STATE OF MICHIGAN
RICK SNYDER
GOVERNOR
MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY
STATE HISTORIC PRESERVATION OFFICE
KEVIN ELSENHEIMER
EXECUTIVE DIRECTOR

June 8, 2016

JAMES E. MYSTER
REGIONAL HISTORIC PRESERVATION OFFICER / ARCHAEOLOGIST
U S FISH AND WILDLIFE SERVICE
MIDWEST REGION
5600 AMERICAN BOULEVARD WEST SUITE 1049
BLOOMINGTON MN 55437-1173

RE: ER-5813 Removal of Lyons & Hale Dams, Sec. 19, T7N, R5W, Lyons, Ionia County (FWS)

Dear Mr. Myster:

Under the authority of Section 106 of the National Historic Preservation Act of 1966, as amended, we have reviewed the above-cited undertaking at the location noted above. Based on the information provided for our review, it is the opinion of the State Historic Preservation Officer (SHPO) that **no historic properties are affected** within the area of potential effects of this undertaking.

This letter evidences the USFWS's compliance with 36 CFR § 800.4 "Identification of historic properties," and the fulfillment of the USFWS's responsibility to notify the SHPO, as a consulting party in the Section 106 process, under 36 CFR § 800.4(d)(1) "No historic properties affected." **If the scope of work changes in any way, or if artifacts or bones are discovered, please notify this office immediately.**

We remind you that federal agency officials or their delegated authorities are required to involve the public in a manner that reflects the nature and complexity of the undertaking and its effects on historic properties per 36 CFR § 800.2(d). The National Historic Preservation Act also requires that federal agencies consult with any Indian tribe and/or Tribal Historic Preservation Officer (THPO) that attach religious and cultural significance to historic properties that may be affected by the agency's undertakings per 36 CFR § 800.2(c)(2)(ii).

The State Historic Preservation Office is not the office of record for this undertaking. You are therefore asked to maintain a copy of this letter with your environmental review record for this undertaking.

If you have any questions, please contact Brian Grennell, Cultural Resource Management Specialist, at 517-335-2721 or by email at GrennellB@michigan.gov. **Please reference our project number in all communication with this office regarding this undertaking.** Thank you for this opportunity to review and comment, and for your cooperation.

Sincerely,

Brian G. Grennell
Cultural Resource Management Specialist

for Brian D. Conway
State Historic Preservation Officer

DLA:BGG

Copy: Rick Westerhof, USFWS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
East Lansing Field Office (ES)
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823-6316

IN REPLY REFER TO:

August 17, 2015

Memorandum

To: Project Leader, USFWS, Green Bay Fish and Wildlife Conservation Office, New Franken, Wisconsin

From: Project Leader, USFWS, East Lansing Field Office, East Lansing, Michigan Scott Hicks

Re: Biological Opinion for the Removal of Lyons Dam, Ionia County, Michigan; Log No. 15-R3-ELFO-05

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion), regarding the effects of the Lyons Dam Removal and Grand River Restoration Project in Ionia County, Michigan on snuffbox (*Epioblasma triquetra*), in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) [16 U.S.C., 1531 et seq.]. The Service's National Fish Passage Program, Great Lakes Basin Fish Habitat Partnership and Great Lakes Fish and Wildlife Restoration Act are providing partial funding for the project. We received the request for formal consultation on May 28, 2015.

We base this Opinion on information provided in the Biological Assessment (BA) for the Removal of Lyons Dam, as well as telephone conversations and email correspondences with the Service's Green Bay Fish and Wildlife Conservation Office (FWCO) and Michigan Department of Natural Resources (MDNR) Fisheries Division, published literature, and information obtained from species experts. A complete administrative record of this consultation is on file at the Service's East Lansing Field Office (ELFO).

Consultation History

- On March 5, 2013, biologists from ELFO, Green Bay FWCO, and MDNR met to discuss the dam removal project and potential impacts to snuffbox.

- On April 18, 2013, biologists from the Federal and State agencies and mussel researchers from Central Michigan University met to discuss snuffbox and potential surveys.

- On June 25, 2013, biologists from the Federal and State agencies met to discuss the consultation process for the proposed project.

- On January 22, 2014, researchers from Central Michigan University presented their snuffbox survey findings to the agencies at a meeting.
- On October 23, 2014, the Green Bay FWCO provided a draft BA to ELFO.
- On February 12, 2015, biologists from the agencies met to discuss the draft BA.
- On February 25, 2015, Green Bay FWCO sent a second draft BA to ELFO.
- On April 20, 2015, Green Bay FWCO submitted the final BA and request to initiate formal consultation.
- On May 20, 2015, ELFO requested additional information before formal consultation could begin.
- On May 28, 2015, Green Bay FWCO provided the revised final BA to ELFO.
- On June 10, 2015, ELFO sent Green Bay FWCO a letter indicating that all information required to initiate consultation was received.
- On August 6, 2015, ELFO sent a draft Opinion to Green Bay FWCO.
- On August 13, 2015, Green Bay FWCO provided ELFO with comments on the draft Opinion.

BIOLOGICAL OPINION

Description of the Proposed Action

Action Area

Lyons Dam is located on Grand River near the Village of Lyons in Ionia County, Michigan (Figure 1). The dam creates an impoundment of approximately 50ha that extends 3.6km upstream to the bend at Memorial Park. The original millrace and powerhouse are located on the right descending bank east of Grand River and Lyons Dam. Hazel Devore Park is located downstream of the bridge on an island formed by the narrow East Channel. The East Channel has a smaller abandoned dam and causeway, which provides vehicle access to and from the park. Maple River flows into the Grand River approximately 2.6km downriver from the dam.

Figure 1. Lyons Dam and surrounding area (from Biological Assessment for Removal of Lyons Dam)

Project Description

Lyons Dam was constructed using a rock and timber crib core with a concrete facing in 1857 for hydropower generation. The dam partially failed sometime between 1913 and 1919 and was subsequently repaired. Power production was abandoned in 1957, and the dam was sold to the Village of Lyons in 1960. The fish ladder at the east end of Lyons Dam was built in the 1980s and is owned by the MDNR. In 2001, MDNR reinforced the structure due to erosion along the east side of the dam. In 2008, a dam safety report from the Michigan Department of Environmental Quality identified structural deficiencies and concluded the dam represented a high hazard. As a result, the Village of Lyons decided to remove the dam instead of repairing it.

Lyons Dam is also a barrier to fish movement and impounds high-gradient habitat. Currently, salmonids can pass the dam through the fish ladder and ascend the river to the City of Lansing. Native warm-water fish species do not use the ladder, effectively blocking them from upstream movement.

Lyons Dam is 4m high by 84m wide. The proposed project will remove approximately 2.5m of the dam, close the adjacent fish ladder, and restore high-gradient habitat of Grand River. The removal of the dam will reconnect 25km of habitat upstream, 87km of habitat downstream, and provide passage for fish and other aquatic species.

The project will begin with the construction of a 7.62m-wide access road along the downstream face of the dam. The dam will then be slowly breached near the center to allow for a controlled drawdown of the impoundment at a rate of approximately 15cm/24 hrs. Following the drawdown, the dam will be removed to an elevation of 193.35m (634 feet) MSL (NAVDA88). The concrete cap, reinforcement structures, and wooden crib will be removed from the river and placed in the raceway pond or former mill race. The cobble and small boulders under the original rock and crib structure will be used to create a riffle with a final elevation of 193.7m (635.5 feet).

Following construction of the riffle, rip rap and six rock vanes will be placed on the left descending bank to prevent bank erosion. Approximately 500m upstream of the former dam, a toe wood mat consisting of layers of trees, boulders, stone, gravel, and willow mats will be placed to create a 5m-wide bankfull shelf. The existing fish ladder will be closed and filled. Downstream of the former dam a straight vane will be constructed on the left descending bank to protect the abutments of the Bridge Street Bridge. Additional work on the bridge includes replacement of the asphalt wearing surface, guardrail upgrades, light replacement, miscellaneous patching, replacement of the steel ice shields on the pier pilings, bank stabilization with rip rap along the west bank, and slope paving repairs.

A small dam located in the East Channel will also be removed, and a bankfull bench and rip rap will be placed to prevent bank erosion. The existing causeway and culverts in the East Channel will be removed (in the future) and replaced with a new bottomless arch to provide vehicular access to Hazel Devore Park. A grade-control cross vane will be installed upstream of the causeway, and a single straight vane will be installed downstream of the causeway in the East Channel to prevent a head cut and to protect existing infrastructure when the causeway is replaced and if the causeway overtops before then. Rip rap and a rock vane will be placed along the west bank of the island to prevent bank erosion in the park. Construction will occur during the low flow period of mid-July to early-October in 2016.

Conservation Measures

Conservation measures are part of the proposed action; therefore, we consider them in the analysis of effects. The BA includes the following conservation measures:

1. Four routes for the construction activities will be used for river access. Routes were developed using existing roads where possible to minimize impacts on snuffbox.

2. Turbidity curtains and a cofferdam enclosure will be utilized for the Bridge Street Bridge work to prevent downstream movement of fine sediments during construction activities.

3. Trees for the toe wood mat will be obtained locally (two miles upstream from the dam near an old gravel pit) between October 1 and March 31.

4. Snuffbox within the construction zones in regions 3 and 5 will be relocated to region 6 (refer to Figure 2) before construction activities begin. Each snuffbox will be examined for gravidity, measured, and photographed. Hallprint shellfish tags with unique numbers will be affixed to both valves of each snuffbox. All snuffbox will also be tagged with a Passive Integrated Transponder (PIT).

Status of the Species

Species Description

The snuffbox is a small to medium-sized mussel, with males reaching up to 2.8 in (7.0 cm) in length and females up to 1.8 in (4.5 cm) (Parmalee and Bogan 1998). 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 umbo (the inflated area of the shell along the dorsal margin), but become poorly delineated stripes with age. The shape of the shell is somewhat triangular in females and oblong or ovate in males, with the valves solid, thick, and very inflated. The beaks, located somewhat anterior of the middle, are swollen, turned forward and inward, and extend above the hinge line (Cummings and Mayer 1992). Beak sculpture consists of three or four faint, double-looped bars (Cummings and Mayer 1992, Parmalee and Bogan 1998). 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 (Cummings and Mayer 1992). The ventral margin is slightly rounded in males and nearly straight in females. Females have recurved denticles (downward curved tooth-like structures) on the posterior shell margin that aid in holding host fish (Barnhart *et al.* 2008).

The species was historically widespread, existing in 210 streams and lakes in 18 states and Ontario, Canada. Extant populations have been reduced to 79 streams in 14 states and one Canadian province within the upper and lower Great Lakes sub-basins, upper and lower Mississippi River sub-basins, lower Missouri River system, Ohio River basin, and White River system (USFWS 2012).

The snuffbox was listed as endangered on February 14, 2012 (77 FR 8632). Critical habitat has not been designated for this species.

Life History

The snuffbox is found in small to medium-sized creeks to large rivers. It occurs in swift currents of riffles and shoals over gravel and sand with occasional cobble and boulders. Individuals generally burrow deep into the substrate, except when spawning or attempting to attract a host (Parmalee and Bogan 1998).

Adults are suspension-feeders, spending their entire lives partially or completely buried within the substrate (Murray and Leonard 1962). Adults feed on algae, bacteria, detritus, microscopic animals, and dissolved organic material (Christian *et al.* 2004, Nichols and Garling 2000, Silverman *et al.* 1997, Strayer *et al.* 2004). Juvenile mussels utilize foot (pedal) feeding, consuming algae and detritus.

Age at sexual maturity in snuffbox is unknown. Males release sperm into the water. The sperm enter the female through the incurrent siphon tube, and the eggs are fertilized internally (Cummings and Meyer 1992). Fertilization success is influenced by mussel density and flow conditions.

Like other unionids, the snuffbox's life cycle includes a brief, obligatory parasitic stage on fish. Eggs develop into microscopic larvae, called glochidia, within special gill chambers (marsupia) of the female mussel. The female expels the mature glochidia, which must attach to the gills or the fins of an appropriate fish host to complete development. Following successful infestation, glochidia encyst (enclose in a cyst-like structure) and drop off as newly transformed juveniles.

To attract a host fish, a female snuffbox gapes its valves open. When a fish investigates and touches the mussel's exposed mantle, the mussel's valves snap shut, clamping down on the fish. The female snuffbox then releases glochidia directly onto the fish (Barnhart *et al.* 2008). Although snuffbox have successfully transformed on blackside darter *(P.maculata)*, Iowa darter *(E. exile)*, blackspotted topminnow *(Fundulus olivaceous)*, banded sculpin *(C. carolinae),* Ozark sculpin *(C. hypselurus)*, largemouth bass (*Micropterus salmoides*), and brook stickleback *(Culaea inconstans)* in laboratory tests (Barnhart 1998; Barnhart *et al.* 1998; Caldwell 2013; Hillegass and Hove 1997; Hove *et al.* 2000; McNichols and Mackie 2002, 2003, 2004; Sherman 1993, 1994; Sherman Mulcrone 2004; Yeager 1986; Yeager and Saylor 1995), the logperch (*Percina caprodes)* is likely the obligate host for snuffbox due to the mussel's trapping behavior that can kill other fish (Barnhart *et al.* 2008).).

The snuffbox is a long-term brooder. Spawning typically occurs in late summer (late July – August); the female snuffbox then broods the developing glochidia in the marsupia over the winter and releases the glochidia the following May. Sherman (1994) documented glochidial release beginning in mid-May, peaking in mid-June, and ending by mid-July although Caldwell (2013) found gravid females from June through October.

Population Dynamics

The snuffbox now occurs in only 79 streams, 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 (USFWS 2012). Extant populations, with few exceptions, are highly fragmented and restricted to short reaches. Of the 79 streams, 25 (32%) are considered to harbor extant populations represented by only one or two recent live or fresh dead individuals.

Butler (2007) categorized the extant populations into three groups based on population size, general distribution, evidence of recent recruitment, and assessment of current viability. Stronghold populations were identified as having sizable populations generally distributed over a significant and more or less contiguous length of stream [30 or more river miles (48 or more river km)], with ample evidence of recent recruitment, and currently considered viable. Significant populations were defined as small, generally restricted populations with limited recent recruitment and viability. Many significant populations are susceptible to extirpation, but this category has a broad range of quality. Marginal populations were described as very small and highly restricted populations, with no evidence of recent recruitment and of questionable viability. At the time of listing, there were 7 stronghold populations, 24 significant populations, and 48 marginal populations of snuffbox (USFWS 2012).

Status and Distribution

The decline of the snuffbox is primarily the result of habitat loss and degradation (Neves 1991). Chief among the causes of habitat loss are impoundments, channelization, chemical

contaminants, mining, and sedimentation (USFWS 2012). The majority of the remaining populations of the snuffbox is generally small and geographically isolated (Butler 2007). The patchy distributional pattern of populations in short river reaches makes those populations much more susceptible to extirpation from single catastrophic events, such as toxic chemical spills. Furthermore, this level of isolation makes natural repopulation of any extirpated population virtually impossible without human intervention.

The snuffbox has declined range-wide and appears to be extant in 79 of 210 streams and lakes of historical occurrence, a 62 percent decline in occupied streams. Realistically, much more than 62 percent of the habitat historically available for this species no longer supports its populations. Habitat losses measured in the thousands of miles have occurred range-wide (USFWS 2012).

The elimination of this species from scores of streams and thousands of miles of stream reaches indicates catastrophic population losses and a precipitous decline in overall abundance. It is reasonable to estimate that total range reduction and overall population losses for the snuffbox each approximate, if not exceed, 90 percent.

Analysis of the Species Likely to Be Affected

This Opinion considers adverse effects to the snuffbox as a result of the proposed action. No critical habitat has been designated or proposed for this species.

Indiana bat (*Myotis sodalis*), which is federally listed as endangered, and northern long-eared bat (*Myotis septentrionalis*), federally-listed as threatened, may also occur within the action area. Construction of the toe wood mat will require approximately 450 trees. These trees will be gathered locally and cut during October 1 - March 31. The BA indicates that the proposed action is not likely to adversely affect the Indiana and northern long-eared bats.

In Michigan, summering Indiana bats roost in trees in riparian, bottomland, and upland forests from approximately April through September. Indiana bats may summer in a wide range of habitats, from highly altered landscapes to intact forests. Roost trees vary considerably in size, but those used by Indiana bat maternity colonies are typically greater than 9 inches dbh. Male Indiana bats have been observed roosting in trees as small as 3 inches dbh.

During the summer, northern long-eared bats typically roost singly or in colonies underneath bark or in cavities, crevices, or hollows of both live and dead trees and/or snags (typically $\geq$3 inches dbh). This species has also been found roosting in structures, such as barns and sheds, occasionally (particularly when suitable tree roosts are unavailable). These bats forage for insects in upland and lowland woodlots and tree-lined corridors. During the winter, northern long-eared bats hibernate predominantly in caves and abandoned mine portals.

Removing trees during the winter months while bats are not present in the action area would avoid direct take of Indiana and northern long-eared bats. Removal of 450 trees would have an insignificant effect on these species' habitat and to any bats returning after April 1. Based upon this information, we concur that the proposed action is not likely to adversely affect the Indiana bat or northern long-eared bat. As such, these two species will not be considered further in this Opinion.

Environmental Baseline

Status of the Species within the Action Area

Butler (2007) categorized the population of snuffbox in Grand River as "significant," meaning the population is small and generally restricted with limited recent recruitment and viability. The snuffbox is sporadically distributed in approximately 25 river mi (40 river km) of the middle Grand River, approximately between the confluences of Flat and Maple rivers. The medium-sized population appears to be viable, with recruitment noted in 1999 (USFWS 2012).

Surveys for snuffbox were conducted within the action area in 2013 (Woolnough and Barnett 2013). Figure 2 shows the six survey regions, and Table 1 indicates the number of snuffbox found in each region. Although survey efforts did not include fish species, logperch were documented in the action area during a 2014 MDNR fisheries survey (S. Hanshue, MDNR, pers. comm. 2015).

No snuffbox were found in regions 1, 2, or 4. The substrate in region 1 was very unstable and predominantly composed of silt and muck. An abundance of rooted macrophytes indicates little to no suitable substrate for unionids. Region 2 had 15 species and 35 live unionids although there was also evidence of the invasive Chinese mystery snail (*Cipangopaludina chinensis malleata*) and Asian clam (*Corbicula fluminea*). Substrate in region 4 was predominately sand with some silt. Chinese mystery snail was pervasive in this region.

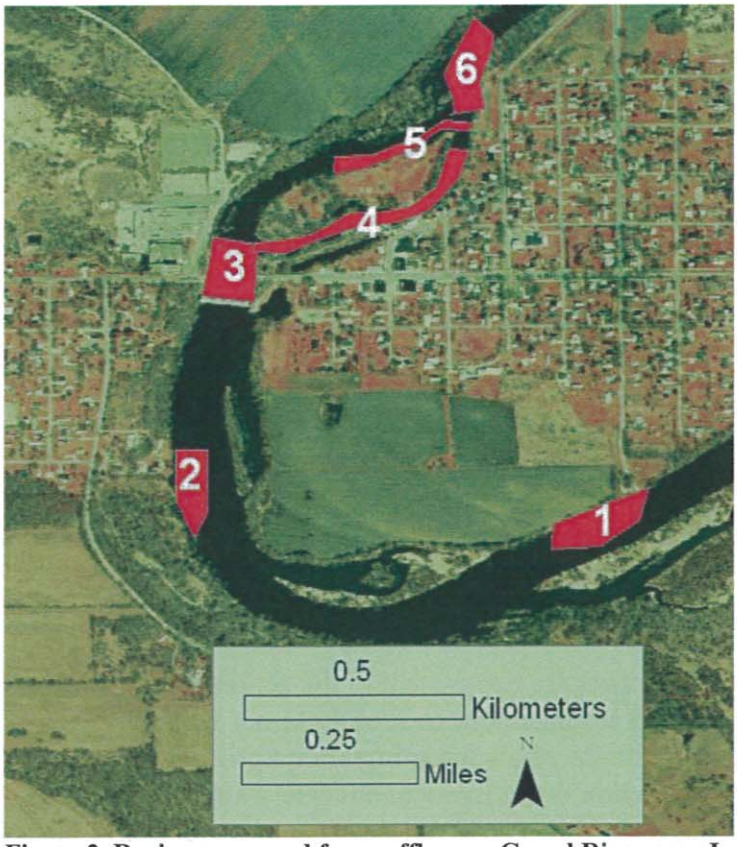

Figure 2. Regions surveyed for snuffbox on Grand River near Lyons Dam (from Woolnough and Barnett 2013)

Table 1. Federally-listed mussels found by river region (from Woolnough and Barnett 2013)

Region	Federally-Listed Species
1	None
2	None
3	62 live Snuffbox
4	None
5	3 live Snuffbox
6	7 live Snuffbox

A total of 296 live unionids, representing 20 species, was collected during the survey efforts in region 3. The overall density of live unionids was 2.78/m^2, and the density of snuffbox was 0.54/m^2. Population estimates for region 3 are 22,240 live unionids and 4,320 live snuffbox. Surveys found evidence of recruitment and various size classes as well as a near 1:1 sex ratio for snuffbox. Region 3 has the most variable habitat and substrate. The overall depth, during the time of survey (Summer 2013), was approximately 72cm and was dominated by a boulder, cobble, gravel, and sand mix, which probably accounted for the high mussel diversity. Snuffbox was typically found in the deeper areas with high gravel composition.

Three live snuffbox were recorded from region 5 during a timed-search survey. Habitat in region 5 was similar to region 3, except there was larger boulder/cobble substrate. Sand and gravel substrate dominated the near-shore areas with larger sized substrate in the mid-channel. Asian clams and Chinese mystery snails were found throughout region 5.

Region 6 had 16 species and 42 live mussels at a density of 1.68/m^2. Seven live snuffbox were collected, comprising 17 percent of the mussel assemblage at a density of 0.28/m^2. Habitat in this region consisted of an even mix of gravel, sand, and silt with some clay. Region 6 is approximately 25,600m^2. Applying the snuffbox density estimate of 0.28/m^2 provides a population estimate of 7,168 individuals in region 6.

Factors Affecting the Species Environment within the Action Area

The habitat conditions within the action area consist of an impoundment of approximately 50 ha that extends 3.6 km upstream of the dam and relatively unimpaired areas below the dam. Habitat conditions, such as substrate and flow, will impact the quality of a site for mussels. According to the survey report, the area immediately below the dam is a complex region due to various water depths, changes in flow, and presence of dam and bridge structures (Woolnough and Barnett 2013). The area immediately upstream of the dam has a substrate composed primarily of silt and muck with rooted macrophytes. The impoundment has significantly reduced flow, which can result in anoxic conditions as well as retard the movement of sediment downstream. The dam also acts as a barrier to fish migration and potentially to the dispersal of mussels.

Webber Dam is approximately six miles upstream of Lyons Dam. This larger dam traps sediment, reducing the amount of sediments downstream although fine sands are carried over the dams during high water flows. Erosion at Hazel Devore Island moves fine sands farther downstream (Ellen River Partners 2015).

The Bridge Street Bridge is supported by 36 piers in Grand River. The East Channel has a smaller abandoned dam and causeway, which provides vehicle access to and from Hazel Devore Park. Three sewer lines traverse the park, with one crossing Grand River to the west and the other crossing the East Channel. At the terminal end of the east sewer line is a sewage lift station. A rock vane was constructed downstream of the park in 2012 to protect a sewer lift pump, and a fishing platform with rip rap was constructed in Hazel Devore Park in 2014. All of these structures may affect the flow and scour patterns in the river.

Other factors possibly affecting the species environment in the watershed include runoff from agricultural land and residential properties, sewer outfalls, and gravel mining in the adjacent watershed. Approximately 6 river miles (9.75 river km) upstream of Lyons is another dam.

Effects of the Action

Effects of the action refer to direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated and interdependent with that action that will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Effects of the Action on Snuffbox

Snuffbox was found in regions 3 and 5 of the action area. Most construction activities, including removal of the dam, filling of the fish ladder, construction of vanes, placement of rip rap, and restoration of the bridge, will occur in region 3. Placement of rip rap and construction of cross vanes will also occur within region 5.

To minimize impacts, snuffbox within the areas of direct impact in regions 3 and 5 will be relocated to region 6 prior to commencement of any construction activities. Relocation will occur from August through September. Relocation of mussels may cause stress and disruption of normal behavior patterns, including spawning and fertilization.

The snuffbox population in region 3 below the dam was estimated at 4,320; only three animals were found in region 5 (Woolnough and Barnett 2013). The BA calculates that the areas of direct impact in regions 3 and 5 cover 907.5m^2. Based on this project footprint, 264 snuffbox are estimated to occur within the construction zones of regions 3 and 5. Finding and relocating all mussels within the areas of direct impact is highly unlikely. Mussels may be overlooked, especially juvenile mussels and any mussels that have burrowed into the substrate. Assuming an 80 percent detection rate (D. Woolnough, Central Michigan University, pers. comm. 2015), 212 snuffbox will be relocated from the construction zones in regions 3 and 5 to region 6.

Relocation likely will result in mortality of some mussels. Success of mussel relocations, in terms of recovery and survival of mussels, depends on several factors, including substrate stability, microhabitat requirements, methods of relocation, and timing (Cope and Waller 1995, Cope *et al.* 2003, Dunn and Sietman 1997, Dunn *et al.* 2000, Hamilton *et al.* 1997). Relocations with low mortality (< 1%) after one year have been linked to relocation sites with stable or consolidated substrate, species-specific habitat requirements, and careful handling of mussels (Dunn and Sietman 1997). Region 6, where mussels will be relocated, has similar substrate composition to region 3 and currently supports snuffbox (Woolnough and Barnett 2013), indicating that the relocation site should provide the necessary substrate and microhabitat features for snuffbox relocation. Studies on mussel relocations have indicated that doubling the density of mussels did not affect the survival of the relocated or resident mussels (Cope *et al.* 2003). Further, stringent relocation protocols will be followed, which will also aid survival. Based on this information, we expect a high survival rate although other unknown or uncontrollable factors may influence survival. Following the relocation guidelines in Dunn *et al.* (2000), we assume a 5 percent mortality rate for relocated mussels is an appropriate estimate that will still reflect a high degree of success for the relocation. Based on this, we anticipate that 11 relocated snuffbox will not survive one year after relocation.

Those mussels remaining in the construction zones in regions 3 and 5 after relocation (i.e., snuffbox that could not be detected during relocation activities) will experience harm or mortality from crushing or displacement during dam removal and construction. Mussels could be crushed or smothered during placement of rock and cobble to build the haul road and rock vanes and by material dropped during demolition of the dam. Localized scour at the point of the dam breach from higher water velocity during the drawdown could result in displacement of mussels; however, the controlled drawdown rate will prevent erosive scour and minimize displacement of snuffbox downstream of the breach. After relocation of mussels, we estimate 52 snuffbox will remain in the construction zones. These mussels will likely be lost from the population due to construction activities.

Snuffbox below the dam but outside of the construction zones may be indirectly affected by the dam removal. Drawdown of the impoundment and removal of the dam may release sediments stored above the dam although there are no large deposits of fine sediments above the dam. In addition, construction and heavy equipment may disturb and mobilize materials in the substrate. The coarse-grained particles (cobble, stones and larger gravel) are not expected to travel far downstream and will be quickly re-deposited. Fine-grained sediments (silt and sand) will settle in slower velocity areas, such as the inside of river bends and deep pools not considered snuffbox habitat, or travel downstream beyond region 6. However, some of these finer-grained sediments could settle in regions 3, 5 and/or 6. Re-suspension of sediments could increase turbidity and reduce water quality; deposition of silt could smother mussels and/or habitat. Increased turbidity, siltation, and sedimentation may negatively affect respiration, feeding, and/or reproduction in mussels. Mussels may be able to withstand such short-term stressors by closing their valves and entering a quiescent state (Sheldon and Walker 1989, Haag 2012).

The amount of affected area and severity of effects will be dependent upon rainfall and water flow as well as substrate type. Indirect effects will be avoided and minimized through use of BMPs, such as turbidity curtains and cofferdams (where appropriate), and by avoiding

construction during times of heavy water flow. These downstream effects are expected to be minimal and temporary.

In addition, mussels could potentially become stranded during the drawdown of the impoundment prior to the removal of the dam; however, no snuffbox were found upstream of the dam. The habitat conditions—with slack water, muck substrate and rooted macrophytes—likely do not support snuffbox above the dam.

The proposed project will also reconnect approximately, 25km of upstream habitat and 87km of downstream habitat and restore more natural conditions to this reach of Grand River. These improved habitat conditions will benefit snuffbox as well as logperch, its host fish.

Cumulative Effects

Cumulative effects include the effects of 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 pursuant to section 7 of the Act.

We are not aware of any specific State, tribal, local, or private actions reasonably certain to occur in the action area. Lyons, Michigan is a small village that is not expanding at a significant rate; however, future development may occur, and existing infrastructure within the action area may need maintenance, repairs or upgrades. Recreational use of Hazel Devore Park will likely continue.

Conclusion

After reviewing the current status of snuffbox, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, we conclude that the Lyons Dam Removal and Grand River Restoration Project, as proposed, is not likely to jeopardize the continued existence of the snuffbox. No critical habitat has been designated for this species; therefore, none will be affected.

Regulations define "jeopardize the continued existence of a species" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." We must analyze how the proposed action and potential effects could impact reproduction, number, and distribution of snuffbox.

A loss of 63 individuals will reduce the number of reproductive adults in the river. Additionally, harassment of 212 adult mussels may interfere with normal breeding activity, potentially reducing the number of glochidia produced in the year of relocation. We expect very short-term alteration of suitable breeding habitat below the dam from silt or sediment moving through the system. The proposed project will not detectably reduce the overall reproductive success of the snuffbox population.

A loss of 63 individuals will reduce the number of mussels in the river. The total snuffbox population estimate for the entire action area is 11,488. Thus, the 63 individuals represent only 0.54 percent of the local population. Although approximately 212 mussels will be relocated from regions 3 and 5, the majority of mussels in those regions will remain and are not expected to be impacted. Further, the proposed action will improve habitat conditions for snuffbox and logperch, potentially expanding the distribution of snuffbox in Grand River. For these reasons, we conclude that the proposed action, taken together with cumulative effects, would not directly or indirectly reduce the likelihood of both the survival and recovery of the snuffbox by reducing the species' reproduction, numbers, or distribution.

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 or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

Amount or Extent of Take

The Service anticipates 264 snuffbox could be taken as a result of this proposed action. We expect incidental take of 212 adults will occur in the form of harassment. Incidental take of 63 adults will occur in the form of mortality, including 52 mortalities from construction-related activities and 11 post-relocation mortalities.

Effect of Take

In the accompanying Opinion, we determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of snuffbox during the proposed action:

1. The Green Bay FWCO will ensure that the proposed project components (e.g., dam removal and associated construction) will occur as planned and as documented in the BA.

2. The Green Bay FWCO will ensure that qualified mussel biologists relocate snuffbox within the 907.5m^2 project impact area, as defined in the "Effects of the Action on Snuffbox" section of this Opinion.

3. The Green Bay FWCO will ensure that qualified mussel biologists monitor the relocated mussels at least twice after relocation.

4. The Green Bay FWCO will report on the progress of the dam removal and its impact on the snuffbox, as required pursuant to 50 CFR 402.14(i)(3).

Terms and Conditions

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

Terms and Conditions to fulfill RPM #1

1.1 Notify contractors of conservation measures and ensure compliance with these measures.

1.2 Submit a report to our office within 60 days of completing the dam removal project. This report will describe the actions taken to implement the terms and conditions and include the dates of actual construction activities.

Terms and Conditions to fulfill RPM #2

2.1 Ensure relocation follows accepted protocols, including:

- Snuffbox shall be collected by hand, by "grubbing" while wading or snorkeling in shallow water, or by divers in deeper water.

- Relocation effort shall be systematically conducted by a "moving transect" or establishing cells not to exceed 10m by 10m.

- Effort shall meet the same standards as surveys, using standards for visual or surface searches.

- Multiple passes shall be made through the area until less than 5 percent of the number collected on the original pass are recovered on the final pass.

- Both valves of each snuffbox will be marked with shellfish tags.

- All snuffbox will be tagged with a Passive Integrated Transponder (PIT).

2.2 Submit a report to our office within 30 days of completion of snuffbox relocation. This report should describe the actions taken to implement the terms and conditions and include the dates of activities.

Terms and Conditions to fulfill RPM #3

3.1 Ensure post-relocation monitoring surveys are conducted one year following relocation before construction activities begin and two years after relocation and follow accepted survey protocols for monitoring.

3.2 Submit a report to our office within 30 days of completion of each of the snuffbox post-relocation monitoring events. This report should describe the actions taken to implement the terms and conditions and include the dates of activities.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service has identified the following actions that, if undertaken by the Green Bay FWCO, will further the conservation and assist in the recovery of snuffbox:

1. Conduct additional years of post-relocation monitoring to assess future survival and growth rates of relocated mussels.

2. Conduct or fund augmentation and/or reintroduction efforts for snuffbox within the Grand River watershed.

3. Support research on snuffbox ecology and distribution.

4. Support production of a peer-reviewed article that can be accessed by the larger conservation community to learn from this experience.

In order to keep the Service informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

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

We believe that no more than 264 snuffbox will be incidentally taken as a result of the proposed action. This includes harassment of 212 individuals during relocation prior to construction and mortality of 63 adults. If any of the following occurs during the course of completing the project, then this represents new information, requiring reinitiation of consultation:

1. Fewer than 212 snuffbox are captured and removed prior to construction.

2. More than 264 snuffbox are captured and removed prior to construction.

LITERATURE CITED

Barnhart, M.C. 1998. Fish hosts and culture of mussel species of special concern. Missouri Department of Conservation, Jefferson City. 44 pp.

Barnhart, M.C., F.A. Riusech, and M.S. Baird. 1998. Hosts of salamander mussel, *Simpsonaias ambigua*, and snuffbox, *Epioblasma triquetra*, from the Meramec River system, Missouri. Triannual Unionid Report No. 16:34.

Butler R.S. 2007. Status assessment report for the snuffbox, *Epioblasma triquetra*, a freshwater mussel occurring in the Mississippi and Great Lakes Basins. U.S. Fish and Wildlife Service, Asheville, NC.

Caldwell, M.L. 2013. Host fish suitability tests and effects of invasive mollusks for snuffbox, *Epioblasma triquetra*, from Laurentian Great Lakes basins. M.S. Thesis, Central Michigan University, Mount Pleasant. 65 + viii pp.

Christian, A.D., B.N. Smith, D.J. Berg, J.C. Smoot, and R.H. Findlay. 2004. Trophic position and potential food sources of 2 species of unionid bivalves (Mollusca: Unionidae) in 2 small Ohio streams. Journal of the North American Benthological Society 23(1):101-113.

Cope, W.G., M.C. Hove, D.L. Waller, D.J. Hornbach, M.R. Bartsch, L.A. Cunningham, H.L. Dunn, and A.R. Kapuscinski. 2003. Evaluation of relocation of unionid mussels to *in situ* refugia. Journal of Molluscan Studies 69: 27-34.

Cope, W.G. and D.L. Waller. 1995. Evaluation of freshwater mussel relocation as a conservation and management strategy. Regulated Rivers: Research & Management 11:147-155.

Cummings, K.S. and C.A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey Manual 5. 194 pp.

Dunn, H.L. and B.E. Sietman. 1997. Guidelines used in four geographically diverse Unionid relocations. Pages 176-183 *in* K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo, eds. Conservation and management of freshwater mussels II: proceedings of a UMRCC symposium. Upper Mississippi River Conservation Committee, Rock Island, IL.

Dunn, H.L., B.E. Sietman, and D.E. Kelner. 2000. Evaluation of recent unionid (Bivalvia) relocations and suggestions for future relocations and reintroductions. Pp. 169-183 *in* R.A. Tankersley, D.I. Warmolts, G.T. Watters, B.J. Armitage, P.D. Johnson, and R.S. Butler, eds. Proceedings of the first freshwater mollusk conservation society symposium, 1999. Ohio Biological Survey, Columbus.

Ellen River Partners, Inc. 2015. Grand River dam removal, Hazel Devore Park restoration, and Grand River high bank protection above the dam, at Lyons, MI. Michigan Department of Environmental Quality Joint Permit Application.

Haag, W.R. 2012. North American freshwater mussels: natural history, ecology, and conservation. Cambridge University Press, Cambridge and New York. 538 pp.

Hamilton, H., J. Brim Box, and R.M. Dorazio. 1997. Effects of habitat suitability on the survival of relocated freshwater mussels. Regulated Rivers: Research & Management 13:537-541.

Hillegass, K.R., and M.C. Hove. 1997. Suitable fish hosts for glochidia of three freshwater mussels: strange floater, ellipse, and snuffbox. Triannual Unionid Report No. 13:25.

Hove, M.C., K.R. Hillegass, J.E. Kurth, V.E. Pepi, C.J. Lee, K.A. Knudsen, A.R. Kapuscinski, P.A. Mahoney, and M.M. Bomier. 2000. Considerations for conducting host suitability studies. Pp. 27-34 *in*: R.A. Tankersley, D.I. Warmolts, G.T. Watters, and B.J. Armitage, eds. Part I. Proceedings of the conservation, captive care, and propagation of freshwater mussels symposium, March 1998, Columbus, Ohio. Ohio Biological Survey, Columbus.

McNichols, K. and G.L. Mackie. 2002. Fish host determination of endangered freshwater mussels in the Sydenham River, Ontario, Canada. Endangered Species Recovery Fund 2002/2003 Final Report. 22 pp.

Mulcrone, R. Sherman. 2004. Incorporating habitat characteristics and fish hosts to predict freshwater mussel (Bivalvia: Unionidae) distributions in the Lake Erie drainage, southeastern Michigan. Ph.D. dissertation, University of Michigan, Ann Arbor. 139 pp.

Murray, H.D. and A.B. Leonard. 1962. Handbook of the unionid mussels of Kansas. University of Kansas Museum of Natural History Miscellaneous Publication No. 28. 184 pp.

McNichols, K., and G.L. Mackie. 2003. Fish host determination of endangered freshwater mussels in the Sydenham River, Ontario, Canada. Endangered Species Recovery Fund 2003/2004 Final Report. 26 pp.

McNichols, K., and G.L. Mackie. 2004. Fish host determination of endangered freshwater mussels in the Sydenham River, Ontario, Canada. Endangered Species Recovery Fund 2004/2005 Final Report. 26 pp.

Neves, R.J. 1991. Mollusks. Pp. 251-319 *in*: K. Terwilliger, coordinator. Virginia's endangered species. Proceedings of a symposium, April 1989, Blacksburg, Virginia. McDonald & Woodward Publishing Co., Blacksburg.

Newton, T.J., E.M. Monroe, R. Kenyon, S. Gutreuter, K.I. Welke, and P.A. Thiel. 2001. Evaluation of relocation of unionid mussels into artificial ponds. Journal of the North American Benthological Society 20(3): 468-485.

Nichols, S.J. and D. Garling. 2000. Food-web dynamics and trophic-level interactions in a multispecies community of freshwater unionids. Canadian Journal of Zoology 78:871-882.

Parmalee, P.W. and A.E. Bogan. 1998. *The freshwater mussels of Tennessee*. Knoxville: University of Tennessee Press.

Sheldon, F. and K. Walker. 1989. Effects of hypoxia on oxygen consumption by two species of freshwater mussel (Unionacea: Hyriidae) from the River Murray. Australian Journal of Marine & Freshwater Research 40(5): 491.

Sherman, R.A. 1993. Glochidial release and reproduction of the snuffbox mussel, *Epioblasma triquetra*: timing in southern Michigan. Abstract, North American Benthological Society Bulletin 10(1):197.

Sherman, R.A. 1994. Life history information critical to the management of the state endangered snuffbox mussel, *Epioblasma triquetra* (Bivalvia: Unionidae) in Michigan. M.S. thesis, University of Michigan, Ann Arbor. 40 pp.

Silverman, H., S.J. Nichols, J.S. Cherry, E. Achberger, J.W. Lynn, and T.H. Dietz. 1997. Clearance of laboratory-cultured bacteria by freshwater bivalves: differences between lentic and lotic unionids. Canadian Journal of Zoology 75:1857-1866.

Strayer, D.L., J.A. Downing, W.R. Haag, T.L. King, J.B. Layzer, T.J. Newton, and S.J. Nichols. 2004. Changing perspectives on pearly mussels, North America's most imperiled animals. BioScience 54(5):429-469.

U.S. Fish and Wildlife Service (USFWS). 2012. Endangered and threatened wildlife and plants; determination of endangered status for the rayed bean and snuffbox mussels throughout their ranges. Final Rule. Federal Register 77(30):8632.

Woolnough, D.A. and S.E. Barnett. 2013. Detection and quantification of snuffbox (*Epioblasma triquetra*) in Grand River Lyons, MI: section 7 permit requirements.

Yeager, B.L. 1986. *Epioblasma brevidens*, *Epioblasma capsaeformis* and *Epioblasma triquetra*. Pp. 45-47 *in*: D.M. Hill, ed. Activity 3: identification of fish hosts. Tennessee Valley Authority Cumberlandian Mollusk Conservation Program, Norris, Tennessee.

Yeager, B.L. and C.F. Saylor. 1995. Fish hosts for four species of freshwater mussels (Pelecypoda: Unionidae) in the upper Tennessee River drainage. American Midland Naturalist 133:1-6.