activities can accelerate erosion (Chesters and Schierow 1985, Myers *et al.* 1985, Waters 1995, Watters 2000). The water quality impacts caused by sedimentation are numerous. Generally, it affects aquatic biota by altering the substratum and by altering the chemical and physical composition of the water (Ellis 1936, Myers *et al.* 1985, USSCS 1988). Heavy sediment loads can directly affect freshwater mussel survival by interfering with respiration and feeding. Due to their difficulty in escaping smothering conditions (Imlay 1972, Aldridge *et al.* 1987), either sudden or gradual blanketing of the stream bottom with sediment can suffocate freshwater mussels (Ellis 1936). Sediment particles may carry contaminants toxic to mussels (Naimo *et al.* 1992). Increased sediment levels may also reduce feeding efficiency (Ellis 1936), which can lead to decreased growth and survival (Bayne *et al.* 1981). Additionally, fine sediment fills interstitial spaces in the substrate in which young juveniles feed (Yeager *et al.* 1994). Sedimentation can also affect mussels indirectly by disrupting the life cycle. Impacts to host fish populations, such as reduced food availability and the elimination of spawning beds and habitat critical to young fish, will affect dependent mussel populations.

River alterations and gravel mining

Channelization, sand and gravel mining, and dredging operations physically remove mussels from the water and may also bury or crush mussels (Watters 2000). More lasting effects of these activities involve the alteration or destruction of important unionid habitat that can extend upstream and downstream of the excavated area. Headcutting, the upstream progression of

stream bed destabilization and accelerated bank erosion, can affect an area much larger than the dredging site (Hartfield 1993). In severe cases, this erosional process can extend for several miles upstream. As relatively immobile bottom-dwelling invertebrates, mussels are particularly vulnerable to channel degradation (Hartfield 1993). Accelerated erosion also releases sediment and pollutants, and in some instances, diminishes mussel diversity and habitat as documented in the Yellow and Kankakee Rivers in Indiana, the Big Vermillion River in Illinois, and the Ohio River (Fuller 1974).

Invasive species

The introduction of non-native freshwater bivalves into the United States has contributed to the decline of the native mussel fauna. The recent invasion of the exotic Zebra and Quagga mussels (*Dreissena polymorpha* and *D. bugensis*) pose a substantial threat to native unionids (Herbert *et al.* 1989). The introduction of *Dreissena* into North America probably resulted from an ocean-crossing vessel that discharged freshwater ballast from Europe containing free-swimming larvae (Griffiths *et al.* 1991). Since the introduction of these species, the zebra mussel has proved to be more widespread and abundant. Since the discovery of Zebra mussels in North America in Lake St. Clair of the Laurentain Great Lakes in 1988, this prolific species has spread throughout the Mississippi River and many of its tributaries including the Illinois and Ohio basins and the Arkansas (into Oklahoma and Kansas) and Tennessee rivers.

Zebra and Quagga mussels have effective dispersal mechanisms, which has facilitated their spread in the United States. Because Zebra mussels attach themselves to hard surfaces, they can spread by attaching and living on commercial and recreational vessels. The free swimming, microscopic larva spread naturally downstream of reproducing populations. The larva are also transported from infected waters via bait buckets and live wells of recreational boats and introduced into new areas. Zebra mussels starve and suffocate native mussels by attaching to their shells and the surrounding habitat in large numbers. The spread of this prolific species has caused severe declines of native freshwater mussel species in many areas (Tucker *et al.* 1993). Populations in navigable rivers and downstream from reservoirs are particularly vulnerable due to commercial and recreational vessels that utilize these water bodies, which will hasten the invasion.

The Asian clam (*Corbicula fluminea*) is another freshwater bivalve that has been introduced into North America. It was first discovered in the United States in the late 1930's (Oesch 1995). Its prolific reproductive capability has allowed it to quickly spread its range across the continent, and the species is now almost ubiquitous throughout the range of the Scaleshell. The Asian clam can become the dominant benthic species as densities of several hundred to 10,000/m^2 have been reported in some rivers (Neves 1986, Sickel 1986). The species is believed to compete with native mussels for resources such as food, nutrients, and space (Kraemer 1979). High densities of Asian clams have been found to negatively affect the survival and growth of juvenile native mussels by disturbance and displacement of young juveniles and possibly through incidental ingestion of newly metamorphosed individuals (Yeager *et al*. 2000). Further, *Corbicula* populations can grow rapidly and are prone to rapid die-offs (McMahon and Williams 1986), which can affect native mussels by depleting the oxygen supply and by producing high levels of ammonia (Strayer 1997).

Critical Habitat

No critical habitat has been designated, or proposed, for these species, therefore, none will be affected.

ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the Action Area, i.e., the species status given the effects from all past, current and ongoing factors within the Action Area. The environmental baseline is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the action under review in the consultation.

Status of the Species within the Action Area

As noted under "DESCRIPTION OF THE PROPOSED ACTION", the action area is located at Route T on the Bourbeuse River. The Bourbeuse River is a low gradient, moderately turbid stream that flows northeasterly out of the northern quarter of the Ozark Highlands. It is a major tributary to the Meramec River and is known for its diverse assemblage of freshwater mussels (Buchanan 1979, Roberts and Bruenderman 2000). In all, the Bourbeuse River supports 40 mussel species including nationally important populations of the federally endangered Snuffbox, scaleshell (*Leptodea leptodon*), sheepnose (*Plethobasus cyphyus*), spectaclecase (*Margaritifera monodonta*), and winged mapleleaf (*Quadrula fragosa*) (Buchanan 1970 and McMurray et al 2012). Aquatic habitat in the Bourbeuse River is dominated by pool and slow run/glide habitat separated by occasional small riffles. An important natural feature of the Bourbeuse River is the occurrence of diverse mussel beds, where multiple mussel species are concentrated in a localized area. The Snuffbox typically occurs in mussel beds (Roberts and Bruenderman 2000), but specifically it has been reported in the Bourbeuse River from shallow water in moderate to swift current (i.e. riffles) in a substrate consisting of gravel and rubble, rubble, or a combination of gravel, rubble, and boulders (Buchanan 1979, Oesch 1995, Roberts and Bruenderman 2000).

The Bourbeuse River supports one of the most important Snuffbox populations in Missouri and range wide. It is considered to be a large population relative to other rivers and is recruiting with a high potential viability and improving population trend (USFWS 2012). Thus, the Bourbeuse River is essential to the recovery of the Snuffbox mussel. While the Bourbeuse River Snuffbox population is considered large, the species is still rare relative to other species. Buchanan (1979) found it at only seven sites (14 living specimens) in the Bourbeuse River during a basin-wide mussel survey. These sites were resurveyed in 1997 and the species was only found at two of Buchanan's sites (16 specimens) (Roberts and Brundermen 2000). Additional Snuffbox sites have been found in the Bourbeuse River during subsequent searches focused on finding the species (McMurray et. al 2012). In all, there are 26 sites (i.e. mussels beds) on the Bourbeuse River where the Snuffbox has been observed live (MDC mussel database, 2018). The Route T bridge is located in the middle of a known Snuffbox site that also supports 22 other mussel species (Buchanan 1979, Roberts and Bruenderman 2000). The mussel bed extends from approximately 100 m upstream to 150 m downstream of the bridge. Buchanan (1979) first surveyed this site and found two living Snuffbox. However, the species was not detected during

a resurvey of the Route T mussel bed in 1997 (Roberts and Bruenderman 2000).

Current mussel survey of Route T mussel bed

On August 21, 2018, the Route T mussel bed was surveyed by USFWS and MoDOT biologists to assess the mussel community and Snuffbox population. A timed visual search was conducted within the downstream end of the mussel bed (downstream of bridge) to confirm the continued presence of mussels at the site, determine the distribution of mussels in relation to the bridge, and delineate occupied habitat for semi-quantitative sampling. Systematic, semi-quantitative sampling was conducted within the delineated habitat to estimate mussel density (individuals/m^2). This involved searching for mussels within 52 0.25-m2 quadrats spaced evenly within delineated mussel habitat with three random starts (Smith et al. 2001, Strayer and Smith 2003). At each random sampling location, the quadrat was placed on the stream bottom, and all visible mussels were collected while removing any loose cobble and flat rocks lying on the surface. The remaining gravel substrate was searched by gently fanning/mixing the substrate to remove algae growth until no mussels were visible. All living mussels collected within each quadrat were identified and replaced into the quadrat location.

During the timed searches, a total of 109 mussels were found in 5.25 person hours representing 15 species, including one live male Snuffbox. At the time of the survey, there were two main flowing channels downstream of the bridge (Figure 2). However, the majority of mussels were found in the shallow riffle within the main channel (left descending channel). The secondary channel on the right descending side likely becomes disconnected during lower flows (Figure 2). A small number of mussels (including a live Snuffbox) were also present in the shallow pool at the downstream end of the sampling area (Figure 2). Mussels were present under the bridge, but only between the scattered outcroppings of bedrock present in this area. The footprint of the proposed causeway (area immediately upstream of the bridge) contained mostly unsuitable habitat; loose gravel in a shallow pool on the right descending side and bedrock across the remaining channel. No further timed searches were conducted once the presence of mussels and Snuffbox were confirmed and the distribution of mussels determined. The mussel habitat delineated for semi-quantitative sampling included an approximately 50-meter area of flowing habitat 30 meters downstream from the bridge (Figure 2).

During the semi-quantitative sampling 58 individual mussels representing 11 species were found in the ¼ m^2 quadrats. This included one male Snuffbox collected near the upstream end of the delineated area. Incidentally, another living Snuffbox (a female specimen) was spotted outside one of the quadrats, also near the upstream end of the delineated area. Overall mussel density in the project area was estimated to be 4.48 mussels/m^2, and the Snuffbox density is estimated to be 0.02 individuals/m^2. According to semi-quantitative sampling, the three most abundant mussels in the mussel bed were ellipse (*Venustaconcha ellipsiformis*), round pigtoe (*Pleurobema sintoxia*), and spike (*Eurynia dilatata*) with 24, 11, and 7 individuals collected respectively. Combining the timed and semi-quantitative sampling (and the incidental collection of the female Snuffbox), 167 mussel were collected in the project area representing 11 species, including three Snuffbox (two male and one female).

Figure 2. Aerial photo of the Route T bridge replacement site showing approximate area of known mussel bed (yellow) and upstream/downstream boundary of area delineated for semi-quantitative sampling.

Factors Affecting the Species within the Action Area

Roberts and Brunderman (2000) listed several ongoing threats to freshwater mussels in the Meramec River Basin including channel and bank degradation, contaminants, small impoundments, sedimentation, and non-native species. The action area is located in the upper portion of the Bourbeuse River within a large rural area. Therefore, the most likely factors affecting the Snuffbox in the action area are bank and channel erosion, water quality degradation, sedimentation, and stochastic events such as droughts and floods. Land use activities that remove vegetation in the watershed upstream of the action area can increase water runoff and cause channel/bank erosion of Bourbeuse River and tributaries. The increased runoff can mobilize sediments. This "bed-load" can enter the Bourbeuse River and smother downstream mussel beds. Likewise, the increased runoff also can destabilize the channel and streambed of the Bourbeuse River proper. Habitat loss associated with these erosional processes was the most evident reason for the decline of mussels in the Meramec Basin observed by Roberts and Bruenderman (2000). Unionids require a stable substrate to survive and reproduce and are particularly susceptible to channel instability (Murray and Leanard 1962, Yokley 1976, Neves *et. al*. 1997, Parmalee and Bogan 1998, Strayer 2008).

Mussels are sensitive to a variety of contaminants (Havlik and Marking 1987, Williams *et al*. 1993, The National Native Mussel Conservation Committee 1998). Mussels are sedentary filter feeders and are vulnerable to contaminants that are dissolved in water, associated with suspended particles, or deposited in bottom sediments (Naimo *et. al*. 1992). Sources of contaminants in the

action area include non-point sources from cultivated fields, pastures, and private wastewater effluents. Discharge to a stream from these sources may accelerate eutrophication, decrease oxygen concentration, increase acidity and conductivity, and cause other changes in water chemistry that are detrimental to the survival of mussel species and may impact host fishes (Goudreau *et al*. 1988, Dance 1981, Fuller 1974). Eutrophication was observed during previous mussel surveys in the reaches of the Bourbeuse River including the action area (Allan Buchanan, MDC, pers. com., 2000; Roberts and Brunderman 2000).

EFFECTS OF THE ACTION

This section includes an analysis of the direct and indirect effects of the proposed action on the species and critical habitat and its interrelated and interdependent activities.

Factors Considered

Our analysis considers the following factors:

Proximity of the action: The proposed action will directly affect occupied habitat of the species.

Distribution: The Action Area includes a relatively small fraction of the range of the species.

Timing: All stages of the proposed bridge work are planned to occur between June 15th and November 15th, 2019. The causeway construction will take approximately two to three days at the start of the project (on or near June 15th) and will remain in the river channel until November 15th (at the latest). The removal of the steel structure from the river channel will take place after construction of the causeway and will take one day. Deconstruction of the causeway will be the last of the instream work and will take approximately two to three days.

Nature of the effect: Direct and indirect effects are described below.

Duration: The causeway will have a footprint in suitable mussel habitat throughout construction period. Other direct effects of the causeway are expected to be short-term, occurring during construction and deconstruction (a total of four to six days). Removal of the steel structure will have short-term effects, starting from the time it is dropped in the channel until it is removed (one day). Indirect effects of the causeway are likely to occur after construction during high water events, while the causeway is in the river from June 15-November 15. Likewise, hydraulic effects of the pilings will occur for many years after construction during high water events.

Disturbance frequency: Disturbance will occur in the vicinity of the causeway throughout the construction period and during the following events: construction/deconstruction of the causeway, removal of the steel structure, pier construction, and high flows in the river channel. Effects of runoff will occur after local rain events.

Disturbance intensity and severity: The intensity and severity of the disturbance are described below.

Impact of the Proposed Action

Direct Effects

Direct effects are defined as the direct or immediate effects of the action on the species or its critical habitat. The primary direct effects of the Route T bridge replacement on the Snuffbox mussel are related to the causeway construction/deconstruction and removal of the existing bridge. The construction of the causeway may crush and kill any remaining mussels in the proposed footprint of the structure (i.e. any mussels missed during the relocation). The instream footprint of the causeway is approximately 40x60 ft. and contains mostly (about 75% of the total area) loose gravel and pockets of bedrock, which is unsuitable substrate for mussels. Streambed disturbance from causeway construction will also cause increased turbidity for mussels downstream for a period of approximately two to three days. Dropping and removing the steel structure will have effects similar to the causeway construction. It may crush and kill any mussels still remaining in the area immediately downstream from the causeway within an area approximately 20x50ft. Additional substrate disturbance and increased turbidity will likely occur when the steel structure is removed from the river. Lastly, when the causeway is removed, turbidity will likely increase over the downstream mussel bed for a period of two to three days. In all, at least 139 m^2 of habitat will likely be destroyed by the direct effects of the causeway and removal of the existing bridge.

Based on the area of direct impact and results from the semi-quantitative survey, we anticipate that up to three Snuffbox mussels may be killed during the above construction activities. This assumes the worst case scenario that no Snuffbox mussels are found during the relocation (i.e. all snuffbox in the area are missed). Snuffbox mussels living in the 150 m reach downstream of the causeway and bridge drop area are likely to experience periods of higher turbidity compared to ambient levels during the day and for the duration of the construction or deconstruction period of the causeway, and bridge removal (as indicated above). The increased turbidity may result in a reduction in feeding and ventilation and interfere with interactions between Snuffbox and its host fish during the later part of the host fish infestation period for Snuffbox.

Several potential direct affects will be minimized or avoided as described in MoDOT's conservation measures. By placing the causeway upstream of the bridge, only 25% of the instream footprint will affect suitable mussel substrate. The existing bridge deck will be removed before the steel superstructure is dropped into the river channel (i.e. the concrete slabs will not be dropped into the water). The steel structure will be cut into pieces before being dropped and immediately removed from the river channel. The causeway will be constructed after the peak of the fish-host infestation period for Snuffbox and fish spawning dates. The causeway will have a minimum of 100 sq. ft. of hydraulic opening, which will not significantly increase flow downstream during normal low flow periods. However, during increased flows, this will not be the case (see **Indirect Effects** below). Deconstruction of the causeway will occur after the spawning period for Snuffbox. The bridge piers will be located outside of the river channel and near the existing pier locations. Any cement that might seep from the forms will be trapped by the work pad that surrounds the shafts and the water from drilled shafts will be pumped out and prevented from entering the river.

Indirect Effects

Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur [50 CFR §402.02]. The indirect effects of the causeway are likely to cause lethal take in a larger area than the footprint of the causeway itself and may extend both upstream and downstream of the structure. The causeway will be in the river channel from June 15th to November 15th (at the longest). Indirect effects will be associated with rainfall events, and the intensity of those effects will be positively correlated with increased flows. As the water rises, current velocity will increase through the culverts and downstream from the openings. This will cause substrate scouring on the downstream side of the culverts, rendering the area unsuitable for mussels. The substrate (e.g. cobble, gravel, sand, and silt) that is mobilized from this flume will settle out on the stream bottom as the current velocity attenuates and is likely to smother mussels living in those areas. According to MoDOT's hydraulic modeling presented in the BA, gravel sized substrate will settle out before traveling past the downstream edge of the existing bridge. Smaller particle sizes (i.e. sand and fine gravel), which are expected to be a smaller volume, will settle out in areas beyond that point. Other effects associated with rainfall will be increased turbidity and sedimentation carried by local runoff from areas of the construction site with disturbed soil.

The causeway structure will hold some water back during higher flows, but not to a great extent. The decrease in water velocity at this point may cause some bedload, probably sand and fine gravel, to settle out on top of the mussel bed in areas adjacent to the culvert openings. As larger rainfall events cause stream flow to overtop the causeway current velocity through the culverts will not increase, but flow over the structure will cause a plunge pool to form on the downstream side. This is likely to scour substrate, which will deposit some distance downstream from the causeway. According to MoDOT hydraulic modeling presented in the BA, the scour and deposition of gravel will occur with an area before the downstream edge of the existing bridge.

Cumulative Effects

For purposes of consultation under ESA Section 7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under Section 7 of the ESA. We are not aware of any non-federal actions in the Action Area that may affect the Snuffbox mussel. Therefore, cumulative effects are not relevant to formulating our opinion for the Action.

Interrelated and Interdependent Actions

Interrelated activities are those that are part of a larger action and depend on the larger action for their justification; interdependent actions have no independent utility apart from the proposed action; and indirect effects are those caused by or result from the agency action, are later in time, and are reasonably certain to occur. There are no interrelated or interdependent activities anticipated related to the proposed bridge replacement project.

Summary of Effects of the Action

As described above, the Service estimates that up to three Snuffbox mussels may be killed by the proposed bridge replacement project by direct and indirect effects from the causeway and bridge demolition. These mussels will be either crushed by the causeway and bridge steel structure or buried from gravel and sediment deposition. The remaining portion of the mussel bed downstream of the bridge will be subject to increased turbidity during construction/deconstruction of the causeway, bridge removal, and land disturbance resulting in reduced feeding and ventilation and interruptions in host fish infestation. Further, the downstream mussel bed will be subject to some level of deposition of a relatively small amount of sand during increased flows while the causeway is in place between June 15th and November 15th. This could also interfere with normal Snuffbox feeding and ventilation.

Because we anticipate impacts to individuals, we must evaluate the aggregated consequences of the effects to individuals and habitat on the fitness of the river population to which those individuals belong. Currently, there are 25 other known sites (i.e. mussel beds) in the Bourbeuse River where the Snuffbox has been collected live (MDC mussel database, 2018). Additional habitat is likely present in some areas that have not been surveyed. Based on this information, and the small scale of impacts relative to the overall population of snuffbox in the Bourbeuse River, we do not think that the loss of Snuffbox mussels at the Route T crossing will affect the long-term persistence of the Bourbeuse River population. Likewise, the local Snuffbox population at Route T is likely to sustain the anticipated effects of the bridge replacement. Lethal take and habitat destruction are expected to occur along approximately 20% of the mussel bed's length. Sublethal effects will be short in duration, occur only downstream of the bridge, and attenuate with distance from the construction site. No effects are expected to the upstream 100 m of the mussel bed, and therefore Snuffbox in that reach should remain unaffected. Because mussels along 80% of the mussel bed are expected to survive, the remaining Snuffbox at Route T should be a sustainable population after bridge construction. Additionally, there is another local population in close proximity to the project area (approximately 300m upstream of the bridge) that is close enough to help repopulate disturbed areas within the project area. The overall habitat in this river reach is expected to remain stable post construction because of the presence of bedrock outcroppings that serve to stabilize the stream bed.

CONCLUSION

After reviewing the current status of the Snuffbox mussel, environmental baseline for the action area, the effects of the proposed bridge replacement, and cumulative effects, it is the Service's biological opinion that the completion of the project, as proposed, is not likely to jeopardize the continued existence of these species. No critical habitat has been designated, or proposed, for this species, therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation 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, 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 an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering [50 CFR §17.3].

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 taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

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

Amount or Extent of Take Anticipated

As described within the accompanying BO, adverse effects to the Snuffbox mussel will occur as a result of the bridge replacement project. During the construction period, it is expected that at least 139 m^2 of habitat will likely be destroyed by direct and indirect effects of the causeway. Within this area, up to three snuffbox will likely be taken (killed) during bridge construction. Snuffbox mussels within 150 m downstream of the existing bridge will likely experience harm from increased turbidity for up to three days during construction and up to three days during deconstruction of the causeway. Similar conditions will occur for one day while the steel structure is dropped and removed from the river channel. The take provided is set based on the results of the mussel survey conducted in the action area.

Effect of Take

In the accompanying biological opinion, the Service determined that the level of anticipated take is not likely to jeopardize the continued existence of the Snuffbox mussel. No critical habitat has been designated for this species; therefore, none will be affected.

Reasonable and Prudent Measures

The Service believes the following RPMs are necessary and appropriate to minimize impacts of incidental take of the Snuffbox mussel:

1. The FHWA will ensure that the conservation measures outlined under the **DESCRIPTION OF THE PROPOSED ACTION** are implemented.

2. The FHWA will require MoDOT to monitor the construction site to ensure that the take is minimized and not exceeded and that the Service is notified of any violations or unforeseen circumstances.

Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the Act, the FHWA must ensure compliance with the following terms and conditions, which implement the RPMs described above. The terms and conditions are non-discretionary.

RPM 1

1.1 MoDOT and the Service will work together to relocate mussels from the impact areas before construction of the causeway begins. The Service and MoDOT will agree upon the relocation site prior to the search and relocation, and the effort will take place when there is no significant rain predicted for 24 hours. Each relocated animal will be measured, tagged with a unique number, and placed on suitable substrate at the relocation site. Before release, the receiving substrate will be lightly loosened by hand to a depth of approximately 8 cm for each individual Snuffbox to facilitate burrowing. The GPS coordinates for each relocated individual will be taken and recorded. This data will be shared with the State Malacologist (Steve McMurray, Missouri Department of Conservation).

1.2 MoDOT and the Service will work together to conduct a post-construction assessment of the habitat conditions in the project area when the instream work is complete. Several tools can be used to assess post-project habitat conditions including recent aerial photos, the presence of living mussels, and overall observations on substrate condition. Field biologist representing the Service and MoDOT (ideally those who were present for the initial mussel survey for this project) will work together to arrive to a consensus on the amount of habitat affected and severity of any impacts observed. Observations may include large changes in channel conveyance, substrate scour, and sediment deposition in the project area.

RPM 2

2.1 The FHWA will ensure that the Service is notified of project initiation and completion dates.

2.2 The FHWA will ensure that the Service is notified of any violations of the U.S. Army Corps of Engineers Nationwide 14 or the General Permit by including the

Service on any non-compliance correspondence.

2.3 If any of the above monitoring requirements cannot be implemented or require modification, contact Service biologist Andy Roberts at 573-234-2132 x 110 for further discussion.

The 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. The Service believes that the action will result in the mortality of no more than three Snuffbox mussels.

If, during the course of the action, these numbers are exceeded, such incidental take represents new information requiring the reinitiation of consultation and review of the reasonable and prudent measures provided. The FHWA 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 programs, or to develop information.

The following recommendations are provided for your consideration, to provide additional conservation benefits for the Snoffbox mussel within its known range.

1. Continue to monitor the habitat, Snuffbox population, and associated mussel community at the Route T project site after the post monitoring project to provide information on future recovery of habitat and mussels.

2. Contribute additional funds to further the recovery of the Snuffbox mussel in the Meramec River Basin.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the BO. 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 shows that the action may affect listed species in a manner or to an extent not considered in this BO; (3) the action is

subsequently modified in a manner that causes an effect to the listed species not considered in this BO; 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.

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