DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R4–ES–2012–0031; 4500030113]

RIN 1018–AX73

Endangered and Threatened Wildlife and Plants; Endangered Status for the Neosho Mucket and Threatened Status for the Rabbitsfoot

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine the Neosho mucket, a freshwater mussel, as endangered, and the rabbitsfoot, a freshwater mussel, as threatened, under the Endangered Species Act. The Neosho mucket occurs in Arkansas, Kansas, Missouri, and Oklahoma. The rabbitsfoot occurs in Alabama, Arkansas, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee, and West Virginia. This final rule implements the protections provided by the Act for these species. We will issue a final determination on the designation of critical habitat for these species in the near future.

DATES: This rule becomes effective October 17, 2013.

ADDRESSES: This final rule is available on the Internet at *http://www.regulations.gov* and at the Arkansas Ecological Services Office. Comments and materials received, as well as supporting documentation used in the preparation of this rule, are available for public inspection at *http://www.regulations.gov.* All of the comments, materials, and documentation that we considered in this rulemaking are available by appointment, during normal business hours at: U.S. Fish and Wildlife Service, Arkansas Ecological Service Office, 110 South Amity Road, Suite 300, Conway, AR 72032, telephone 501–513–4470 or facsimile 501–513–4480.

FOR FURTHER INFORMATION CONTACT: James F. Boggs, Field Supervisor, Arkansas Ecological Services Office, 110 South Amity Road, Suite 300, Conway, AR 72032, by telephone 501–513–4470 or by facsimile 501–513–4480. Persons who use a telecommunications device for the deaf (TDD), may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Endangered Species Act (Act), a species may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. Listing a species as an endangered or threatened species can only be completed by issuing a rule. We will issue a final determination on the designation of critical habitat for the Neosho mucket and rabbitsfoot under the Act in the near future.

The basis for our action. Under the Act, we can determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. We have determined that both species are threatened by destruction, modification, or curtailment of habitat or range (Factor A), inadequate existing regulatory mechanisms (Factor D), and other manmade factors (Factor E).

Peer review and public comment. We sought comments from three independent specialists to ensure that our designation is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment on our listing proposal. The peer reviewers generally concurred with our methods and conclusions and provided additional information, clarifications, and suggestions to improve the final listing rule. We also considered all comments and information received during the comment periods.

Previous Federal Actions

Please refer to the proposed listing rule for the Neosho mucket (*Lampsilis rafinesqueana*) and rabbitsfoot (*Quadrula cylindrica cylindrica*) (October 16, 2012; 77 FR 63440) for a detailed description of previous Federal actions concerning these species.

Summary of Comments and Recommendations

We requested written comments from the public on the proposed listing rule for the Neosho mucket and rabbitsfoot during two comment periods. The first comment period, starting with the publication of the proposed rule (77 FR 63440), opened on October 16, 2012, and closed on December 17, 2012. The second comment period, starting with the publication of the notice of availability for the draft economic analysis and draft environmental assessment (78 FR 27171) opened on May 9, 2013, and closed on June 10, 2013. We held public information meetings in Joplin, Missouri, on May 21, 2013, and Greenville, Missouri, on May 23, 2013. We did not receive any requests for a public hearing during either comment period. We also contacted appropriate Federal, State, and local agencies, scientific organizations, and other interested parties and invited them to comment on the proposed rule. In addition, we published a total of 27 legal public notices in the States affected by the listing of both species. All substantive information provided during the comment periods has either been incorporated directly into this final determination or is addressed below.

Peer Reviewer Comments

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from three knowledgeable individuals with scientific expertise on freshwater mussel conservation and biology, with familiarity of Neosho mucket and rabbitsfoot, the geographic region and river basins in which they occur, and conservation biology principles associated with the species. We received responses from all of the peer reviewers we contacted.

We reviewed all comments received from the peer reviewers for substantive issues and new information regarding the listing of Neosho mucket and rabbitsfoot. The peer reviewers generally concurred with our methods and conclusions and provided additional information, clarifications, and suggestions to improve the final listing rule. Peer reviewer comments on the listing of the mussels are addressed in the following summary and incorporated into this final rule as appropriate.

(1) *Comment:* One peer reviewer suggested that we discuss the lure used by rabbitsfoot to attract its fish hosts and redefine the marsupium as a ''brooding pouch'' rather than a ''pouch''.

Our Response: We incorporated language to address this topic under the *Background* section of this final determination.

(2) *Comment:* One peer reviewer questioned whether the Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to threatened wildlife the same as endangered wildlife.

Our Response: The prohibitions of section 9(a)(1) of the Act, incorporated into our regulations at 50 CFR 17.21, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt any of these), import, export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any species listed as endangered. Our regulations at 50 CFR 17.31 contain the same prohibitions for species listed as threatened, unless exceptions are made in a rule issued under section 4(d) of the Act.

(3) *Comment:* One peer reviewer suggested Neosho mucket and rabbitsfoot are thermally sensitive because closely related mussel species, such as pimpleback (*Quadrula pustulosa*), pistolgrip (*Quadrula verrucosa*), plain pocketbook (*Lampsilis cardium*), and yellow sandshell (*Lampsilis teres*), are known to be thermally sensitive, although no physiological thermal tolerance data is available for Neosho mucket and rabbitsfoot.

Our Response: We agree that the best available scientific information indicates that Neosho mucket and rabbitsfoot may be thermally sensitive and added language to address the topic under *Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence—Temperature* section of this final determination.

(4) *Comment:* One peer reviewer suggested there is substantial evidence the interaction of climate warming and water management is negatively affecting mussels in the south-central United States.

Our Response: We agree that a combination of climate patterns and local water management practices (e.g., reduced reservoir releases) led to shifts in the species richness and overall abundance of mussel assemblages dominated by thermally sensitive to thermally tolerant species in southeast Oklahoma. We incorporated language to address this topic under *Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence—Temperature* section of this final determination.

(5) *Comment:* One peer reviewer suggested poultry production is a potential threat to Neosho mucket and rabbitsfoot in the Little River basin.

Our Response: We agree and incorporated language to address the topic under Factor A. *The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range—Chemical Contaminants* section of this final determination.

(6) *Comment:* One peer reviewer recommended we include rabbitsfoot density information for the Little River from Galbraith and Vaughn (2011). This reviewer also recommended we include information from Galbraith (2009) on the effects of water temperature to rabbitsfoot.

Our Response: We agree and incorporated language to address the topic in the *Taxonomy, Life History, and Distribution* section for Rabbitsfoot and under *Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence—Temperature* section of this final determination.

(7) *Comment:* One peer reviewer recommended we include detailed anatomy of the rabbitsfoot information provided by Williams *et al.* (2008). This peer reviewer also noted several scientific citations omitted from the proposed rule that pertain to historical and modern rabbitsfoot records in the Tennessee River, lower Duck River, Ohio River, and Monongahela River.

Our Response: While not directly cited in the proposed rule, Butler (2005) cited several of the citations provided by the peer reviewer, and, accordingly, they are incorporated in the Service's analysis and administrative record. Our assessment of the rabbitsfoot population indicates extirpation in the Monongahela River occurred circa 1890 and is consistent with Ortmann (1919). We incorporated the other citations provided by the peer reviewer (related to soft anatomy and rabbitsfoot distribution) to address the topic in the *Summary of Biological Status and Threats* section for rabbitsfoot into this final determination.

(8) *Comment:* One peer reviewer noted the rainbow darter (*Etheostoma caeruleum*) is a host fish for rabbitsfoot.

Our Response: We agree and incorporated language to address the topic in the *Summary of Biological Status and Threats* section for rabbitsfoot of this final determination.

(9) *Comment:* One peer reviewer suggested it would be prudent to add the work by Vaughn and Taylor (1999) on dams and their downstream effects to freshwater mussels.

Our Response: We agree and incorporated language to address the topic under *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range—Impoundments* section of this final determination.

Federal Agency Comments

(10) *Comment:* The U.S. Army Corps of Engineers Pittsburgh District (COEPD) indicated listing of rabbitsfoot may affect the COEPD's navigation and maintenance dredging activities in the Allegheny River, its operation of Allegheny Reservoir, and its regulatory program. They indicate additional avoidance measures will be required to adequately protect rabbitsfoot and its habitat.

Our Response: The federally endangered clubshell (*Pleurobema clava*), northern riffleshell (*Epioblasma torulosa rangiana*), rayed bean (*Villosa fabalis*), and snuffbox (*Epioblasma triquetra*) mussels occur in the same reach of the Allegheny River as rabbitsfoot. Section 7 of the Act already requires Federal agencies to consult with the Service to ensure that any action authorized, funded, or carried out will not likely jeopardize the continued existence of these listed species. Project modifications that minimize effects to these listed mussel species also would minimize effects to rabbitsfoot. Thus, we would not expect additional conservation measures and costs for the rabbitsfoot over what are already required for these other endangered mussels.

(11) *Comment:* The COEPD asked how tributary streams will be affected by the listing of rabbitsfoot.

Our Response: The listing of the rabbitsfoot will occur in 15 States. We are unable to definitively determine how many tributary streams will be covered by the final designation. Section 7 of the Act requires Federal agencies to consider direct, indirect, and cumulative effects to listed species. The Service will work with COEPD to determine whether any of the current, ongoing or planned COEPD projects may have direct, indirect, or cumulative effects on tributaries within their District. As stated previously, the Service does not expect additional project modifications to minimize effects to rabbitsfoot beyond those already required for other listed mussels in the Allegheny River basin.

(12) *Comment:* The COEPD indicated stakeholders in the sand and gravel industry rely on an Adaptive Management Group Mussel Survey Protocol and conclude the protocol will need to be revised to include rabbitsfoot.

Our Response: This protocol is for use only in the impounded Allegheny River navigation channel (river mile 0 to near 65) and Ohio River navigation channel in Pennsylvania (river mile 0 to 40). While this area is within the range of the rabbitsfoot, it has been more than 80 years since a rabbitsfoot specimen was found in this reach of the river. Nevertheless, we agree the protocol will

need to be revised to include rabbitsfoot. However, in the past using the protocol has failed to locate the federally listed northern riffleshell and clubshell mussels while others sampling the same location using a different method have detected them. In addition, these mussels tend to be more difficult to locate than rabbitsfoot. Therefore, the protocol should be revised because of its apparent lack of effectiveness regardless of whether rabbitsfoot is listed under the Act.

State Agency Comments

The listing for the Neosho mucket covers Arkansas, Kansas, Missouri, and Oklahoma and for rabbitsfoot covers Alabama, Arkansas, Georgia, Kansas, Kentucky, Illinois, Indiana, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee, and West Virginia. We received comments from the States of Louisiana, Pennsylvania, Ohio, and Oklahoma regarding the proposal.

(13) *Comment:* The Pennsylvania Fish and Boat Commission (PFBC) supports the listing. PFBC concluded that golden alga (*Prymnesium parvum*) is an invasive species that has the potential to threaten the existing Shenango River rabbitsfoot population based on work by Barkoh and Fries (2010).

Our Response: We appreciate the support and look forward to continuing work with the PFBC to recover rabbitsfoot. We agree that golden alga is a threat to rabbitsfoot in the Shenango River and incorporated language to address the topic under *Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence—Invasive Nonindigenous Species* section of this final determination.

(14) *Comment:* The Oklahoma Department of Wildlife Conservation (ODWC) asserts the decline of rabbitsfoot geographic range is not a recent phenomenon, but rather a gradual decline over a century. It provided a breakdown of extirpation dates based on table 2 in the proposed rule, with 10 percent of those extirpations occurring prior to 1900; 26 percent from 1900 to 1930; 11 percent from 1930 to 1960; and 34 percent from 1960 to 1980, or 81 percent of the total extirpations occurring prior to 1980. ODWC concludes it is uncertain which factors contributed to earlier extirpations, but some threats may have been ameliorated in the intervening decades. It further contends the relative magnitude and importance of each threat is not adequately quantified (speculative and not supported by empirical data) for extant or extirpated rabbitsfoot populations.

Our Response: In determining which of the listing factors contained in Section 4 of the Act justified listing the species, we used information on the biology, ecology, distribution, abundance, status, and trends of each species from a wide variety of sources. These sources included professional journal articles, distributional status surveys, biological assessments, and other unpublished material (that is, ''gray literature'') from State natural resource agencies and natural heritage programs, Tribal governments, other Federal agencies, consulting firms, contractors, and individuals associated with professional organizations and higher educational institutions.

Although we have sporadic documentation of rabbitsfoot collections from the last century, as discussed under the *Status Assessment for Neosho Mucket and Rabbitsfoot* and *Summary of Factors Affecting the Species* sections in the proposed rule, rangewide trends indicate declining populations and, despite attempts at some locations to alleviate threats, no population is without threats significantly affecting the species. These threats are expected to be exacerbated by increased water demand, habitat degradation, and climate change in the future (Spooner and Vaughn 2008; Galbraith *et al.* 2010). We respectfully disagree that available scientific information supports the conclusion that threats have been ameliorated in many historical rivers throughout the entirety of the species range. Each threat is discussed in detail in the *Summary of Factors Affecting the Species* and is further summarized in the *Summary of Biological Status* and *Determination* sections of this final determination.

(15) *Comment:* The ODWC does not support listing rabbitsfoot as threatened. The ODWC asserts that listing is premature and may impede conservation strategies such as augmenting and reestablishing populations. It also contends that the rapid elevation of rabbitsfoot from candidate status in 2009 to a proposed threatened species in 2012 is premature and did not include sufficient coordination with the State of Oklahoma. The ODWC also concludes that 51 extant rabbitsfoot populations, albeit most of which are small and declining, are sufficient to preclude listing as a threatened species.

Our Response: The Act requires that we identify species of wildlife and plants that are endangered or threatened based on the best available scientific information. As defined in section 3 of the Act, a threatened species is any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. As part of our program to add species to the list of threatened and endangered wildlife, we also maintain a list of species which are candidates for listing. A candidate species is one for which we have sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened, but for which preparation and publication of a rule is precluded by higher priority listing actions.

The rabbitsfoot was added to our candidate list in 2009 (75 FR 69222) and has remained on the candidate list through our most recent candidate notice of review (CNOR) in 2012 (77 FR 70054). Additionally, the Service presented a rangewide status assessment and overview of the proposed listing process for rabbitsfoot at the Interior Highlands Mollusk Conservation Council (IHMCC) annual meeting in 2011 and 2012. We sent out requests in 2008, 2009, and 2010 to the Unio list serve maintained by the Freshwater Mollusk Conservation Society requesting information on the status of rabbitsfoot populations and threats. We sent a letter dated March 15, 2011, to interested parties in Oklahoma including the ODWC. The Service has received numerous responses to these inquiries and our efforts to reach out to the agencies, Tribes, organizations, and academia to solicit information and input.

While the rabbitsfoot still occurs in 51 streams, it sustains recruitment and population viability consistently in only 11 large, extant river populations. This accounts only for 8 percent of the historical or 22 percent of the extant distribution of rabbitsfoot. Further, the species also sustains limited recruitment and distribution in another 17 river populations, of which 15 (88 percent) are declining. The synergistic effects of threats discussed in the proposed rule and this final determination are often complex in aquatic environments and, while making it difficult to predict changes in mussel and fish host(s) distribution, abundance, and habitat availability, it is probable that these threats are acting simultaneously on the remaining rabbitsfoot populations with negative results and are expected to continue to do so based on the best available scientific information. Based on this information and information provided in our above response, we believe there is sufficient scientific information to support our final determination of listing rabbitsfoot as a threatened species.

(16) *Comment:* ODWC requested that the Service delay listing of the rabbitsfoot until the final year (2016) of the Multi-District Litigation (MDL) settlement and listing workplan.

Our Response: The multiyear listing workplan was developed through a settlement agreement with plaintiff groups to resolve multidistrict litigation. It is an effort to improve implementation of the Act while adhering to our court-approved obligations under the settlement agreement. The listing workplan enables the Service to systematically review and address the needs of more than 250 species listed on the 2010 CNOR and determine if they should be added to the Federal Lists of Endangered and Threatened Wildlife and Plants. The listing workplan has established deadlines for each candidate species, including the rabbitsfoot. In making this final determination at this time, the Service is adhering to the requirements of the listing workplan and settlement agreement. Additionally, the Act requires that we make a final listing determination within 1 year of a proposal. Therefore, we cannot postpone a final determination.

(17) *Comment:* ODWC contends that implementation of recovery efforts, particularly population augmentation and reintroduction, for the rabbitsfoot will be more cumbersome due to lack of public support compared to nonlisted species.

Our Response: We believe that listing either mussel will not impede progress with ongoing or future population augmentation and reintroduction efforts or hinder our ability to recover the species. We agree that some property owners are reluctant to work with the Service and our partners to conduct conservation on their lands due to fear of future property use restrictions related to the Act. To address this concern, the Service has various programs that provide regulatory assurance for property owners. For example, the Safe Harbor Agreement program provides assurances to non-Federal landowners that future property use limitations will not occur without the property owner's consent, if voluntary conservation measures they implement on their property provide a net conservation benefit to the recovery of a listed species.

Further, we believe that listing the species will make additional conservation resources available. Although we are unaware of any ongoing efforts to augment or reestablish mussel populations in Oklahoma, many States (such as, Missouri, Kansas, Kentucky, Tennessee, Alabama, and Ohio) have successful propagation, augmentation, and reintroduction efforts ongoing for threatened and endangered mussels. In accordance with Service policy (65 FR 56916), the Service will work with our partners to develop a propagation, augmentation, and reintroduction plan for the Neosho mucket and rabbitsfoot to help ensure smooth transitions between various phases of conservation efforts. The Service is committed to these conservation efforts and looks forward to working closely with the State of Oklahoma and our other conservation partners to permit such efforts under section 10(a)(1)(A) of the Act. In addition, pursuant to section 6 of the Act, Oklahoma as well as the other States within the range of the rabbitsfoot would be eligible for Federal funds to implement management actions that promote the protection or recovery of the rabbitsfoot (*http://www.fws.gov/grants).*

(18) *Comment:* The Pennsylvania Department of Transportation (PDOT) opposes listing the rabbitsfoot as threatened due to the financial hardship it will bring to Pennsylvania taxpayers. PDOT concludes it is not a prudent use of transportation dollars to consult with the Service.

Our Response: Listing the rabbitsfoot under the Act must be based on the five listing factors (threats to the species), which do not include economic impacts. Critical habitat designation does require the Service to consider economic impacts, but that will be addressed in the rule to designate critical habitat for both mussels, which will be published at a later date.

(19) *Comment:* PDOT requested minor road work (such as rehabilitation or resurfacing) and bridge work (such as replacement and repair) on existing roads be exempt (*sic*) from formal coordination (consultation), including areas 100 feet upstream and downstream of the project footprint.

Our Response: All PDOT activities authorized or funded, in whole or part, by the Federal Highway Administration (FHWA) or permitted (such as, placement of bridge piers in a navigable stream) by a Federal agency such as the U.S. Army Corps of Engineers (Corps) are required to adhere to the consultation requirements of section 7(a)(2) of the Act, regardless of size. However, once the rabbitsfoot is listed, the Service can work with PDOT and FHWA or other Federal agencies to prepare a programmatic consultation that would address routine highway maintenance and other regular projects, thereby streamlining the consultation process and reducing associated costs.

(20) *Comment:* PDOT states that it issues road posting, bonding, and hauling permits to hauling industries for the purpose of protecting secondary roads from vehicle damage. PDOT acknowledges its potential liability under section 9 of the Act in the event that a hauling industry permittee has an accidental spill resulting in take of rabbitsfoot. They conclude that the Service operating under its mandate to err conservatively to protect species may be considering all road crossings as posing a threat of chemical contamination from spills. They conducted an analysis of their aforementioned program and provided information to refine our analysis of threats associated with chemical contaminants, but only identify one conflict of road bonding at State Road 2005 in Crawford County, Pennsylvania.

Our Response: The Service appreciates PDOT's willingness to provide an analysis of their road posting, bonding, and hauling permit program. There are instances where chemical spills have resulted in the loss of high numbers of mussels (Jones *et al.* 2001, p. 20; Brown *et al.* 2005, p. 1457; Schmerfeld 2006, pp. 12–13), and are considered a serious threat to mussel species. Therefore, chemical spills are identified as a threat to rabbitsfoot. The Service conducted an examination of land use trends, nonpoint- and point-source discharges, and determined that rabbitsfoot is subjected to the subtle, pervasive effects of chronic, low-level contamination that is ubiquitous in watersheds where it occurs. The Service has reviewed the information provided by PDOT and incorporated it into this rule where applicable. However, this information does not change our conclusion that biological and habitat effects due to chemical contaminants are a significant and ongoing threat contributing to the decline of rabbitsfoot populations.

(21) *Comment:* PDOT expressed concern with its ability to quickly issue hauling permits for oversize and overweight loads and restrict routing for materials such as fracking brine. It asserts that a need to restrict routing for a subset of haulers such as hazardous material haulers would preclude its ability to electronically permit and route these haulers, thus resulting in extensive time delays and subsequently a need for a significant increase in manpower. PDOT concludes that manual permit review to minimize section 9 liability that would result from listing rabbitsfoot represents a significant economic burden to both the State of Pennsylvania and many

industries because of needed increases in manpower to process permits.

Our Response: Listing the Neosho mucket and rabbitsfoot under the Act must be based on the five listing factors (threats to the species), which do not include economic impacts. Critical habitat designation does require the Service to consider economic impacts, but that will be addressed in the rule to designate critical habitat for both mussels which will be published at a later date.

Further, as discussed above (response to Comment 10), the federally endangered clubshell (*Pleurobema clava*), northern riffleshell (*Epioblasma torulosa rangiana*), rayed bean (*Villosa fabalis*), and snuffbox (*Epioblasma triquetra*) occur in the same reach of the Allegheny and Shenango Rivers and French and Muddy Creeks as rabbitsfoot. Project modifications and conservation efforts that minimize effects to these listed mussel species also would minimize effects to rabbitsfoot. Therefore, we do not believe the listing of rabbitsfoot would increase PDOT's section 9 liability on the State of Pennsylvania and industries transporting hazardous materials. However, as noted previously, the Service can work with PDOT to prepare standardized conservation measures that address the transportation of hazardous material and would minimize effects to rabbitsfoot and other federally protected mussels.

Public Comments

(22) *Comment:* One commenter requested that Neosho mucket and rabbitsfoot should not be removed from the Federal List of Endangered and Threatened Wildlife.

Our Response: We believe the commenter may have misunderstood the intent of the proposed rule. We wish to clarify that we proposed adding Neosho mucket and rabbitsfoot to the Federal List of Endangered and Threatened Wildlife and Plants, not removing them.

(23) *Comment:* One commenter suggested we should focus our efforts more on the Indiana bat rather than mussels.

Our Response: The Act requires that we list species that meet the definition of threatened or endangered. According to the best available science, the Neosho mucket and rabbitsfoot meet the criteria for listing and, therefore, we are required by the Act to list them. The Indiana bat (*Myotis sodalis*) was federally listed as endangered throughout its range under the Endangered Species Preservation Act of 1966 on March 11, 1967, and remains listed as endangered under the Act. Consistent with this status, the Service is focusing efforts on the bat: the Service has approved a recovery plan for the Indiana bat, and we are currently working with our partners to implement recovery actions specified in that recovery plan.

(24) *Comment:* One commenter stated the economic benefits of large impoundments and channelization projects outweigh the adverse effects to Neosho mucket and rabbitsfoot populations.

Our Response: Listing the Neosho mucket and rabbitsfoot under the Act must be based on the five listing factors (threats to the species), which do not include economic impacts. Critical habitat designation does require the Service to consider economic impacts, but that will be addressed in the rule to designate critical habitat for both mussels, which will be published at a later date.

(25) *Comment:* One commenter was concerned that private landowner water development projects, development of or modification of livestock and irrigation water rights, normal farming and ranching activities, and development of mineral rights on private property may trigger section 7 consultations. The commenter asked whether these activities on private property represent a federal nexus and thereby are subject to section 7 consultation.

Our Response: The effects of private activities, such as normal operations for rearing of livestock, farming, and modification of water rights and development of mineral rights are not subject to the Act's section 7 consultation requirements unless they are connected to a Federal action (require Federal permits, are federally funded, or are a Federal action).

Summary of Changes From the Proposed Rule

The information below is provided as a result of the peer and public review process. In this final determination, we have made changes to the discussion of biological status and threats for both mussels from the proposed rule. We have clarified that the rabbitsfoot uses all four gills as a marsupium or ''brooding pouch'' rather than ''pouch'' for its glochidia (Fobian 2007, p. 26). Watters *et al.* (2009, p. 269) reported the rainbow darter (*E. caeruleum*) as a host fish for rabbitsfoot, but we did not cite it in the proposed rule. Also, newly included is information on the status of the rabbitsfoot in the Red River basin. In addition, new information related to the factors (threats) affecting Neosho mucket and rabbitsfoot has been added. This includes information on thermal tolerance and effects of impoundments, chemical contaminants, climate change, and invasive nonindigenous species to mussels, discussed in the Summary of Factors Affecting the Species, *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range—Chemical Contaminants* and *Impoundments* and *Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence—Temperature* and *Climate Change.*

Background

Please refer to the proposed listing rule for the Neosho mucket and rabbitsfoot (October 16, 2013, 77 FR 63440) for a summary of species information.

Summary of Biological Status

For more information on relative abundance and trends of extant populations of Neosho mucket and rabbitsfoot by river basin please refer to the *Taxonomy, Life History, and Distribution* section of the proposed rule published in the **Federal Register** on October 16, 2012 (77 FR 63440).

Our assessment evaluated the biological status of these species and threats affecting their continued existence. It was based upon the best available scientific and commercial data and expert opinions.

The Neosho mucket is declining rangewide, with the exception of one population. Based on historical and current data, Neosho mucket has been extirpated from approximately 1,342 rkm (834 rmi) of its historical range (62 percent). Most of this extirpation has occurred within the Oklahoma and Kansas portions of its range. The extirpation of this species from numerous streams and stream reaches within its historical range signifies that substantial population losses have occurred. Extant populations are disjunct (not contiguous) in approximately 819 rkm (509 rmi). The Spring River in Missouri supports the only viable population based on the presence of a large number of individuals and evidence of recent recruitment. Given this compilation of current distribution, abundance, and status trend information, the Neosho mucket exhibits range reductions and population declines throughout its range.

Based on historical and current data, the rabbitsfoot is declining rangewide. In 10 of the 15 States comprising the rabbitsfoot's historical range, the species is considered by State law to be

endangered (Illinois, Indiana, Kansas, Mississippi, Ohio, and Pennsylvania); threatened (Kentucky and Tennessee); of special concern (Arkansas); or it is assigned an uncategorized conservation status (Alabama). The American Malacological Union and American Fisheries Society also consider the rabbitsfoot to be threatened (*in* Butler 2005, p. 21). It is presently extant in 51 of the 141 streams of historical occurrence, a 64 percent decline. Further, in the streams where it is extant, populations with few exceptions are highly fragmented and restricted to short reaches. We add this information, which was not in the proposed rule, on the rabbitsfoot in streams within the Red River basin. The Red River basin streams primarily drain the Ouachita Mountains in southeastern Oklahoma and southwestern Arkansas and northern Louisiana; extant populations of rabbitsfoot still occur in three stream reaches within the Gulf Coastal Plain ecoregion in southern Arkansas, southeastern Oklahoma, and northern Louisiana. In addition to the density information published in the proposed rule, we add this information on rabbitsfoot density in Oklahoma, which was not in the proposed rule. Rabbitsfoot density ranged from 0.3 to 2.4 individuals per square meter at three sites in Oklahoma (Galbraith and Vaughn 2011, p. 197) in the Red River basin. In addition, the species has been extirpated from West Virginia and Georgia. The extirpation of this species from numerous streams and stream reaches within its historical range signifies that substantial population losses have occurred in each of the past several decades.

Seventeen streams (33 percent of extant populations or 12 percent of historical populations) have small populations with limited levels of recruitment and are generally highly restricted in distribution, making their viability unlikely and making them extremely susceptible to extirpation in the near future. In addition, 15 of those 17 streams (88 percent) have populations that are declining. In many of these streams, rabbitsfoot is only known from one or two documented individuals in the past decade. Its viability in these streams is doubtful, and additional extirpations may occur if this downward population trend continues. Eleven populations (22 percent of extant populations or 8 percent of historical populations; Ohio, Green, Tippecanoe, Tennessee, Paint Rock, Duck, White, Black, Strawberry, and Little Rivers and French Creek) are considered viable (Butler 2005, p. 88; Service 2010, p. 16). Given this compilation of current distribution, abundance, and status trend information, the rabbitsfoot exhibits range reductions and population declines throughout its range.

Summary of Factors Affecting the Species

Section 4 of the Act and its implementing regulations (50 CFR 424) set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1) of the Act: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

The habitats of freshwater mussels are vulnerable to water quality degradation and habitat modification from a number of activities associated with modern civilization. The decline, extirpation, and extinction of mussel species are often attributed to habitat alteration and destruction (Neves *et al.* 1997, pp. 51–52). Bogan (1993, pp. 599–600 and 603–605) linked the decline and extinction of mussels to a wide variety of threats including siltation, industrial and municipal effluents, modification of stream channels, impoundments, pesticides, heavy metals, invasive species, and the loss of host fish. Chief among the causes of decline in distribution and abundance of the Neosho mucket and rabbitsfoot, and in no particular order of ranking, are impoundment, channelization, sedimentation, chemical contaminants, mining, and oil and natural gas development (Mather 1990, pp. 18–19; Obermeyer *et al.* 1997b, pp. 113–115; Neves *et al.* 1997, pp. 63–72; Davidson 2011, pers. comm.). Neosho mucket and rabbitsfoot are both found within medium to large river drainages exposed to a variety of landscape uses. These threats to mussels in general (and Neosho mucket and rabbitsfoot where specifically known) are individually discussed below.

Impoundments

Dams eliminate and alter river flow within impounded areas, trap silt leading to increased sediment deposition, alter water quality, change hydrology and channel geomorphology, decrease habitat heterogeneity, affect normal flood patterns, and block upstream and downstream movement of mussels and fish (Layzer *et al.* 1993, pp. 68–69; Neves *et al.* 1997, pp. 63–64; Watters 2000, pp. 261–264). Within impounded waters, decline of mussels has been attributed to direct loss of supporting habitat, sedimentation, decreased dissolved oxygen, temperature levels, and alteration in resident fish populations (Neves *et al.* 1997, pp. 63–64; Pringle *et al.* 2000, pp. 810–815; Watters 2000, pp. 261–264). Downstream of dams, mussel declines are associated with changes and fluctuation in flow regime, channel scouring and bank erosion, reduced dissolved oxygen levels and water temperatures, and changes in resident fish assemblages (Williams *et al.* 1992, p. 7; Layzer *et al.* 1993, p. 69; Neves *et al.* 1997, pp. 63–64; Watters 2000, pp. 265–266; Pringle *et al.* 2000, pp. 810–815). Dams that are low to the water surface, or have water passing over them (small low head or mill dams) can have some of these same effects on mussels and their fish hosts, particularly reducing species richness and evenness and blocking fish host movements (Watters 2000, pp. 261–264; Dean *et al.* 2002, pp. 235–238).

The decline of mussels within the Arkansas, Red, White, Tennessee, Cumberland, Mississippi, and Ohio River basins has been directly attributed to construction of numerous impoundments (Miller *et al.* 1984, p. 109; Williams and Schuster 1989, pp. 7–10; Layzer *et al.* 1993, pp. 68–69; Neves *et al.* 1997, pp. 63–64; Obermeyer *et al.* 1997b, pp. 113–115; Watters 2000, pp. 262–263; Sickel *et al.* 2007, pp. 71–78; Hanlon *et al.* 2009, pp. 11–12; Vaughn and Taylor 1999, pp. 915–917; Watters and Flaute 2010, pp. 3–7). Population losses due to impoundments have likely contributed more to the decline of the Neosho mucket and rabbitsfoot than any other factor. River habitat throughout the ranges of the Neosho mucket and rabbitsfoot has been impounded, leaving short, isolated patches of suitable habitat that sometimes lacks suitable fish hosts. Neither Neosho mucket nor rabbitsfoot occur in reservoirs lacking riverine characteristics. They are unable to successfully reproduce and recruit under these conditions (Obermeyer *et al.* 1997b, p. 114; Butler 2005, p. 96). On the other hand, rabbitsfoot may persist

and even exhibit some level of recruitment in some large rivers with locks and dams where appropriate habitat quality and quantity remain (Ohio and Tennessee Rivers in riverine reaches between a few locks and dams) (Butler 2005, p. 96).

The majority of the mainstem Ohio, Cumberland, Tennessee, and White Rivers and many of their largest tributaries are impounded, in many cases resulting in tailwater (downstream of dam) conditions unsuitable for rabbitsfoot (Butler 2005, p. 96). There are 36 major dams within the Tennessee River basin (Holston, Little Tennessee, Clinch, Elk, Flint, and Sequatchie Rivers, and Bear Creek) that have resulted in the impoundment of 3,680 rkm (2,300 rmi) of the Tennessee River and its largest tributaries (Butler 2005, p. 95). Only three of these rivers support viable populations—the Tennessee, Paint Rock, and Duck Rivers. Ninety percent of the Cumberland River downstream of Cumberland Falls (rkm 866, rmi 550) as well as numerous tributaries are either directly impounded or otherwise adversely affected by cold tailwater releases from dams.

Rabbitsfoot and its fish hosts are warm-water species and the change in temperature to cold water below the dams further reduces suitable habitat for the species and may eliminate fish hosts that cannot adapt to colder water temperatures (see the Temperature section below for more information). Rabbitsfoot in the Little River, Oklahoma, were found at locations farthest from impoundments (Vaughn and Taylor 1999, p. 915). Mussel species richness and total abundance downstream of dams increases as the distance from dams increases. Little River mussel populations did not recover from impoundment effects until 20 rkm (12 rmi) downstream, with a peak of species richness and abundance at 53 rkm (33 rmi) downstream of the impoundment (Vaughn and Taylor 1999, p. 915). Other tributary impoundments that negatively impact rabbitsfoot and its fish hosts within the Ohio River basin include, but are not limited to, the Walhonding, Barren, Rough, and Eel Rivers and two rivers with viable populations, Green and Tippecanoe Rivers. The majority (7 of 11 populations or 64 percent) of viable rabbitsfoot populations (Ohio, Green, Tippecanoe, Tennessee, Duck, White, and Little Rivers) occur downstream of main stem impoundments that make these populations more susceptible to altered habitat quality and quantity associated with the impoundment or dam operation, which may be exacerbated during stochastic events such as droughts and floods.

Navigational improvements on the Ohio River began in 1830, and now include 21 lock and dam structures stretching from Pittsburgh, Pennsylvania, to Olmsted, Illinois, near its confluence with the Mississippi River. Lock and dam structures convert riverine habitat to unsuitable static habitat for the mussel and prevent movement of their fish hosts. Numerous Ohio River tributaries also have been altered by lock and dam structures. For example, a 116-rkm (72-rmi) stretch of the Allegheny River in Pennsylvania has been altered with nine locks and dams from Armstrong County to Pittsburgh. A series of six locks and dams were constructed on the lower half of the Green River decades ago that extend upstream to the western boundary of Mammoth Cave National Park, Kentucky. The declines of rabbitsfoot populations are attributable to navigational locks and dams on the Ohio, Allegheny, Monongahela, Muskingum, Kentucky, Green, Barren, and White Rivers, and are widespread throughout the species range.

Impoundments have eliminated a large portion of the Neosho mucket population and habitat in the Arkansas River basin. For example, mussel habitat in the Neosho River in Kansas has been negatively impacted by at least 15 city dams and 2 Federal dams, both with regulated flows. Almost the entire length of the river in Oklahoma is now impounded or adversely affected by tailwater releases from three major dams (Matthews *et al.* 2005, p. 308). Several reservoirs and numerous small watershed lakes have eliminated suitable mussel habitat in several larger Neosho River tributaries in Kansas and Missouri (Spring, Elk, and Cottonwood Rivers and Shoal Creek). The Verdigris River (Kansas and Oklahoma) has two large reservoirs with regulated flows, and the lower section has been channelized as part of the McClellan-Kerr Arkansas River Navigation System. All the major Verdigris River tributaries in Kansas and Oklahoma have been partially inundated by reservoirs with regulated flows and numerous flood control watershed lakes (Obermeyer *et al.* 1995, pp. 7–21). Construction of Lake Tenkiller eliminated Neosho mucket populations and habitat in the lower portion of the Illinois River, Oklahoma (Davidson 2011, pers. comm.).

Dam construction has a secondary effect of fragmenting the ranges of mussel species by leaving relict habitats and populations isolated upstream or between structures as well as creating extensive areas of deep uninhabitable, impounded waters. These isolated populations are unable to naturally recolonize suitable habitat downstream and become more prone to further extirpation from stochastic events, such as severe drought, chemical spills, or unauthorized discharges (Layzer *et al.* 1993, pp. 68–69; Cope *et al.* 1997, pp. 235–237; Neves *et al.* 1997, pp. 63–75; Watters 2000, pp. 264–265, 268; Miller and Payne 2001, pp. 14–15; Pringle *et al.* 2000, pp. 810–815; Watters and Flaute 2010, pp. 3–7). We conclude that habitat effects due to impoundment are an ongoing threat to the Neosho mucket and rabbitsfoot.

Channelization

Dredging and channelization activities have profoundly altered riverine habitats nationwide. Hartfield (1993, pp. 131–139), Neves *et al.* (1997, pp. 71–72), and Watters (2000, pp. 268–269) reviewed the specific upstream and downstream effects of channelization on freshwater mussels. Channelization affects a stream physically (accelerates erosion, increases sediment bed load, reduces water depth, decreases habitat diversity, creates geomorphic (natural channel dimensions) instability, and eliminates riparian canopy) and biologically (decreases fish and mussel diversity, changes species composition and abundance, decreases biomass, and reduces growth rates) (Hartfield 1993, pp. 131–139). Channel modification for navigation has been shown to increase flood heights (Belt 1975, p. 684), partly as a result of an increase in stream bed slope (Hubbard *et al.* 1993, p. 137). Flood events are exacerbated, conveying large quantities of sediment, potentially with adsorbed contaminants, into streams. Channel maintenance often results in increased turbidity and sedimentation that often smothers mussels (Stansbery 1970, p. 10).

Channel maintenance operations for commercial navigation have affected habitat for the rabbitsfoot in many large rivers rangewide. Periodic navigation maintenance activities (such as dredging and snag removal) may continue to negatively impact this species in the lower portions of the Ohio, Tennessee, and White Rivers, which represent 44 percent of the viable rabbitsfoot populations. In the Tennessee River, a plan to deepen the navigation channel has been proposed (Hubbs 2009, pers. comm.). Some rabbitsfoot streams were ''straightened'' to decrease distances traversed by barge traffic (for example, Verdigris River). Hundreds of miles of many midwestern (Eel, North Fork Vermilion, and Embarras Rivers) and southeastern (Paint Rock and St. Francis Rivers and Bear Creek) streams with

rabbitsfoot populations were channelized decades ago to reduce the probability and frequency of flood events. Because mussels are relatively immobile, they require a stable substrate to survive and reproduce and are particularly susceptible to channel instability (Neves *et al.* 1997, p. 23) and alteration. Channel and bank degradation have led to the loss of stable substrates in numerous rivers with commercial navigation throughout the range of rabbitsfoot. While dredging and channelization have had a greater effect on rabbitsfoot, the Neosho mucket has been affected by these activities in the Verdigris River. We conclude that habitat effects due to channelization are an ongoing threat to the Neosho mucket and rabbitsfoot.

Sedimentation

Excessive sediments are believed to negatively impact riverine mussel populations requiring clean, stable streams (Ellis 1936, pp. 39–40; Brim Box and Mossa 1999, p. 99). Adverse effects resulting from sediments have been noted for many components of aquatic communities. Potential sediment sources within a watershed include virtually all activities that disturb the land surface. Most localities occupied by the Neosho mucket and rabbitsfoot, including viable populations, are currently being affected to varying degrees by sedimentation.

Sedimentation has been implicated in the decline of mussel populations nationwide, and remains a threat to Neosho mucket and rabbitsfoot (Ellis 1936, pp. 39–40; Vannote and Minshall 1982, pp. 4105–4106; Dennis 1984, p. 212; Brim Box and Mosa 1999, p. 99; Fraley and Ahlstedt 2000, pp. 193–194; Poole and Downing 2004, pp. 119–122). Specific biological effects include reduced feeding and respiratory efficiency from clogged gills, disrupted metabolic processes, reduced growth rates, limited burrowing activity, physical smothering, and disrupted host fish attraction mechanisms (Ellis 1936, pp. 39–40; Marking and Bills 1979, p. 210; Vannote and Minshall 1982, pp. 4105–4106; Waters 1995, pp. 173–175; Hartfield and Hartfield 1996, p. 373). In addition, mussels may be indirectly affected if high turbidity levels significantly reduce the amount of light available for photosynthesis, and thus, the production of certain food items (Kanehl and Lyons 1992, p. 7).

Studies tend to indicate that the primary effects of excess sediment levels on mussels are sublethal, with detrimental effects not immediately apparent (Brim Box and Mossa 1999, p. 101). The physical effects of sediment on mussel habitat appear to be multifold, and include changes in suspended and bed material load; bed sediment composition associated with increased sediment production and runoff in the watershed; channel changes in form, position, and degree of stability; changes in depth or the width and depth ratio that affects light penetration and flow regime; actively aggrading (filling) or degrading (scouring) channels; and changes in channel position. These effects to habitat may dislodge, transport downstream, or leave mussels stranded (Vannote and Minshall 1982, p. 4106; Kanehl and Lyons 1992, pp. 4–5; Brim Box and Mossa 1999, pp. 109–112). For example, many Kansas streams (such as Verdigris and Neosho Rivers) supporting mussels have become increasingly silted in over the past century, reducing habitat for the Neosho mucket and rabbitsfoot (Obermeyer *et al.* 1997a, pp. 113–114).

Increased sedimentation and siltation may explain in part why Neosho mucket and rabbitsfoot are experiencing recruitment failure in some streams. Interstitial spaces in the substrate provide crucial habitat (shelter and nutrient uptake) for juvenile mussel survival. When interstitial spaces are clogged, interstitial flow rates and spaces are reduced (Brim Box and Mossa 1999, p. 100), and this decreases habitat for juvenile mussels. Furthermore, sediment may act as a vector for delivering contaminants, such as nutrients and pesticides, to streams, and juvenile mussels may ingest contaminants adsorbed to silt particles during normal feeding activities. Neosho mucket and rabbitsfoot reproductive strategies depend on clear water (enables fish hosts to see mussel lures) during critical reproductive periods.

Agricultural activities are responsible for much of the sediment affecting rivers in the United States (Waters 1995, p. 170). Sedimentation associated with agricultural land use is cited as one of the primary threats to 7 of the 11 (64 percent) viable rabbitsfoot populations (French Creek, Tippecanoe, Paint Rock, Duck, White, Black, and Strawberry Rivers; Smith *et al.* 2009, Table 1; USACE 2011, pp. 21–22; Indiana Department of Environmental Management (IDEM) 2001, pp. 11–12; EPA 2001, p. 10; Brueggen 2010, pp. 1–2; MDC 2012, *http://mdc.mo.gov/landwater-care/stream-and-watershed-management/;* Environmental Protection Agency Water Quality Assessment Tool, *http://ofmpub.epa.gov/tmdl_waters10/attains_nation_cy.control?p_report_type=T*). In addition, numerous stream segments in the Duck, White, Black, Little, and Strawberry River watersheds are listed as impaired waters under section 303(d) of the Clean Water Act (CWA) by the Environmental Protection Agency (EPA) due to sedimentation associated with agriculture (USACE 2011, p. 21; EPA Water Quality Assessment Tool, *http://ofmpub.epa.gov/tmdl_waters10/attains_nation_cy.control?p_report_type=T*). An impaired water is a water body (i.e., stream reaches, lakes, water body segments) with chronic or recurring monitored violations of the applicable numeric or narrative water quality criteria. An impaired water cannot support one or more of its designated uses (e.g., swimming, the protection and propagation of aquatic life, drinking, industrial supply, etc.).

Once a stream segment is listed as an impaired water, the State must complete a plan to address the issue causing the impairment; this plan is called a Total Maximum Daily Load (TMDL). A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards (WQS). Completion of the plan is generally all that is required to remove the stream segment from the EPA's section 303(d) impaired water list and does not mean that water quality has changed. Once the TMDL is completed, the stream segment may be placed on the EPA's section 305(b) list of impaired streams with a completed TMDL (*http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/intro.cfm*). For example, some stream segments within the White, Barren, Little River Mountain Fork, and Wabash Rivers, and French Creek have completed TMDL plans and have attained WQS for low dissolved oxygen, pathogens, nutrients, polychlorinated biphenyls (PCBs), and siltation. However, some of these same stream segments still have not attained WQS for lead (Little River Mountain Fork) and mercury (Wabash River).

Impaired streams in the Duck River watershed (approximately 483 rkm (300 rmi)) are losing 5 to 55 percent more soil per year than the natural streams (USACE 2011, pp. 21–22). Unrestricted livestock access occurs on many streams and potentially threatens associated mussel populations (Fraley and Ahlstedt 2000, pp. 193–194). Grazing may reduce water infiltration rates and increase runoff; trampling and vegetation removal increases the probability of erosion (Armour *et al.* 1991, pp. 8–10; Brim Box and Mossa 1999, p. 103).

Developed land can increase sediment loads and increase runoff (Wang *et al.* 2001, pp. 261–262). Hopkins (2009, p.

952) found rabbitsfoot occurrence positively correlated with riparian areas that were 70 percent forested and averaged 15 hectares (37 acres) in the Upper Green River in Ohio. Rabbitsfoot begins to respond negatively to 0.5 percent of developed land within the riparian area (Hopkins 2009, pp. 948–952).

As discussed above, specific impacts on mussels from sediments include reduced feeding and respiratory efficiency, disrupted metabolic processes, reduced growth rates, increased substrata instability, and the physical smothering of mussels. Increased turbidity levels due to siltation can be a limiting factor that impedes the ability of sight-feeding fishes to forage. Turbidity within the rivers and streams during the times that the mussels attempt to attract host fishes may have contributed and may continue to contribute to the decline of the Neosho mucket and rabbitsfoot by reducing their efficiency at attracting the fish hosts necessary for reproduction. In addition, sediment can eliminate or reduce the recruitment of juvenile mussels, interfere with feeding activity, and act as a vector in delivering contaminants to streams. Because the Neosho mucket and rabbitsfoot are filter-feeders and may bury themselves in the substrate, they are exposed to these contaminants contained within suspended particles and deposited in bottom substrates. We conclude that biological and habitat effects due to sedimentation are an ongoing threat to the Neosho mucket and rabbitsfoot.

Chemical Contaminants

Chemical contaminants are ubiquitous in the environment and are considered a major contributor to the decline of mussel species (Richter *et al.* 1997, p. 1081; Strayer *et al.* 2004, p. 436; Wang *et al.* 2007a, p. 2029; Cope *et al.* 2008, p. 451). Chemicals enter the environment through point- and nonpoint-source discharges including spills, industrial and municipal effluents, and residential and agricultural runoff. These sources contribute organic compounds, heavy metals, nutrients, pesticides, and a wide variety of newly emerging contaminants such as pharmaceuticals to the aquatic environment. As a result, water and sediment quality can be degraded to the extent that results in adverse effects to mussel populations.

Cope *et al.* (2008, p. 451) evaluated the pathways of exposure to environmental pollutants for all four freshwater mollusk life stages (free glochidia, encysted glochidia, juveniles, adults) and found that each life stage has both common and unique characteristics that contribute to observed differences in exposure and sensitivity. Almost nothing is known of the potential mechanisms and consequences of waterborne toxicants on sperm viability. In the female mollusk, the marsupial region of the gill is thought to be physiologically isolated from respiratory functions, and this isolation may provide some level of protection from contaminant interference with a female's ability to achieve fertilization or brood glochidia (Cope *et al.* 2008, p. 454). A major exception to this assertion is with chemicals that act directly on the neuroendocrine pathways controlling reproduction (see discussion below). Nutritional and ionic exchange is possible between a brooding female and her glochidia, providing a route for chemicals (accumulated or waterborne) to disrupt biochemical and physiological pathways (such as maternal calcium transport for construction of the glochidial shell). Glochidia can be exposed to waterborne contaminants for up to 36 hours until encystment occurs between 2 and 36 hours, and then from fish host tissue burdens (for example, atrazine), that last from weeks to months and could affect transformation success of glochidia into juveniles (Ingersoll *et al.* 2007, pp. 101–104).

Juvenile mussels typically remain burrowed beneath the sediment surface for 2 to 4 years. Residence beneath the sediment surface necessitates deposit (pedal) feeding and a reliance on interstitial water for dissolved oxygen (Watters 2007, p. 56). The relative importance of exposure of juvenile Neosho mucket and rabbitsfoot to contaminants in overlying surface water, interstitial water, whole sediment, or food has not been adequately assessed. Exposure to contaminants from each of these routes varies with certain periods and environmental conditions (Cope *et al.* 2008, pp. 453 and 457).

The primary routes of exposure to contaminants for adult Neosho mucket and rabbitsfoot are surface water, sediment, interstitial (pore) water, and diet; adults can be exposed when either partially or completely burrowed in the substrate (Cope *et al.* 2008, p. 453). Adult mussels have the ability to detect toxicants in the water and close their valves to avoid exposure (Van Hassel and Farris 2007, p. 6). Adult mussel toxicity and relative sensitivity (exposure and uptake of toxicants) may be reduced at high rather than at low toxicant concentrations because uptake is affected by the prolonged or periodic toxicant avoidance responses (when the avoidance behavior of keeping their valves closed can no longer be sustained for physiological reasons (respiration and ability to feed) (Cope *et al.* 2008, p. 454). Toxicity results based on low-level exposure of adults are similar to estimates for glochidia and juveniles for some toxicants (for example, copper). The duration of any toxicant avoidance response by an adult mussel is likely to vary due to several variables, such as species, age, shell thickness and gape, properties of the toxicant, and water temperature. There is a lack of information on toxicant response(s) for Neosho mucket and rabbitsfoot, but results of tests using glochidia and juveniles may be valuable for protecting adults (Cope *et al.* 2008, p. 454).

Mussels are very intolerant of heavy metals (such as, lead, zinc, cadmium, and copper) compared to commonly tested aquatic organisms. Metals occur in industrial and wastewater effluents and are often a result of atmospheric deposition from industrial processes and incinerators, but also are associated with mine water runoff (for example, Tri-State Mining Area in southwest Missouri) and have been attributed to mussel declines in streams such as Shoal, Center, and Turkey Creeks and Spring River in the Arkansas River basin (Angelo *et al.* 2007, pp. 485–489), which are streams with historical and extant Neosho mucket and rabbitsfoot populations. Heavy metals can cause mortality and affect biological processes, for instance, disrupting enzyme efficiency, altering filtration rates, reducing growth, and changing behavior of freshwater mussels (Keller and Zam 1991, p. 543; Naimo 1995, pp. 351–355; Jacobson *et al.* 1997, p. 2390; Valenti *et al.* 2005, p. 1244; Wang *et al.* 2007b, pp. 2039–2046; Wang *et al.* 2007c, pp. 2052–2055; Wang *et al.* 2010, p. 2053). Mussel recruitment may be reduced in habitats with low but chronic heavy metal and other toxicant inputs (Yeager *et al.* 1994, p. 217; Naimo 1995, pp. 347 and 351–352; Ahlstedt and Tuberville 1997, p. 75). Newly transformed juveniles (age at 5 days) are more sensitive to acute toxicity than glochidia or older juveniles (age at 2 to 6 months) (Wang *et al.* 2010, p. 2062).

Mercury is another heavy metal that has the potential to negatively affect mussel populations. Mercury has been detected throughout aquatic environments as a product of municipal and industrial waste and atmospheric deposition from coal-burning plants. One study on rainbow mussel (*Villosa iris*) concluded that glochidia were more sensitive to mercury than were juvenile mussels, with a median lethal

concentration value of 14 *u*g/L for glochidia and 114 *u*g/L for juvenile mussels (Valenti *et al.* 2005, p. 1242). The chronic toxicity is a test that usually measures sublethal effects (e.g., reduced growth or reproduction) in addition to lethality. These tests are usually longer in duration or conducted during some sensitive period of an organism's life cycle. For this species, the chronic toxicity test showed that juveniles exposed to mercury greater than or equal to 8 *u*g/L exhibited reduced growth (Valenti *et al.* 2005, p. 1245). Mercury also affects oxygen consumption, byssal thread production, and filtration rates (Naimo 1995, Jacobsen *et al.* 1997, and Nelson and Calabrese 1988 *in* Valenti *et al.* 2005, p. 1245). Effects to mussels from mercury toxicity may be occurring in some streams due to illegal dumping, spills, and permit violations. For example, acute mercury toxicity was determined to be the cause of extirpation of diverse mussel fauna for a 112-rkm (70-rmi) reach of the North Fork Holston River (Brown *et al.* 2005, pp. 1455–1457). Of the 11 viable rabbitsfoot populations, 4 populations (French Creek, Duck River, Green River, and Ohio River) currently inhabit river reaches that are impaired by mercury and are listed as impaired waters under section 303(d) of the CWA.

One chemical that is particularly toxic to early life stages of mussels is ammonia. Sources of ammonia include agricultural wastes (animal feedlots and nitrogenous fertilizers), municipal wastewater treatment plants, and industrial waste (Augspurger *et al.* 2007, p. 2026) as well as precipitation and natural processes (decomposition of organic nitrogen) (Goudreau *et al.* 1993, p. 212; Hickey and Martin 1999, p. 44; Augspurger *et al.* 2003, p. 2569; Newton 2003, p. 1243). Therefore, ammonia is considered a limiting factor for survival and recovery of some mussel species due to its ubiquity in aquatic environments and high level of toxicity, and because the highest concentrations typically occur in mussel microhabitats (Augspurger *et al.* 2003, p. 2574). In addition, studies have shown that ammonia concentrations increase with increasing temperature, pH, and low flow conditions (Cherry *et al.* 2005, p. 378; Cooper *et al.* 2005, p. 381; Wang *et al.* 2007, p. 2045), which may be exacerbated by the effects of climate change, and may cause ammonia (unionized and ionized) to become more problematic for juvenile mussels (Wang *et al.* 2007, p. 2045). Sublethal effects include, but may not be limited to, reduced time the valves are held open for respiration and feeding; impaired secretion of the byssal thread (used for substrate attachment), reduced ciliary action impairing feeding, depleted lipid, glycogen, and other carbohydrate stores, and altered metabolism (Goodreau *et al.* 1993, pp. 216–227; Augspurger *et al.* 2003, pp. 2571–2574; Mummert *et al.* 2003, pp. 2548–2552).

Polychlorinated biphenyls (PCBs) are ubiquitous contaminants in the environment due to their widespread use from the 1920s to 1970s as insulating material in electric equipment, such as transformers and capacitors, as well as in heat transfer fluids and in lubricants. PCBs have also been used in a wide range of products, such as plasticizers, surface coatings, inks, adhesives, flame retardants, paints, and carbonless duplicating paper. PCBs were still being introduced into the environment at many sites (such as landfills and incinerators) until the 1990s. The inherent stability and toxicity of PCBs have resulted in them being a persistent environmental problem (Safe 1994 *in* Lehmann *et al.* 2007, p. 356). PCBs are lipophilic (affinity to combine with fats or lipids), adsorb easily to soil and sediment, and are present in the sediment and water column in aquatic environments, making them available to bioaccumulate and induce negative effects in living organisms (Livingstone 2001 *in* Lehmann *et al.* 2007, p. 356). Studies have demonstrated increased PCB concentrations in native freshwater mussels (Ruessler *et al.* 2011, pp. 1, 7), marine bivalves (Krishnakumar *et al.* 1994, p. 249), and nonnative, invasive mollusks (zebra mussels and Asian clams) (Gossiaux *et al.* 1996, p. 379; Lehmann *et al.* 2007, p. 363) in areas with high levels of PCBs. Oxidative stress (imbalance in the normal redox state of cells that causes toxic effects that damage all components of the cell, including proteins, lipids, and DNA) is a direct consequence of exposure to PCBs. Relevant changes, whether directly or indirectly due to oxidative stress, may occur at the organ and organism levels and will likely result in mussel population-wide effects, including reduced fecundity and chronic maladies due to PCB exposure (Lehmann et al. 2007, p. 363). Two of the 11 viable rabbitsfoot populations (18 percent) inhabit waters listed as impaired due to PCBs under section 303(d) of the CWA.

Agriculture, timber harvest, and lawn management practices utilize nutrients and pesticides. These are two broad categories of chemical contaminants that have the potential to negatively impact mussel species. Nutrients, such as nitrogen and phosphorus, primarily occur in runoff from livestock farms, feedlots, heavily fertilized row crops and pastures (Peterjohn and Correll 1984, p. 1471), post timber management activities, and urban and suburban runoff, including leaking septic tanks, and residential lawns.

Studies have shown that excessive nitrogen concentrations can be lethal to the adult freshwater pearl mussel (*Margaritifera margaritifera*) and reduce the life span and size of other mussel species (Bauer 1988, p. 244; Bauer 1992, p. 425). Nutrient enrichment can result in an increase in primary productivity, and the associated algae respiration depletes dissolved oxygen levels. This may be particularly detrimental to juvenile mussels that inhabit the interstitial spaces in the substrate where lower dissolved oxygen concentrations are more likely than on the sediment surface where adults tend to live (Sparks and Strayer 1998, pp. 132–133). For example, Galbraith *et al.* (2008, pp. 48–49) reported a massive die-off of greater than 160 rabbitsfoot specimens at a long-term monitoring site in the Little River, Oklahoma. While the exact cause for the die-off is unknown, the authors speculate that the 2005 Oklahoma drought coupled with high water temperature and extensive blooms of filamentous algae may have resulted in extreme physiological stress. Over-enriched conditions are exacerbated by low flow conditions, such as those experienced during a typical summer season and that may occur with greater frequency and severity as a result of climate change. Three of the 11 viable rabbitsfoot populations (French Creek, Duck River, and Tippecanoe River) are listed as impaired waters under section 303(d) of the CWA due to nutrient enrichment.

Elevated concentrations of pesticide frequently occur in streams due to residential or commercial pesticide runoff, overspray application to row crops, and lack of adequate riparian buffers. Agricultural pesticide applications often coincide with the reproductive and early life stages of mussels, and effects to mussels may be increased during a critical time period (Bringolf *et al.* 2007a, p. 2094). Recent studies tested the toxicity of glyphosate, its formulations, and a surfactant (MON 0818) used in several glyphosate formulations, to early life stages of the fatmucket (*Lampsilis siliquoidea*), a U.S. native freshwater mussel (Bringolf *et al.* 2007a, p. 2094). Studies conducted with juvenile mussels and glochidia determined that the surfactant (MON 0818) was the most toxic of the compounds tested and that *L. siliquoidea* glochidia were the most

sensitive organism tested to date (Bringolf *et al.* 2007a, p. 2094). Roundup®, technical grade glyphosate isopropylamine salt, and isopropylamine were also acutely toxic to juveniles and glochidia (Bringolf *et al.* 2007a, p. 2097). The study of other pesticides, including atrazine, chlorpyrifos, and permethrin, on glochidia and juvenile life stages determined that chlorpyrifos was toxic to both *L. siliquoidea* glochidia and juveniles (Bringolf *et al.* 2007b, pp. 2101 and 2104). The above results indicate the potential toxicity of commonly applied pesticides and the threat to mussel species as a result of the widespread use of these pesticides.

Chemical spills have resulted in the loss of high numbers of mussels (Jones *et al.* 2001, p. 20; Brown *et al.* 2005, p. 1457; Schmerfeld 2006, pp. 12–13) and are considered a serious threat to mussel species. The Neosho mucket and rabbitsfoot are especially threatened by chemical spills because these spills can occur anywhere that highways with tanker trucks, industries, or mines overlap with their distribution.

Other examples of the influence of point- and nonpoint-source pollutants on streams throughout the range of the Neosho mucket and rabbitsfoot include two documented mussel kills in Fish Creek (circa 1988) as a result of manure runoff from a hog farm and a diesel spill (Watters 1988, p. 18). Twelve point-source discharges occur on the Green River (Kentucky State Nature Preserves Commission and The Nature Conservancy 1998, pp. 15–19). The Illinois and Little Rivers are subject to nonpoint-source organic runoff from poultry farming and municipal wastewater. Pharmaceutical chemicals used in commonly consumed drugs are increasingly found in surface waters. A recent nationwide study sampling 139 stream sites in 30 States detected the presence of numerous pharmaceuticals, hormones, and other organic wastewater contaminants downstream from urban development and livestock production areas (Kolpin *et al.* 2002, pp. 1208–1210). Another study in northwestern Arkansas found pharmaceuticals or other organic wastewater constituents at 16 of 17 sites in 7 streams surveyed in 2004 (Galloway *et al.* 2005, pp. 4–22). Toxic levels of exposure to chemicals that act directly on the neuroendocrine pathways controlling reproduction can cause premature release of viable or nonviable glochidia. For example, the active ingredient in many human prescription antidepressant drugs belonging to the class of selective serotonin reuptake inhibitors may exert negative reproductive effects on mussels because of the drug's action on serotonin and other neuroendocrine pathways (Cope *et al.* 2008, p. 455). Pharmaceuticals or organic wastewater constituents are generally greater downstream of wastewater treatment facilities (Galloway *et al.* 2005, p. 28). Pharmaceuticals that alter mussel behavior and influence successful attachment of glochidia on fish hosts may have population-level implications for the Neosho mucket and rabbitsfoot.

The information presented in this section represents some of the threats from chemical contaminants that have been documented both in the laboratory and field and demonstrates that chemical contaminants pose a substantial threat to Neosho mucket and rabbitsfoot. A cursory examination of land use trends, nonpoint- and point-source discharges, and the list of impaired waters under section 303(d) of the CWA suggests that all 11 rabbitsfoot populations currently considered viable may be subjected to the subtle, pervasive effects of chronic, low-level contamination that is ubiquitous in these watersheds. For example, the 8 of the 11 (73 percent) streams with viable rabbitsfoot populations are listed as impaired waters under section 303(d) of the CWA. Reasons for impairment include mercury, nutrients, organic enrichment and dissolved oxygen depletion, pathogens, turbidity (sediment), and PCBs. Potential effects from contaminant exposure may result in death, reduced growth, altered metabolic processes, or reduced reproduction. We conclude that biological and habitat effects of chemical contaminants are an ongoing threat contributing to the decline of Neosho mucket and rabbitsfoot populations.

Mining

Gravel, coal, and metal mining are activities negatively affecting water quality in Neosho mucket and rabbitsfoot habitat. Instream and alluvial gravel mining has been implicated in the destruction of mussel populations (Hartfield 1993, pp. 136–138; Brim Box and Mossa 1999, pp. 103–104). Negative effects associated with gravel mining include stream channel modifications (altered habitat, disrupted flow patterns, sediment transport), water quality modifications (increased turbidity, reduced light penetration, increased temperature), macroinvertebrate population changes (elimination), and changes in fish populations, resulting from adverse effects to spawning and nursery habitat and food web disruptions (Kanehl and Lyons 1992, pp. 4–10). Gravel mining activities continue to be a localized threat in several streams with viable rabbitsfoot populations (Ohio, Tennessee, White, Strawberry, and Little Rivers). In the lower Tennessee River, instream mining occurs in 18 reaches totaling 77.1 rkm (47.9 rmi) between the Duck River confluence and Pickwick Landing Dam (Hubbs 2010, pers. comm.).

Coal mining activities, resulting in heavy metal-rich drainage, and associated sedimentation has adversely affected many drainages with rabbitsfoot populations, including portions of the upper Ohio River system in Kentucky, Pennsylvania, and West Virginia; the lower Ohio River system in eastern Illinois; the Rough River drainage in western Kentucky; and the upper Cumberland River system in Kentucky and Tennessee (Ortmann 1909 *in* Butler 2005, p. 102; Gordon 1991, pp. 4 and 5; Layzer and Anderson 1992 *in* Butler 2005, p. 102). Numerous mussel toxicants, such as polycyclic aromatic hydrocarbons and heavy metals (copper, manganese, and zinc) from coal mining contaminate sediments when released into streams (Ahlstedt and Tuberville 1997, p. 75). Low pH commonly associated with mine runoff can reduce glochidial attachment rates on host fish (Huebner and Pynnonen 1990, pp. 2350–2353). Thus, acid mine runoff may have local effects on mussel recruitment and may lead to mortality due to improper shell development or erosion.

Metal mining (lead, cadmium, and zinc) in the Tri-State Mining Area (15,000 square kilometers: 5,800 square miles) in Kansas, Missouri, and Oklahoma) has negatively affected Center and Shoal Creeks and the Spring River. It has been implicated in the loss of Neosho mucket and rabbitsfoot from portions of these streams (Obermeyer *et al.* 1997b, p. 114). A study by the Kansas Department of Health and Environment documented a strong negative correlation between the distribution and abundance of native mussels, including Neosho mucket, and sediment concentrations of lead, zinc and cadmium in the Spring River system (Angelo *et al.* 2007, pp. 477–493). Sediment and water quality samples exceeded EPA 2006 threshold effect concentrations for cadmium, lead, and zinc at numerous sampling locations within the Tri-State Mining Area (Gunter 2007, pers. comm.). These physical habitat threats combined with poor water quality and agricultural nonpoint-source pollution are serious threats to all existing mussel fauna in the basin.

In the St. Francis River basin, past metal mining and smelting (early

eighteenth century through the 1940s) have resulted in continuing heavy metal (lead, iron, nickel, copper, cobalt, zinc, cadmium, chromium) contamination of surface waters in the area upstream of the extant rabbitsfoot population. Recent and historical metals mining and smelting produced large volumes of contaminated wastes. Most of these mining wastes are stored behind poorly constructed dams and impoundments (Roberts 2008, pers. comm.). Wappapello Reservoir and the confluence with Big Creek (with habitat degradation primarily from mining activities) may effectively limit the distribution of the rabbitsfoot in the St. Francis River. We conclude that biological and habitat effects due to mining activities are a significant and ongoing threat contributing to declining Neosho mucket and rabbitsfoot populations.

Oil and Natural Gas Development

Oil and natural gas resources are present in some of the watersheds that are known to support rabbitsfoot, including the Allegheny and Middle Fork Little Red Rivers and two watersheds with viable populations (White River and French Creek). Exploration and extraction of these energy resources can result in increased siltation, a changed hydrograph (graph showing changes in the discharge of a river over a period of time), and altered water quantity and quality even at considerable distances from the mine or well field because effects are carried downstream from the original source. Rabbitsfoot habitat in streams can be threatened by the cumulative effects of multiple mines and well fields (adapted from Service 2008, p. 11).

Recently, oil and gas exploration has been able to expand in areas of shale due to new technologies (i.e., hydraulic fracturing and horizontal drilling), making access possible to oil and gas reserves in areas that were previously inaccessible. Extraction of these resources, particularly natural gas, has increased dramatically in recent years in Arkansas, Oklahoma, Pennsylvania, and West Virginia. Although oil and natural gas extraction generally occurs away from the river, extensive road and pipeline networks are required to construct and maintain wells and transport the extracted resources. These road and pipeline networks frequently cross or occur near tributaries, contributing sediment to the receiving waterway. In addition, the construction and operation of wells may result in the discharge of chemical contaminants and subsurface minerals.

Several of the viable rabbitsfoot populations occur in active shale basins (areas of shale gas formations) (*http://www.eia.gov/analysis/studies/worldshalegas/*). In 2006, more than 3,700 permits were issued for oil and gas wells by the Pennsylvania Department of Environmental Protection, which also issued 98 citations for permit violations at 54 wells (Hopey 2007; adapted from Service 2008, p. 13). A natural gas pipeline company pled guilty to three violations of the Act in 2011 for unauthorized take of a federally endangered mussel in Arkansas as a result of a large amount of sediment being transported from pipeline right-of-ways to tributary streams in the affected watershed (Department of Justice 2011, pers. comm.). Where oil and natural gas development occurs within the range of extant Neosho mucket and rabbitsfoot populations, we conclude that the resulting biological and habitat effects are a significant and ongoing threat contributing to the decline of both species.

Conservation Measures

Nonregulatory conservation efforts that are or have addressed range curtailment include monitoring of the species distribution and status and habitat enhancement and restoration projects. Survey work encompassing the entire range of the Neosho mucket has been completed for all four States. The Service and its many State and Federal partners have funded projects to private landowners to enhance riparian habitat in many streams with Neosho mucket and rabbitsfoot populations. For instance, specific watershed-level projects that have benefited habitat for the rabbitsfoot include the critically important populations in the Green and Duck Rivers. Another example includes the State of Kentucky securing 100,000 acres of agricultural riparian lands in the upper Green River watershed. Other efforts have focused on sediment remediation work in rabbitsfoot streams. Reservoir releases from dams have been modified in recent years improving water quality and habitat conditions in many tailwaters occupied by rabbitsfoot. Flow improvements below dams have enabled partners to attempt the reintroduction of listed species such as the rabbitsfoot. TVA has modified the Tims Ford Dam operations on the Elk River that will add 30 river miles of good habitat upstream from Fayetteville and in the dam tailwaters. TVA has committed to water quality and biological monitoring for a period of 10 years.

Methods have been devised and implemented for the propagation of Neosho mucket and rabbitsfoot. The States of Kansas and Missouri have released thousands of juvenile Neosho mucket individuals in the Fall, Verdigris, and Spring Rivers. The State of Kansas reintroduced Neosho mucket at two sites in the Cottonwood River. The State of Alabama reintroduced rabbitsfoot in Limestone Creek. Similar efforts to augment rabbitsfoot populations in Kentucky are under way.

The Service is processing Safe Harbor Agreements and Candidate Conservation Agreements with Assurances with private landowners to conserve aquatic species. Rabbitsfoot is one of the species included in two programmatic Safe Harbor Agreements (SHA) in Arkansas. Implementation of the upper Little Red River SHA began in 2007, and approximately 12,000 acres have been enrolled to date. This SHA is currently undergoing permit amendment to add rabbitsfoot, but the SHA already covers another mussel (speckled pocketbook) and conservation measures currently being implemented on enrolled lands will benefit rabbitsfoot. A similar programmatic SHA is currently in the final stages of development and awaiting permit approval from the Service in the Saline, Ouachita, and Caddo Rivers (headwaters) watershed.

Summary of Factor A

The decline of mussels in the eastern United States is primarily the result of long-lasting direct and secondary effects of habitat alterations such as impoundments, channelization, sedimentation, chemical contaminants, oil and gas development, and mining, and it is reasonable to conclude that the changes in the river basins historically and currently occupied by the species are the cause of population-level (river basin) effects. Historical population losses due to impoundments have probably contributed more to the decline and range reductions of the Neosho mucket and rabbitsfoot than any other single factor. Seven of the 11 (64 percent) viable rabbitsfoot populations (Ohio, Green, Tippecanoe, Tennessee, Duck, White, and Little Rivers) occur downstream of main stem impoundments that make these populations more susceptible to altered habitat quality and quantity associated with the impoundment and dam operation, which may be exacerbated during stochastic events such as droughts and floods. Sedimentation resulting from a variety of sources such as channelization, agricultural and silvicultural practices, and construction

activities has degraded Neosho mucket and rabbitsfoot habitat and altered biological processes essential to their survival. For example, sedimentation associated with agricultural land use is cited as one of the primary threats to 7 of the 11 (64 percent) streams with viable rabbitsfoot populations.

Land use conversion, particularly urbanization that increases impervious surfaces in watersheds (impervious surface increases flood intensity and duration), channelization, and instream gravel and sand mining alter natural hydrology and stream geomorphology characteristics that also degrade mussel habitat in streams that support the Neosho mucket and rabbitsfoot. Contaminants associated with industrial and municipal effluents, agricultural practices, and mining degrade water and sediment quality leading to environmental conditions that have lethal and sublethal effects to Neosho mucket and rabbitsfoot, particularly the highly sensitive early life stages. Eight of the 11 (73 percent) streams with viable rabbitsfoot populations are listed as impaired waters under section 303(d) of the CWA, which means that the rabbitsfoot may be subjected to the subtle, pervasive effects of chronic, low-level contamination that is ubiquitous in these watersheds. Chronic contamination can affect the mussels in a variety of ways including sublethal effects (such as suppressed immune systems and effects to reproduction and fecundity from neuroendocrine disrupters) and lethal effects (such as sediment smothers and disruption of other metabolic processes).

In summary, we have determined that impoundments, channelization, sedimentation, chemical contaminants, mining, and oil and natural gas development are ongoing threats to the Neosho mucket and rabbitsfoot and their habitat that are expected to continue into the future. Although efforts have been made to restore habitat in some areas, these threats are still ongoing, as evidenced by population declines and range reduction.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The Neosho mucket was valuable in the pearl button industry (1800s to early 1940s), and historical episodes of overharvest in the Neosho River may have contributed to its decline (Obermeyer *et al.* 1997b, p. 115). The rabbitsfoot was never a valuable shell for the commercial pearl button industry (Meek and Clark 1912, p. 15; Murray and Leonard 1962, p. 65), nor the cultured pearl industry (Williams and Schuster 1989, p. 23), and hence these activities were probably not significant factors in its decline. However, it was noted occasionally in commercial harvests as evidenced from mussel cull piles (Isely 1924; Parmalee *et al.* 1980, p. 101). Currently, Neosho mucket and rabbitsfoot are not commercially valuable species but may be increasingly sought by collectors as they become rarer. Although scientific collecting is not thought to represent a significant threat, unregulated collecting could adversely affect localized Neosho mucket and rabbitsfoot populations.

Commercial mussel harvest is illegal in some States (for example, Indiana and Ohio), but regulated in others (for example, Arkansas, Alabama, Kentucky, and Tennessee). These species may be inadvertently harvested by inexperienced commercial harvesters unfamiliar with species identification. Although illegal harvest of protected mussel beds occurs (Watters and Dunn 1995, pp. 225 and 247–250), commercial harvest is not known to have a significant effect on the Neosho mucket and rabbitsfoot.

Conservation Measures

We are not aware of any nonregulatory actions that are being conducted to ameliorate overutilization for commercial, recreational, scientific, or educational purposes at this time.

Summary of Factor B

Though it is possible that the intensity of inadvertent or illegal harvest may increase in the future, we have no evidence that this stressor is currently increasing in severity. On the basis of this analysis, we find that overutilization for commercial, recreational, scientific, or educational purposes is not a current threat to the Neosho mucket or rabbitsfoot in any portion of their range at this time nor is likely to become so in the future.

Factor C. Disease or Predation

Little is known about diseases in freshwater mussels (Grizzle and Brunner 2007, p. 6). However, mussel die-offs have been documented in streams inhabited by rabbitsfoot (Neves 1986, pp. 8–11), and some researchers believe that disease may be a factor contributing to the die-offs (Buchanan 1986, p. 53; Neves 1986, p. 11). Mussel parasites include water mites, trematodes, oligochaetes, leeches, copepods, bacteria, and protozoa (Grizzle and Brunner 2007, p. 4). Generally, parasites are not suspected of being a major limiting factor in the species' survival (Oesch 1984, p. 6). However, mite and trematode burdens can affect reproductive output and physiological condition, respectively, in mussels (Gangloff *et al.* 2008, pp. 28–30). Stressors that reduce fitness may make mussels more susceptible to parasites (Butler 2007, p. 90). Furthermore, nonnative mussels may carry diseases and parasites that are potentially devastating to the native mussel fauna on an individual or population-level basis (river basin), including Neosho mucket and rabbitsfoot (Strayer 1999b, p. 88). However, while individual mussels or beds of mussels historically or currently may have been affected by disease or parasites, we have no evidence that the severity of disease or parasite infestations impact either mussel on a population level (river basin).

The muskrat (*Ondatra zibethicus*) is cited as the most prevalent mussel predator (Kunz 1898, p. 328; Convey *et al.* 1989, pp. 654–655; Hanson *et al.* 1989, pp. 15–16). Muskrat predation may limit the recovery potential of endangered or threatened mussels or contribute to local extirpations of previously stressed populations, according to Neves and Odom (1989, p. 940), who consider it, however, primarily a seasonal or localized threat. Galbraith *et al.* (2008, p. 49) hypothesized that predation may have exacerbated rabbitsfoot mortality in the Little River, Oklahoma, during the 2005 drought. Harris *et al.* (2007, p. 31) reported numerous dead rabbitsfoot from muskrat middens (mound or deposit containing shells) in the Spring River, Arkansas. Other mammals (for example, raccoon, mink, otter, hogs, and rats), turtles, and aquatic birds also occasionally feed on mussels (Kunz 1898, p. 328; Neck 1986, pp. 64–65). Recently, predation of Neosho mucket by reintroduced otters has been documented in a mussel bed also supporting rabbitsfoot in the Spring River, Kansas (Barnhart 2003, pp. 16–17), and likely occurs elsewhere. Muskrat predation has been documented for Neosho mucket and rabbitsfoot, but the overall threat is generally considered insignificant.

Some species of fish feed on mussels (for example, common carp (*Cyprinus carpio*), freshwater drum (*Aplodinotus grunniens*), and redear sunfish (*Lepomis microlophus*)) and potentially on young Neosho mucket and rabbitsfoot. Various invertebrates, such as flatworms, hydra, nonbiting midge larvae, dragonfly larvae, and crayfish, feed on juvenile mussels (Zimmerman *et al.* 2003, p. 28). Although predation by naturally occurring predators is a normal aspect of the population dynamics of a healthy mussel population, predation may

amplify declines in small populations of this species. In addition, the potential now exists for black carp (*Mylopharyngodon piceus*), a mollusk-eating Asian fish recently introduced into the waters of the United States (Strayer 1999b, p. 89), to eventually disperse throughout the range of the Neosho mucket and rabbitsfoot. However, we have no evidence that the severity of predation has reached levels where populations (river basin) of either mussel have been historically or recently impacted or should be impacted in the future based on current information.

The life cycle of freshwater mussels is intimately related to that of the freshwater fish they use as hosts for their parasitic glochidia. For this reason, diseases that affect populations of freshwater fishes also pose a significant threat to mussels in general. Viral hemorrhagic septicemia (VHS) disease has been confirmed from much of the Great Lakes and St. Lawrence River system. If the VHS virus successfully migrates out of Clearfork Reservoir or the Great Lakes and into the Ohio and Mississippi River basins, it could spread rapidly and cause fish kills throughout the river basins. Few Neosho mucket and rabbitsfoot populations are currently recruiting at sustainable levels, and fish kills, particularly if VHS infects suitable fish hosts, could further reduce glochidia encounters with fish hosts and exacerbate mussel recruitment reductions. However, we have no evidence that fish kills affecting potential fish hosts of these two mussel species have had population effects historically or recently.

Conservation Measures

Nonregulatory conservation measures implemented include control of the Asian carp and black carp. Both species are listed under the Injurious Wildlife Provision of the Lacey Act, which prohibits the import, export, and transport between States. Numerous States within the range of Neosho mucket and rabbitsfoot are engaging in efforts (such as, eradication) to minimize the effects of Asian carp on native fishery resources.

Summary of Factor C

Disease in mussels is poorly known and not currently considered a threat rising to a level such that it would have an effect on the Neosho mucket, nor the rabbitsfoot, as a whole. Studies indicate that, in some localized areas, disease and predation may have negative effects on mussel populations. Though it is possible that the intensity of disease or predation may increase in the future, we have no evidence that this stressor is currently increasing in severity.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

The objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA) (33 U.S.C. 1251 *et seq.*), is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources. The CWA has a stated goal that ''. . . wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983.'' States are responsible for setting and implementing water quality standards that align with the requirements of the CWA. Overall, implementation of the CWA could benefit both mussel species through the point and nonpoint programs.

Nonpoint source (NPS) pollution comes from many diverse sources, unlike pollution from industrial and sewage treatment plants. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it transports natural and human-made pollutants. While some pollutants may be ''deposited,'' some may remain in suspension (dissolved) as they are transported through various waterbodies. States report that nonpoint source pollution is the leading remaining cause of water quality problems. The effects of nonpoint-source pollutants on specific waters vary and may not always be fully assessed. However, these pollutants have harmful effects on fisheries and wildlife (*http://www.epa.gov/owow_keep/NPS/whatis.html*).

Sources of NPS pollution within the watersheds occupied by both mussels include timber clearcutting, clearing of riparian vegetation, urbanization, road construction, and other practices that allow bare earth to enter streams (The Nature Conservancy 2004, p. 13). Numerous stream segments in the Duck, White, Black, Little, and Strawberry River watersheds are listed as impaired waters under section 303(d) of the CWA by EPA due to sedimentation associated with agriculture (USACE 2011, p. 21; EPA Water Quality Assessment Tool, *http://ofmpub.epa.gov/tmdl_waters10/attains_nation_cy.control?p_report_type=T*). For example, impaired streams in the Duck River watershed (483 rkm (300 rmi)) are losing 5 to 55 percent more soil per year than streams not labeled as impaired (USACE 2011, pp. 21–22). Currently, the CWA may not adequately protect Neosho mucket and rabbitsfoot habitat from NPS pollution. The Service has no information concerning the implementation of the CWA regarding NPS pollution specific to protection of both mussels. However, insufficient implementation could become a threat to both mussel species if they continue to decline in numbers or if new information becomes available.

Point-source discharges within the range of the Neosho mucket and rabbitsfoot have been reduced since the enactment of the CWA. Despite some reductions in point-source discharges, adequate protection may not be provided by the CWA for filter-feeding organisms that can be affected by extremely low levels of contaminants (see *Chemical Contaminants* discussion under Factor A). The Neosho mucket and rabbitsfoot continue to decline due to the effects of habitat destruction, poor water quality, contaminants, and other factors. Eight of the 11 (73 percent) streams with viable rabbitsfoot populations are listed as impaired waters under section 303(d) of the CWA. Reasons for impairment include mercury, nutrients, organic enrichment, dissolved oxygen depletion, pathogens, turbidity (sediment), and PCBs. In addition, numerous tributaries within watersheds supporting viable Neosho mucket and rabbitsfoot populations also are listed as impaired waters under section 303(d) of the CWA, which means that both species may be subjected to greater, albeit subtle, pervasive effects of chronic, low-level contamination that is ubiquitous in these watersheds. However, we are aware of no specific information about the sensitivity of the Neosho mucket and rabbitsfoot to common point-source pollutants like industrial and municipal pollutants and very little information on other freshwater mussels. Because little information is available about water quality parameters necessary to fully protect freshwater mussels, such as the Neosho mucket and rabbitsfoot, it is difficult to determine whether the CWA is adequately addressing the threats to these species. However, given that a goal of the CWA is to establish water quality standards that protect shellfish and given that documented declines of these mussel species still continue due to poor water quality and other factors, we take a conservative approach in favor of the species and conclude that the CWA has been insufficient to reduce or remove the threats to the Neosho mucket and rabbitsfoot.

Summary of Factor D

In summary, the CWA has a stated goal to establish water quality standards that protect aquatic species, including the Neosho mucket and rabbitsfoot. However, the CWA has generally been insufficient at protecting mussels, and adequate water quality criteria that are protective of all life stages, particularly glochidia and juveniles, may not have been established. Little information is known about specific sensitivities of mussels to various pollutants, but both species continue to decline due to the effects of habitat destruction, poor water quality, contaminants, and other factors.

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Population Fragmentation and Isolation

Population fragmentation and isolation prohibit the natural interchange of genetic material between populations. Most of the remaining Neosho mucket and rabbitsfoot populations are small and geographically isolated, and, thus, are susceptible to genetic drift, inbreeding depression, and stochastic changes to the environment, such as toxic chemical spills (Smith 1990, pp. 311–321; Watters and Dunn 1995, pp. 257–258; Avise and Hamrick 1996, pp. 463–466). For example, the Spring River (White River basin) and Muddy Creek (Ohio River basin) rabbitsfoot populations are the only small populations not isolated from a viable population. Three marginal populations (Alleghany River and LeBoeuf and Conneauttee Creeks), considered metapopulations with French Creek, also are not isolated from a viable rabbitsfoot population (French Creek). However, 41 of 51 extant rabbitsfoot populations (80 percent) are isolated from other extant populations, excluding those discussed above and the Strawberry, Tennessee, and Ohio Rivers, which are viable populations that are not isolated from another viable population (Black River) or each other (lower Tennessee and Ohio Rivers).

Inbreeding depression can result in early mortality, decreased fertility, smaller body size, loss of vigor, reduced fitness, and various chromosome abnormalities (Smith 1990, pp. 311–321). A species' vulnerability to extinction is increased when they are patchily distributed due to habitat loss and degradation (Noss and Cooperrider 1994, pp. 58–62; Thomas 1994, p. 373). Although changes in the environment may cause populations to fluctuate naturally, small and low-density populations are more likely to fluctuate below a minimum viable population size (the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval) (Shaffer 1981, p. 131; Shaffer and Samson 1985, pp. 148–150; Gilpin and Soulé 1986, pp. 25–33). Furthermore, this level of isolation makes natural repopulation of any extirpated population unlikely without human intervention. Population isolation prohibits the natural interchange of genetic material between populations, and small population size reduces the reservoir of genetic diversity within populations, which can lead to inbreeding depression (Avise and Hambrick 1996, p. 461).

Neosho mucket and rabbitsfoot were once widespread throughout their respective ranges with few natural barriers to prevent migration (via fish host species) among suitable habitats. However, construction of dams extirpated many Neosho mucket and rabbitsfoot populations and isolated others. Recruitment reduction or failure is a potential problem for many small Neosho mucket and rabbitsfoot populations rangewide, a potential condition exacerbated by their reduced range, increasingly small populations, and increasingly isolated populations. If these trends continue, further significant declines in total population size and subsequent reduction in long-term survivability may be observed in the future.

The likelihood is high that some rabbitsfoot and Neosho mucket populations are below the effective population size (EPS—the number of individuals in a population who contribute offspring to the next generation), based on restricted distribution and populations only represented by a few individuals, and achieving the EPS is necessary for a population to adapt to environmental change and maintain long-term viability. Isolated populations eventually are extirpated when population size drops below the EPS or threshold level of sustainability (Soulé 1980, pp. 162–164). Evidence of recruitment in many populations of these two species is scant, making recruitment reduction or outright failure suspect. These populations may be experiencing the bottleneck effect of not attaining the EPS. Small, isolated, below the EPS-threshold populations of short-lived species (most fish hosts) theoretically die out within a decade or so, while below-threshold populations of long-lived species, such as the Neosho mucket and rabbitsfoot, might take decades to die out even given years of total recruitment failure. Without genetic interchange, small, isolated populations could be slowly expiring, a phenomenon termed the extinction debt (Tilman *et al.* 1994, pp. 65–66). Even given the absence of existing or new anthropogenic threats, disjunct populations may be lost as a result of current below-threshold effective population size. Additionally, evidence indicates that general habitat degradation continues to decrease habitat patch size, further contributing to the decline of Neosho mucket and rabbitsfoot populations.

We find that fragmentation and isolation of small remaining populations of the Neosho mucket and rabbitsfoot are current and ongoing threats to both species throughout all of their ranges and will continue into the future. Further, stochastic events may play a magnified role in population extirpation when small, isolated populations are involved.

Invasive Nonindigenous Species

Various invasive or nonnative species of aquatic organisms are firmly established in the range of the Neosho mucket and rabbitsfoot. The nonnative, invasive species that poses the most significant threat is the zebra mussel, *Dreissena polymorpha,* introduced from Europe. Its invasion poses a threat to mussel faunas in many regions, and species extinctions are expected as a result of its continued spread in the eastern United States (Ricciardi *et al.* 1998, p. 613). Strayer (1999b, pp. 75–80) reviewed in detail the mechanisms by which zebra mussels affect native mussels. Zebra mussels attach in large numbers to the shells of live native mussels and are implicated in the loss of entire native mussel beds. Fouling effects include impeding locomotion (both laterally and vertically), interfering with normal valve movements, deforming valve margins, and locally depleting food resources and increasing waste products. Heavy infestations of zebra mussels on native mussels may overly stress the animals by reducing their energy stores. They may also reduce food concentrations to levels too low to support reproduction, or even survival in extreme cases. Zebra mussels also may affect Neosho mucket and rabbitsfoot through filtering and removing their sperm and possibly glochidia from the water column, thus reducing reproductive potential. Habitat for native mussels also may be degraded by large deposits of zebra mussel pseudofeces (undigested waste material passed out of the incurrent siphon) (Vaughan 1997, p. 11).

Overlapping much of the current range of the Neosho mucket and rabbitsfoot, zebra mussels have been

detected or are established in Neosho mucket (Neosho and Verdigris Rivers) and rabbitsfoot streams (Ohio, Allegheny, Green, Tennessee, White, and Verdigris Rivers, and French and Bear Creeks). Zebra mussel populations appear to be maintained primarily in streams with barge navigation (Stoeckel *et al.* 2003, p. 334). As zebra mussels may maintain high densities in big rivers, large tributaries, and below infested reservoirs, rabbitsfoot populations in these affected areas have the potential to be significantly affected. In addition, there is long-term potential for zebra mussel invasions into other systems that currently harbor Neosho mucket and rabbitsfoot populations. However, evidence is mounting in some northern streams where there is no barge navigation (French Creek and Tippecanoe River) and southern ones with barge traffic (Tennessee River) that the zebra mussel threat to native mussels may be minimal because native freshwater mussel populations are able to survive when zebra mussel abundance is low (Butler 2005, p.116; Fisher 2009, pers. comm.).

The Asian clam (*Corbicula fluminea*) has spread throughout the range of Neosho mucket and rabbitsfoot since its introduction in the early twentieth century. It competes with native mussels, particularly juveniles, for resources such as food, nutrients, and space (Neves and Widlak 1987, p. 6; Leff *et al.* 1990, p. 414), and may ingest sperm, glochidia, and newly metamorphosed juveniles of native mussels (Strayer 1999b, p. 82; Yeager *et al.* 2000, p. 255). Periodic die-offs of Asian clams may produce enough ammonia and consume enough dissolved oxygen to kill native mussels (Strayer 1999b, p. 82). Yeager *et al.* (2000, pp. 257–258) determined that high densities of Asian clams negatively affect the survival and growth of newly metamorphosed juvenile mussels and thus reduced recruitment. Dense Asian clam populations actively disturb sediments that may reduce habitat for juveniles of native mussels (Strayer 1999b, p. 82).

Asian clam densities vary widely in the absence of native mussels or in patches with sparse mussel concentrations, but Asian clam density is never high in dense mussel beds, indicating that the clam is unable to successfully invade small-scale habitat patches with high unionid biomass (Vaughn and Spooner 2006, pp. 334–335). The invading clam, therefore, appears to preferentially invade sites where mussels are already in decline (Strayer 1999b, pp. 82–83; Vaughn and Spooner 2006, pp. 332–336) and does not appear to be a causative factor in the decline of mussels in dense beds. However, an Asian clam population that thrives in previously stressed, sparse mussel populations might exacerbate mussel decline through competition and by impeding mussel population expansion (Vaughn and Spooner 2006, pp. 335–336).

A molluscivore (mollusk eater), the introduced black carp (*Mylopharyngodon piceus*), is a potential threat to Neosho mucket and rabbitsfoot (Strayer 1999b, p. 89). It has been proposed for widespread use by aquaculturists to control snails, the intermediate host of a trematode (flatworm) parasite affecting catfish in ponds in the southeast and lower midwest. They are known to feed on various mollusks, including mussels and snails, in China. They are the largest of the Asiatic carp species, reaching more than 1.2 meters (4 feet) in length (Nico and Williams 1996, p. 6). Foraging rates for a 4-year-old fish average 1.4–1.8 kg (3 or 4 pounds) a day, indicating that a single individual could consume 9,072 kilograms (10 tons) of native mollusks during its lifetime (MICRA 2005, p. 1). In 1994, 30 black carp escaped from an aquaculture facility in Missouri during a flood. The escape of nonsterile black carp is considered imminent by conservation biologists (Butler 2007, pp. 95–96). The black carp was officially added to the Federal list of injurious wildlife species on October 18, 2007 (72 FR 59019).

The round goby (*Neogobius melanostomus*) is another nonnative, invasive fish species released in the 1980s that is well established and likely to spread through the Mississippi River system (Strayer 1999b, pp. 87–88). This species is an aggressive competitor of similar-sized benthic fishes (sculpins and darters), as well as a voracious carnivore, despite its size (less than 25.4 centimeters (10 inches) in length), preying on a variety of foods, including small mussels and fishes that could serve as glochidial hosts (Strayer 1999b, p. 88; Janssen and Jude 2001, p. 325). Round gobies may, therefore, pose a threat to Neosho mucket and rabbitsfoot reproduction.

The golden alga (*Prymnesium parvum)* is an invasive marine or estuarine algae that likely originated in Europe (Barkoh and Fries 2010, p. 2). Golden alga is found throughout 20 States in the United States. Algae blooms and fish kills have been reported in the following States that overlap the range of Neosho mucket and rabbitsfoot: Arkansas, Oklahoma, Alabama, Louisiana, Mississippi, Georgia, West Virginia, and Kentucky (Hambright 2012, p. 33). Golden alga blooms have been associated with mine and gas outfalls, specifically high chlorides (Sextone 2012, p. 1). Golden alga can give off toxins, when inorganic nitrogen and phosphorous are scarce, that are lethal to gill-breathing organisms, such as mussels and fishes. The toxins also can kill other invertebrates, planktonic algae, and bacteria (Barkoh and Fries 2010, p. 1). A golden alga bloom can be detrimental to Neosho mucket and rabbitsfoot by directly killing individuals and fish hosts and destroying their food base. Nonnative, invasive species, such as those described above, are an ongoing threat to the Neosho mucket and rabbitsfoot. This threat is likely to increase as these and potentially other invasive species expand their occupancy within the ranges of the Neosho mucket and rabbitsfoot through displacement, recruitment interference, and direct predation of the mussels and their fish hosts.

Temperature

Natural temperature regimes can be altered by impoundments, tailwater releases from dams, industrial and municipal effluents, and changes in riparian habitat. Low temperatures can significantly delay or prevent metamorphosis in mussels (Watters and O'Dee 1999, pp. 454–455). Cold water effluent below dams may negatively impact populations; rabbitsfoot were less abundant and in poor condition below a cold water outflow on the Little River, compared to two other sites upstream (Galbraith and Vaughn 2011, p. 198). Low water temperatures caused by dam releases also may disrupt seasonal patterns in reproduction on the Little River (Galbraith and Vaughn 2009, pp. 43–44).

Exact critical thermal limits for survival and normal functioning of many freshwater mussel species are unknown. However, high temperatures can reduce dissolved oxygen concentrations in the water, which slows growth, reduces glycogen stores, impairs respiration, and may inhibit reproduction (Fuller 1974, pp. 240–241). Thermally sensitive species decrease their water filtering and oxygen consumption at higher temperatures (Spooner and Vaughn 2008, p. 314). Although we do not have physiological data on rabbitsfoot and Neosho mucket, closely related species, the plain pocketbook (*Lampsilis cardium)* and the pimpleback (*Quadrula pustulosa),* are thermally sensitive (Spooner and Vaughn 2008, p. 313). Water temperature increases have been documented to shorten the period of

glochidial encystment, reduce righting speed (various reflexes that tend to bring the body into normal position in space and resist forces acting to displace it out of normal position), and slow burrowing and movement responses (Bartsch *et al.* 2000, p. 237; Watters *et al.* 2001, p. 546; Schwalb and Pusch 2007, pp. 264–265). Several studies have documented the influence of temperature on the timing aspects of mussel reproduction (Gray *et al.* 2002, p. 156; Allen *et al.* 2007, p. 85; Steingraeber *et al.* 2007, pp. 303–309). Peak glochidial releases are associated with water temperature thresholds that can be thermal minimums or maximums, depending on the species (Watters and O'Dee 2000, p. 136).

Alterations in temperature regimes in streams, such as those described above, are an ongoing threat to the Neosho mucket and rabbitsfoot. This threat is likely to continue and increase in the future due to additional navigation or water supply projects and as land use conversion to urban uses increases within the entire ranges of the Neosho mucket and rabbitsfoot.

Climate Change

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). ''Climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Projected changes in climate and related effects can vary substantially across and within different regions of the world (e.g., IPCC 2007a, pp. 8–12). Thus, although global climate projections are informative and in some cases are the only or the best scientific information available, to the extent possible we use ''downscaled'' climate projections which provide higher resolution information that is more relevant to the spatial scales used to assess effects to a given species (see Glick *et al.* 2011, pp. 58–61 for a discussion of downscaling). With regard to our analysis for the Neosho mucket and the rabbitsfoot, downscaled projections of climate change are available, but projecting precise effects on these two species from downscaled models is difficult because of the large geographic areas inhabited by both species. However, projections for the change in annual air temperature by the year 2080 for the Neosho mucket ranges between an increase of 7 to 8 degrees Fahrenheit (°F) and for the rabbitsfoot, an increase of 4.5 to 8 °F in annual air temperature (Maura *et al.* 2007, as displayed on *http://www.climatewizard.org/# 2012*).

Mussels can be placed into thermal guilds, thermally sensitive and thermally tolerant species, according to their response to warm summer water temperatures greater than 35 °C (95 °F) (Spooner and Vaughn 2008, p. 313). Although we do not have physiological data on rabbitsfoot and Neosho mucket, closely related species, *Lampsilis cardium* and *Quadrula pustulosa,* are thermally sensitive (Spooner and Vaughn 2008, p. 313). Data for the Kiamichi River in Oklahoma suggests that, over the past 17 years as water and air temperatures have increased, mussel beds once dominated by thermally sensitive species are now dominated by thermally tolerant species (Galbraith *et al.* 2010, p. 1179; Spooner and Vaughn 2008, p. 316). As temperature increases due to climate change throughout the range of Neosho mucket and rabbitsfoot, both species may experience population declines as warmer rivers are more suitable for thermally tolerant species.

Ficke *et al.* (2005, pp. 67–69; 2007, pp. 603–605) described the general potential effects of climate change on freshwater fish populations worldwide. Overall, the distribution of fish species is expected to change, including range shifts and local extirpations. Because freshwater mussels are entirely dependent upon a fish host for successful reproduction and dispersal, any changes in local fish populations would also affect freshwater mussel populations. Therefore, mussel populations will reflect local extirpations or decreases in abundance of fish species.

Conservation Measures

Nonregulatory conservation measures that address these threats include implementing artificial propagation programs (see Summary of Factor A). The Interior Highlands Mollusk Conservation Council, Ohio River Ecosystem Team—Mollusk Subcommittee and similar working groups targeting mussel conservation efforts, has been created and includes the Service, State and Federal agencies, nongovernmental organizations, academia, and Tribes.

Summary of Factor E

A variety of natural and manmade factors threatens the continued existence of Neosho mucket and rabbitsfoot. Forty-one of the 51 (80 percent) extant rabbitsfoot populations are isolated from viable populations. A lack of recruitment and genetic isolation pose a threat to the continued existence of these species. Invasive, nonindigenous species, such as zebra mussel, black carp, and Asian clam, have potentially adversely affected populations of the Neosho mucket and rabbitsfoot and their fish hosts, and these effects are expected to persist into the future. Evidence exists that the interaction of climate change and water management negatively impacts mussels (Galbraith *et al.* 2010, pp. 1179–1180). Drought combined with water management practices has led to high mortality in thermally sensitive species (Galbraith *et al.* 2010, pp. 1180–1181). Based on the best available information, we are unable to predict the timing and scope of any changes to these mussel species that may occur as a result of climate change effects, particularly when combined with effects from water management practices.

Cumulative Effects of Threats

The life-history traits and habitat requirements of the Neosho mucket and rabbitsfoot, and other freshwater mussels in general, make them extremely susceptible to environmental change. Unlike other aquatic organisms (e.g., aquatic insects and fish), mussels have limited refugia from stream disturbances (e.g., droughts, sedimentation, chemical contaminants). Mechanisms leading to the decline of Neosho mucket and rabbitsfoot, as discussed above, range from local (e.g., riparian clearing, chemical contaminants, etc.) to regional influences (e.g., altered flow regimes, channelization, etc.), to global climate change. The synergistic (interaction of two or more components) effects of threats are often complex in aquatic

environments, making it difficult to predict changes in mussel and fish host(s) distribution, abundance, and habitat availability that may result from these effects. While these stressors may act in isolation, it is more probable that many stressors are acting simultaneously (or in combination) (Galbraith *et al.* 2010, p. 1176) on Neosho mucket and rabbitsfoot populations.

Summary of Threats

The decline of the Neosho mucket and rabbitsfoot (described by Butler 2005, entire; described by Service 2010, entire) is primarily the result of habitat loss and degradation (Neves 1991, p. 252). Chief among the causes of decline, but in no particular ranking order, are impoundments, sedimentation, channelization, chemical contaminants, oil and natural gas development, and mining (Neves 1991, p. 252; Neves 1993, pp. 4–6; Williams *et al.* 1993, pp. 7–9; Neves *et al.* 1997, pp. 60 and 63–75; Watters 2000, pp. 262–267). These stressors have had profound adverse effects on Neosho mucket and rabbitsfoot populations, their habitats, and fish hosts.

Regulations at the Federal level may not be providing the protection needed for the Neosho mucket and rabbitsfoot. For example, 8 of the 11 (73 percent) viable rabbitsfoot populations are located in waters listed as impaired under section 303(d) of the CWA. In addition, numerous tributaries within watersheds with viable Neosho mucket and rabbitsfoot populations also are listed as impaired waters under section 303(d) of the CWA. The CWA has a stated goal to establish water quality standards that protect aquatic species, including mussel species. However, the CWA has generally been insufficient at protecting mussels, and adequate water quality criteria that are protective of all mussel life stages, particularly glochidia and juveniles, may not be established. Little information is known about specific sensitivities of mussels to various pollutants, but both species continue to decline due to the effects of poor water quality, contaminants, and other factors.

The majority of extant Neosho mucket populations are small and isolated, with only one viable population remaining. The majority of extant rabbitsfoot populations are marginal and small (78 percent) and isolated (80 percent), with only two small (5 percent) and 4 viable populations (36 percent) not isolated from another viable population (Butler 2005, p. 22; Service 2010, pp. 3–8). The patchy distributional pattern of populations in short river reaches makes them more susceptible to extirpation from single catastrophic events, such as toxic chemical spills (Watters and Dunn 1995, p. 257). Furthermore, this level of isolation makes natural recolonization of extirpated populations virtually impossible without human intervention. Various nonnative species of aquatic organisms are firmly established in the range of the Neosho mucket and rabbitsfoot. The nonnative species that poses the most significant threat to the Neosho mucket and rabbitsfoot is the zebra mussel. Although attempts to alleviate some of these threats are ongoing at some locations, no populations appear to be without threats that are negatively impacting the species.

Determination

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Neosho mucket and the rabbitsfoot. Section 3(6) of the Act defines an endangered species as ''any species that is in danger of extinction throughout all or a significant portion of its range'' and defines a threatened species as ''any species that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' As described in detail above, these two species are currently at risk throughout all of their respective ranges due to the immediacy, severity, and scope of threats from habitat destruction and modification (Factor A) and other natural or manmade factors affecting their continued existence (Factor E). Existing regulatory mechanisms applicable to these species, such as the CWA, appear to be inadequate to reduce these threats from water quality degradation, in particular, chemical contaminants (Factor D). Although there are ongoing actions to alleviate some threats, no populations appear to be without current threats. These isolated species have a limited ability to recolonize historically occupied stream and river reaches and are vulnerable to natural or human-caused changes in their stream and river habitats.

Their range curtailment, small population size, and isolation make the Neosho mucket and rabbitsfoot more vulnerable to threats such as sedimentation, disturbance of riparian corridors, changes in channel morphology, point- and nonpoint-source contaminants, urbanization, and invasive species and to stochastic events (such as chemical spills).

Neosho Mucket

The Neosho mucket has been extirpated (no longer in existence) from approximately 62 percent of its historical range with only 9 of 16 historical populations remaining (extant). This mussel is declining rangewide (eight of the nine extant populations), with only one remaining large, viable population. Based on the best available scientific and commercial information, we have determined that the Neosho mucket is in danger of extinction throughout all of its range. Therefore, we are listing it as an endangered species. In other words, we find that a threatened species status is not appropriate for the Neosho mucket due to its contracted range and only one remaining stable and viable population.

Rabbitsfoot

The rabbitsfoot has been extirpated from approximately 64 percent of its historical range. While this species is declining rangewide, it sustains recruitment and population viability consistently in 11 (8 percent of historical or 22 percent of extant distribution) large, extant river populations and, while reduced in numbers, it also sustains limited recruitment and distribution in another 17 river populations. Of the 17 river populations with limited recruitment and distribution, 15 of these populations (88 percent) are declining.

All remaining rabbitsfoot populations continue to be reduced in size or quality by habitat degradation as a result of impoundments and dams, navigation projects, commercial and residential development, agriculture, chemical contaminants, mining, and oil and natural gas development (Factor A). Climate change could affect in-stream water temperatures, seasonal water flows, and mussel and fish host reproductive activities, including the availability of mussel fish host species (Factor E). Invasive species occupying rabbitsfoot habitat will likely cause additional displacement and recruitment interference (Factor E). Eight of the 11 (73 percent) viable rabbitsfoot populations are in watersheds that have numerous tributaries that are listed as impaired waters under section 303(d) of the CWA. Regulatory mechanisms such as the CWA have been insufficient to significantly reduce or remove these types of threats to rabbitsfoot (Factor D). The synergistic effects of threats such as these are often complex in aquatic environments and make it difficult to predict changes in mussel and fish host(s) distribution, abundance, and

habitat availability. These threats are probably acting simultaneously on the remaining rabbitsfoot populations with negative results and are expected to continue to do so. Thus, while rabbitsfoot sustains 11 viable populations, these populations continue to be at risk, and the remaining extant populations are affected by isolation, fragmentation, limited recruitment and distribution, and population declines, which make the species particularly susceptible to extinction in the near future if threats continue or increase.

While we have determined that the rabbitsfoot is not currently in danger of extinction, because of the threats facing the species and impacts to its life history, we find that the species is likely to become endangered in the foreseeable future throughout all of its range. Therefore, we are listing it as a threatened species. In other words, we find that endangered status is not appropriate for the rabbitsfoot because 8 percent of the historical populations or 22 percent of extant populations remaining in its historical streams can be considered viable, but are facing subtle, pervasive threats that are ubiquitous in each watershed.

Significant Portion of the Range

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. The Act defines ''endangered species'' as any species which is ''in danger of extinction throughout all or a significant portion of its range,'' and ''threatened species'' as any species which is ''likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' The definition of ''species'' is also relevant to this discussion. The Act defines ''species'' as follows: ''The term 'species' includes any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature.''

Two recent district court decisions have addressed whether the SPR language allows the Service to list or protect less than all members of a defined ''species'': *Defenders of Wildlife* v. *Salazar,* 729 F. Supp. 2d 1207 (D. Mont. 2010), concerning the Service's delisting of the Northern Rocky Mountains gray wolf (74 FR 15123, April 2, 2009); and *WildEarth Guardians* v. *Salazar,* 2010 U.S. Dist. LEXIS 105253 (D. Ariz. September 30, 2010), concerning the Service's 2008 finding on a petition to list the Gunnison's prairie dog (73 FR 6660, February 5, 2008). The Service had asserted in both of these determinations that it had authority, in effect, to protect only some members of a ''species,'' as defined by the Act (i.e., species, subspecies, or DPS), under the Act. Both courts ruled that the determinations were arbitrary and capricious on the grounds that this approach violated the plain and unambiguous language of the Act. The courts concluded that reading the SPR language to allow protecting only a portion of a species' range is inconsistent with the Act's definition of ''species.'' The courts concluded that once a determination is made that a species (i.e., species, subspecies, or DPS) meets the definition of ''endangered species'' or ''threatened species,'' it must be placed on the list in its entirety and the Act's protections applied consistently to all members of that species (subject to modification of protections through special rules under sections 4(d) and 10(j) of the Act).

We evaluated the current range of the Neosho mucket and rabbitsfoot to determine if there is any apparent geographic concentration of potential threats for either species. The Neosho mucket and rabbitsfoot are highly restricted in their ranges, and the threats occur throughout their ranges. We considered the potential threats due to impoundments, sedimentation, channelization, chemical contaminants, oil and gas development, mining, and climate change. We found no concentration of threats because of the species' limited and curtailed ranges, and uniformity of the threats throughout their entire range. Having determined that the Neosho mucket is endangered throughout its entire range, it is not necessary to evaluate whether there are any significant portions of its range. Having determined that the rabbitsfoot is threatened throughout its entire range, we must next consider whether there are any significant portions of the range where the rabbitsfoot is in danger of extinction or is likely to become endangered in the foreseeable future.

We found no portion of the rabbitsfoot's range where potential threats are significantly concentrated or substantially greater than in other portions of its range. Therefore, we find that factors affecting the species are essentially uniform throughout its range, indicating no portion of the range of the species warrants further consideration of possible endangered or threatened status under the Act. Therefore, we find there is no significant portion of the rabbitsfoot range that may warrant a different status.

Critical Habitat

In the October 16, 2012, proposed rule to list the species (77 FR 63440), we also determined that designation of critical habitat was prudent, and critical habitat was determinable, for both the Neosho mucket and rabbitfoot, and we proposed critical habitat for both species. We will issue a final determination on critical habitat for Neosho mucket and rabbitsfoot under the Act in the near future.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened species under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, Tribal, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. Revisions of the plan may be done to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan identifies site-specific management actions that set a trigger for review of the five factors that control whether a species remains endangered

or may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprising species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from our Arkansas Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

Once these species are listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost-share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the States of Alabama, Arkansas, Indiana, Illinois, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee, and West Virginia would be eligible for Federal funds to implement management actions that promote the protection or recovery of the Neosho mucket and rabbitsfoot. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Federal agency actions within these species' habitat that may require conference or consultation or both as described in the preceding paragraph include, but are not limited to, the funding of, carrying out, or the issuance of permits for reservoir construction, navigation, natural gas extraction, stream alterations, discharges, wastewater facility development, water withdrawal projects, pesticide registration, mining, and road and bridge construction. This may include, but is not limited to, management and any other landscape-altering activities on Federal lands administered by the Department of Defense, and U.S. Department of Agriculture Forest Service; issuance of CWA permits by the Army Corps of Engineers and EPA; construction and maintenance of interstate power and natural gas transmission line right-of-ways by the Federal Energy Regulatory Commission; and construction and maintenance of roads or highways by the FHWA.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered and threatened wildlife. The prohibitions of section 9(a)(1) of the Act, codified at 50 CFR 17.21 and 17.31 for endangered and threatened wildlife make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these), import, export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. Under the Lacey Act (18 U.S.C. 42–43; 16 U.S.C. 3371–3378), it is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the Service and State conservation agencies.

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 for endangered species, and at 17.32 for threatened species. With regard to endangered wildlife, a permit must be issued for the following purposes: For scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities.

Our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), is to identify, to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on planned and ongoing activities within the range of species proposed for listing. The following activities could potentially result in a violation of section 9 of the Act for the Neosho mucket and rabbitsfoot; this list is not comprehensive:

(1) Collecting, handling, possessing, selling, delivering, carrying, or transporting of the species, including import or export across State lines and international boundaries that are unauthorized, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act;

(2) Introduction of nonnative species that compete with or prey upon the Neosho mucket and rabbitsfoot, such as the introduction of a predator of mussels like the nonnative black carp, to any water body where these species occur;

(3) The release of biological control agents that attack any life stage of Neosho mucket and rabbitsfoot that is unauthorized;

(4) Modification of the channel or water flow of any stream in which the Neosho mucket and rabbitsfoot are known to occur that is unauthorized or not covered under the Act for impacts to these species; and

(5) Discharge of chemicals or fill material into any waters supporting the Neosho mucket and rabbitsfoot that are unauthorized or not covered under the Act for impacts to these species.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Service's Ecological Services Field Office in the State where the proposed activities will occur. Requests for copies of the regulations concerning listed animals and general inquiries regarding prohibitions and permits may be addressed to the U.S. Fish and Wildlife Service, Endangered Species Permits, 1875 Century Boulevard, Suite

200, Atlanta, GA 30345; telephone: 404–679–7140; facsimile: 404–679–7081.

Under section 4(d) of the Act, the Secretary has discretion to issue such regulations as she deems necessary and advisable to provide for the conservation of threatened species. Our implementing regulations (50 CFR 17.31) for threatened wildlife generally incorporate the prohibitions of section 9 of the Act for endangered wildlife, except when a ''special rule'' promulgated pursuant to section 4(d) of the Act has been issued with respect to a particular threatened species. In such a case, the general prohibitions in 50 CFR 17.31 would not apply to that species, and instead, the special rule would define the specific take prohibitions and exceptions that would apply for that particular threatened species, which we consider necessary and advisable to conserve the species. The Secretary also has the discretion to prohibit by regulation with respect to a threatened species any act prohibited by section 9(a)(1) of the Act. We are not proposing to promulgate a special section 4(d) rule, and as a result, all of the section 9 prohibitions, including the ''take'' prohibitions, will apply to the rabbitsfoot.

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (NEPA), need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination With Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes. We determined that tribal lands or their interests will not be affected by the listing of the Neosho mucket and rabbitsfoot.

References Cited

A complete list of all references cited in this rule is available on the Internet at *http://www.regulations.gov* and upon request from the Field Supervisor, Arkansas Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this document are the staff members of the Arkansas Ecological Service Field Office (see **FOR FURTHER INFORMATION CONTACT**).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245; unless otherwise noted.

■ 2. Amend § 17.11(h) by adding new entries for ''Mucket, Neosho'' and ''Rabbitsfoot'' to the List of Endangered and Threatened Wildlife in alphabetical order under Clams to read as set forth below:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*		*
CLAMS							
*	*	*	*	*	*		*
Mucket, Neosho	*Lampsilis rafinesqueana.*	U.S.A. (AR, KS, MO, OK).	Entire	E	816	NA	NA
*	*	*	*	*	*		*
Rabbitsfoot	*Quadrula cylindrica cylindrica.*	U.S.A. (AL, AR, GA, IN, IL, KS, KY, LA, MO, MS, OH, OK, PA, TN, WV).	Entire	T	816	NA	NA
*	*	*	*	*	*		*

Dated: August 26, 2013.

Rowan W. Gould,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 2013–22245 Filed 9–16–13; 8:45 am]

BILLING CODE 4310–55–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 679

[Docket No. 120918468–3111–02]

RIN 0648–XC873

Fisheries of the Exclusive Economic Zone Off Alaska; Pollock in Statistical Area 620 in the Gulf of Alaska

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Temporary rule; closure.

SUMMARY: NMFS is prohibiting directed fishing for pollock in Statistical Area 620 in the Gulf of Alaska (GOA). This action is necessary to prevent exceeding the C season allowance of the 2013 total allowable catch of pollock for Statistical Area 620 in the GOA.

DATES: Effective 1200 hours, Alaska local time (A.l.t.), September 13, 2013, through 1200 hours, A.l.t., October 1, 2013.

FOR FURTHER INFORMATION CONTACT: Josh Keaton, 907–586–7228.

SUPPLEMENTARY INFORMATION: NMFS manages the groundfish fishery in the GOA exclusive economic zone according to the Fishery Management Plan for Groundfish of the Gulf of Alaska (FMP) prepared by the North Pacific Fishery Management Council under authority of the Magnuson-Stevens Fishery Conservation and Management Act. Regulations governing fishing by U.S. vessels in accordance with the FMP appear at subpart H of 50 CFR part 600 and 50 CFR part 679.

The C season allowance of the 2013 total allowable catch (TAC) of pollock in Statistical Area 620 of the GOA is 7,600 metric tons (mt) as established by the final 2013 and 2014 harvest specifications for groundfish of the GOA (78 FR 13162, February 26, 2013). In accordance with § 679.20(a)(5)(iv)(B), the Administrator, Alaska Region, NMFS (Regional Administrator), hereby increases the C season pollock allowance by 166 mt to reflect the total underharvest of the B season allowance in Statistical Area 620. Therefore, the revised C season allowance of the pollock TAC in Statistical Area 620 is 7,766 mt (7,600 mt plus 166 mt).

In accordance with § 679.20(d)(1)(i), the Regional Administrator has determined that the C season allowance of the 2013 TAC of pollock in Statistical Area 620 of the GOA has been reached. Therefore, the Regional Administrator is establishing a directed fishing allowance of 7,566 mt and is setting aside the remaining 200 mt as bycatch to support other anticipated groundfish fisheries. In accordance with § 679.20(d)(1)(iii), the Regional Administrator finds that this directed fishing allowance has been reached. Consequently, NMFS is prohibiting directed fishing for pollock in Statistical Area 620 of the GOA.

After the effective date of this closure the maximum retainable amounts at § 679.20(e) and (f) apply at any time during a trip.

Classification

This action responds to the best available information recently obtained from the fishery. The Acting Assistant Administrator for Fisheries, NOAA (AA), finds good cause to waive the requirement to provide prior notice and opportunity for public comment pursuant to the authority set forth at 5 U.S.C. 553(b)(B) and as such requirement is impracticable and contrary to the public interest. This requirement is impracticable and contrary to the public interest as it would prevent NMFS from responding to the most recent fisheries data in a timely fashion and would delay the closure of directed fishing for pollock in Statistical Area 620 of the GOA. NMFS was unable to publish a notice providing time for public comment because the most recent, relevant data only became available as of September 10, 2013.

The AA also finds good cause to waive the 30-day delay in the effective date of this action under 5 U.S.C. 553(d)(3). This finding is based upon the reasons provided above for waiver of prior notice and opportunity for public comment.

This action is required by § 679.20 and is exempt from review under Executive Order 12866.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: September 11, 2013.

James P. Burgess,

Acting Deputy Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. 2013–22588 Filed 9–12–13; 4:15 pm]

BILLING CODE 3510–22–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 679

[Docket No. 121018563–3418–02]

RIN 0648–XC872

Fisheries of the Exclusive Economic Zone Off Alaska; Sharks in the Bering Sea and Aleutian Islands Management Area

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Temporary rule; closure.

SUMMARY: NMFS is prohibiting retention of sharks in the Bering Sea and Aleutian Islands management area (BSAI). This action is necessary because the 2013 total allowable catch (TAC) of sharks in the BSAI has been reached.

DATES: Effective 1200 hrs, Alaska local time (A.l.t.), September 12, 2013, through 2400 hrs, A.l.t., December 31, 2013.

FOR FURTHER INFORMATION CONTACT: Josh Keaton, 907–586–7269.

SUPPLEMENTARY INFORMATION: NMFS manages the groundfish fishery in the GOA exclusive economic zone according to the Fishery Management Plan for Groundfish of the Gulf of Alaska (FMP) prepared by the North Pacific Fishery Management Council under authority of the Magnuson-Stevens Fishery Conservation and Management Act. Regulations governing fishing by U.S. vessels in accordance with the FMP appear at subpart H of 50 CFR part 600 and 50 CFR part 679.

The 2013 TAC sharks in the BSAI is 100 metric tons (mt) as established by the final 2013 and 2014 final harvest specifications for groundfish of the GOA (78 FR 13813, March 1, 2013).

In accordance with § 679.20(d)(2), the Administrator, Alaska Region, NMFS (Regional Administrator), has determined that the 2013 TAC of sharks in the BSAI has been reached. Therefore, NMFS is requiring that sharks caught in the BSAI be treated as prohibited species in accordance with § 679.21(b).

Classification

This action responds to the best available information recently obtained from the fishery. The Assistant Administrator for Fisheries, NOAA (AA), finds good cause to waive the requirement to provide prior notice and opportunity for public comment