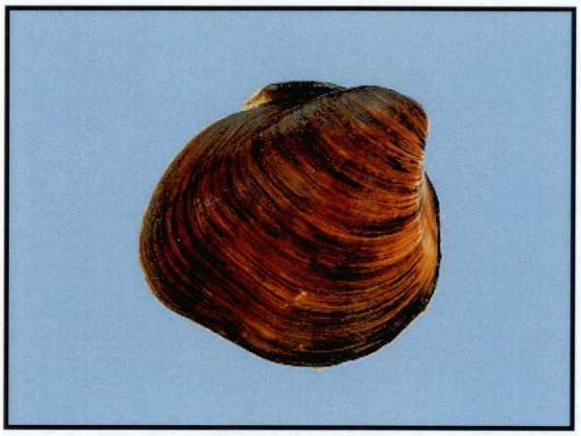
Rough Pigtoe
Pleurobema plenum

5-Year Review:
Summary and Evaluation



U.S. Fish and Wildlife Service
Southeast Region
Kentucky Ecological Services Field Office
Frankfort, Kentucky

5-YEAR REVIEW
Rough Pigtoe (*Pleurobema plenum*)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

We provided public notice of this five-year review in the *Federal Register* on September 21, 2007 (72 FR 54057) and opened a 60-day public comment period. During this comment period, we obtained information on the status of this species from several experts; additional data was obtained from the recovery plan, peer-reviewed scientific literature, and our State partners. Once all known literature and information was collected for this species, Leroy Koch, the lead Recovery Biologist for this species located in the Kentucky Ecological Services Field Office, completed the review. The draft document was peer-reviewed by Dr. Monte McGregor, Kentucky Department of Fish and Wildlife Resources (KDFWR) malacologist; Steve Ahlstedt, U.S. Geological Survey (USGS) biologist (retired); and Don Hubbs, Tennessee Wildlife Resources Agency (TWRA) malacologist. Comments received were evaluated and incorporated as appropriate (see Appendix A).

B. Reviewers

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C. Background

1. Federal Register Notice citation announcing initiation of this review: September 21, 2007 (72 FR 54057)

2. Species status: 2013: Stable.

3. Recovery achieved: 1 (1= 0-25% species' recovery objectives achieved)

4. Listing history
Original Listing
FR notice: 41 FR 21062
Date listed: June 14, 1976
Entity listed: species
Classification: endangered

5. Associated rulemakings:
FR notice: Establishment of Nonessential Experimental Population Status for 15 Freshwater Mussels, 1 Freshwater Snail, and 5 Fishes in the Lower French Broad River and in the Lower Holston River, Tennessee; 72 FR 52433
Date: September 13, 2007

6. Review History:
Recovery Plan: Recovery Plan, 1984
Recovery Data Call: 2008-2012
Five Year Review: November 6, 1991.
In this review (56 FR 56882), different species were simultaneously evaluated with no species-specific, in-depth assessment of the five factors as they pertained to the different species' recovery. In particular, no changes were proposed for the status of this mussel in the review.

7. Species' Recovery Priority Number at start of review (48 FR 43098): 5.
This number indicates a high degree of threat and a low recovery potential.

8. Recovery Plan

Name of plan: Recovery Plan for the Rough Pigtoe Pearly Mussel, *Pleurobema plenum* (Lea, 1840)
Date issued: August 6, 1984

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

The rough pigtoe is an invertebrate, and therefore, not covered by the DPS policy, and will not be addressed further in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes.

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? No. See the next item for further detail.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? No.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The recovery plan does not list criteria to downlist the species from endangered to threatened. The recovery plan says that to remove the rough pigtoe from the Federal list of threatened and endangered species, the following criteria must be met:

1. A viable population of *Pleurobema plenum* exists in the Tennessee, Clinch, Cumberland, and Green Rivers. These four populations are dispersed through each river so that it is unlikely that any one event would cause the total loss of any population.

2. Through reestablishments and/or discoveries of new populations, viable populations exist in two additional rivers. Each of these rivers will contain a viable population that is distributed such that a single event would be unlikely to eliminate *P. plenum* from the river system. For reestablished populations, surveys must show that three year-classes including one year-class 10 years old or older have been naturally produced within the river system.

3. The species and its habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations.

4. Noticeable improvements in siltation problems and substrate quality have occurred.

These criteria have not been met. In addition to not being met, these criteria are vague, in that: (1) population viability is not well defined; (2) the separation distance (between sub-populations) necessary to ameliorate catastrophic events is not identified.

C. Updated Information and Current Species Status

1. Biology and Habitat

No new, specific information is available on the biology and habitat preferences for the rough pigtoe. The most current and complete summary is provided in the recovery plan (USFWS 1984).

The specific life history details of the rough pigtoe remain unknown but are thought to be similar to that of other unionid mussel species (Parmalee and

Bogan 1998). Gravid females have been observed in late spring or early summer.

a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features, or demographic trends:

Rough pigtoe mussels are cryptic, with portions of a population occurring below the substrate surface; therefore, qualitative population estimates must take into account undetected individuals. In addition, where rough pigtoe mussels are found at low population densities, population estimates may have large margins of error due to undetected mussels. Sparsely distributed juveniles and/or subadults, indicative of successful reproduction, are likely even more difficult to detect.

Successful recruitment of rough pigtoe populations is often difficult to detect when densities are very low and/or when survey efforts are inadequate to detect rare species. Few intensive, statistically valid surveys have been conducted on populations of this species outside of the Clinch River and Green River, and populations with densities near or below the detection rate may not be practically assessed with quantitative techniques. The difficulty in detecting rough pigtoe mussels results in poorly-defined information about the species' distribution and abundance, even within the streams where the species is known to occur.

All streams containing known rough pigtoe populations are discussed below. All of these lie within the Ohio River basin. There is no indication this species' distribution has changed substantially since the recovery plan was prepared. At that time, populations of this species were known from only four Ohio River tributaries: the Tennessee, Cumberland, Green, and Barren Rivers (USFWS, 1984).

Tennessee River System

Clinch River

Based on quantitative, 1-meter quadrat data taken from 2004 to 2007, a stable and recruiting population is thought to occur in a short 10 to 15 mile reach of the Clinch River in Tennessee (Jess Jones, USFWS, personal communication, 2008). Mr. Jones considers this population viable because it is recruiting and the species has a relatively long lifespan (>20 years). Mr. Jones also indicated he has not discovered any previously unknown populations or rediscovered any population previously thought to be extirpated.

Tennessee River

The rough pigtoe is considered extremely rare in the Tennessee River mainstem and its current status is unknown (Bob Butler, USFWS, personal Communication, 2008). Some evidence of recruitment has been observed in the Wilson Dam (Tennessee River) tailwaters in Alabama (Jeff Garner, State of Alabama malacologist, personal communication, 2008). In 2001 and 2006, three individuals were observed in the tailwaters and estimated to be 12 years

old or less. Mr. Garner also believes that this species is extant in the Guntersville Dam tailwaters, but little time has been spent searching for it there. Overall, there is very little evidence of recruitment for this species, and it is present in low population numbers (*e.g.*, one individual was encountered in 2006 among 110 quarter-meter square quadrats). Mr. Garner also indicated he has not discovered any previously unknown populations or rediscovered any population previously thought to be extirpated. Mr. Garner (Personal communication, May 23, 2013) indicated the he still occasionally finds this species downstream of Wilson Dam. Mr. Garner has observed no evidence of recruitment within the past 5 years; however, he believes this species is still recruiting. Downstream of Pickwick Landing Dam, a population of this species likely still occurs; however, very little specific searching, if any, has been done for this species since the recovery plan was written in 1984. At that time, 10 rough pigtoe mussels were observed in commercial shell piles (Leroy Koch, USFWS, personal observation, 2008). Less commercial brailing activity has occurred since that time, and observations of shell piles have not been conducted from such brailing activity. One rough pigtoe mussel was observed near the Diamond Island area downstream of Pickwick Landing Dam during August 2008 (Don Hubbs, TWRA, personal communication, 2008). Recent conversations with Don Hubbs of TWRA (Don Hubbs, personal communication, May 22, 2013) indicate essentially no change in the perceived status, as presented above, of this species in the Tennessee River.

Cumberland River System

Cumberland River

The rough pigtoe is considered a rare mussel in stretches of the middle Cumberland River, where it has been observed in commercial shell harvests (Parmalee and Bogan, 1998, p. 189). Two live individuals were observed in 1983 downstream of Cordell Hull dam (Steve Ahlstedt, USGS retired, personal communication, 2008). A Cumberland Region Mollusk Recovery assessment regards the rough pigtoe as extirpated from the entire Cumberland River (Bob Butler, USFWS, personal communication, 2008). However, others do not believe that enough is known about the current status of the rough pigtoe in the Cumberland River to classify it as extirpated from the entire river (Don Hubbs, TWRA, personal communication, 2008). More intensive survey efforts are needed to determine the status of this species in the Cumberland River. The rough pigtoe mussel may still occur in the Cumberland River; however, it may appropriately be considered functionally extinct. Recent conversations with Don Hubbs of TWRA (Don Hubbs, personal communication, May 22, 2013) indicate essentially no change in the perceived status of this species in the Cumberland River as presented above.

Green River System

Green River

The Green River in Kentucky probably contains the best remaining population of rough pigtoe mussels. Recent surveys by KDFWR malacologist, Dr. Monte McGregor, indicate this species occurs from upstream of the Munfordville area

downstream to the Lock and Dam 5 tailwaters near Glenmore, an approximate 64-kilometer (40-mile) reach. Unfortunately, only old adult individuals have been observed. Dr. McGregor conducted quantitative mussel sampling in 2005 (McGregor 2005) at the Glenmore site and Munfordville site. At Munfordville, the rough pigtoe comprised 0.04 percent of mussels sampled (0.004 mussel per square meter [0.04 per square ft]) and at Glenmore they comprised 3.51 percent of mussels sampled (.066 mussel per square meter [0.71 per square ft]). Dr. McGregor indicated that no juvenile rough pigtoe mussels were observed in any of these survey efforts or any other qualitative mussel survey efforts he has conducted on the Green River; however, there is the possibility that juveniles could be present. Juvenile mussels for several other species, some with densities similar to those recorded for the rough pigtoe, have been observed in the Green River in the last five years. Dr. James Layzer (Tennessee Technological University, personal communication, 2008) has conducted a considerable amount of mussel work in the Green River since the mid 1990s. He observed one individual shell of the rough pigtoe in 1995, but he has not observed it in more recent years. Miller and Payne (1994) did not observe any rough pigtoe mussels during their re-evaluation of the mussel fauna in portions of the lower Green River downstream of Lock and Dam 4. In 2012, survey efforts conducted by Lewis Environmental Consulting in portions of Pool 4 of the Green River resulted in 48 individual observations of this species from Green River Mile 155.4 to 168.4 (Lewis, 2013). Various size classes were observed so it is possible that a viable population of this species occurs in Pool 4 of the Green River. This survey has increased the known extent of the Green River population, but additional surveys will be needed to determine the exact extent and status of the species in this portion of the Green River. Dr. Monte McGregor (Monte McGregor, personal communication, May 23, 2013) has translocated 101 adult specimens, since 2007, from the Dam 5 tailwaters of the Green River to an area upstream of Munfordville, to augment the population at this site. No evidence of recruitment resulting from this translocation effort has been observed yet.

Barren River

Recent observations of rough pigtoe from the Barren River are all from downstream of Lock and Dam No. 1 near Greencastle, which is downstream of Bowling Green, Kentucky. This is similar to that reported in the recovery plan for this species. Dr. Monte McGregor (personal communication) observed a few individuals in 2005 and 2006 from this reach. Rough pigtoe mussels were also observed at four of five sampling sites downstream of Lock and Dam No. 1 in the early 1990s (Weiss and Layzer, 1993). Lewis Environmental Consulting (Chad Lewis, personal communication) recorded a live rough pigtoe in this section of river in 2008.

Wabash River System

East Fork White River

Mr. Brant Fisher (Indiana Department of Natural Resources [IDNR], personal communication, 2008) provided information on the species' distribution in the East Fork White River. The only recent record of a live rough pigtoe from

Indiana was recorded on September 14, 1992 by Mr. Bob Anderson, who observed the specimens from the East Fork White River in Martin County during a dive survey (Robert Anderson, USFWS, personal communication, 2008). This individual was the only one observed, and none have been observed since, nor have any specimens been observed in muskrat middens or shell piles. Mr. Anderson had some questions about his identification of the specimen; however, he sent a photograph of it to Dr. David Stansbery of The Ohio State University, who confirmed the identification. Indiana (USFWS and IDNR) currently considers this record as valid based on the identifications by Mr. Anderson and Dr. Stansbery. Without further records or information on this species from this area in Indiana, we can only speculate that a 'population' of rough pigtoe persists in this portion of the East Fork White River.

In summary, rough pigtoe mussels appear to be restricted to essentially the same rivers identified in the 1984 recovery plan. Except for the East Fork White River specimen, we are not aware of any other information to suggest other locations where this species occurs. Only the populations in portions of the Clinch River and the Green River, show evidence of any recent recruitment. The population in the Green River is probably the most extensive based on the quantitative information provided.

b. Genetics, genetic variation, or trends in genetic variation:

A recent genetic characterization of extant populations of the rough pigtoe mussel in the Clinch River, Tennessee, and Green River, Kentucky, was conducted by Jones *et. al.* (2006). Collected individuals from these two populations were shown to be closely-related based on phylogenetic analyses of mitochondrial DNA sequences, and on analyses of variation at nine hypervariable nuclear DNA microsatellite loci. Individuals from both populations of rough pigtoe grouped together into a monophyletic clade. No discernable differences were observed in mitochondrial DNA sequences between the Clinch River and Green river populations.

c. Taxonomic classification or changes in nomenclature:

There has been no change in the classification or nomenclature of this species since it was listed.

d. Spatial distribution, trends in spatial distribution, or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

The rough pigtoe is now sparsely distributed within a restricted range. The currently known populations are only remnants within the historical range of this species. It is not likely that these populations are experiencing any genetic exchange between the different river populations.

e. Habitat:

This species is endemic to the Ohio River system and is found in stable substrates composed of a mixture of relatively firm and clean gravel, sand, and

silt. They are often associated with other riverine mussels that also prefer this type of habitat.

The Kentucky Chapter of The Nature Conservancy (TNC) has been working in recent years to improve land practices and stream conditions in the Green River Basin. The Nature Conservancy recognizes the entire mussel fauna in general and G1to G3 mussels specifically (including *Pleurobema plenum*) as conservation targets in the Green River. TNC's conservation action plan (CAP) includes comprehensive strategies intended to abate threats to freshwater mussel viability by improving water quality, habitat quality, and river flows for mussels. Action steps implemented over the past 10 years include a reoperation of the Green River dam to mimic more natural flows in the river and implementation of a Conservation Reserve Enhancement Program (USDA), which has resulted in the enrollment of nearly 40,450 hectares (100,000 acres) of agricultural land along the upper Green into riparian buffers and sediment-capturing native warm season grass fields. TNC's land acquisitions and conservation easements permanently protect over 56 kilometers (35 miles) of stream bank on the Green River or its tributaries (Dr. Richie Kessler, Campbellsville University, personal communication, 2008). TNC, in partnership with the Kentucky Wild Rivers Program, is developing an environmental education site on the Green River in Hart County. A visitor's center will allow the public, particularly schoolchildren, the chance to learn about and observe the area's plants, animals and geology. The site encompasses nearly 300 acres owned by Kentucky Wild Rivers and TNC and will also showcase best management practices for agriculture, forestry and native plant restoration.

2. Five-Factor Analysis

The 1984 recovery plan identified three primary factors responsible for the decline of rough pigtoe populations: siltation, impoundments, and pollution (USFWS 1984).

a. Present or threatened destruction, modification or curtailment of its habitat or range:

Ongoing threats to the rough pigtoe include water quality degradation from point and non-point sources, particularly in tributaries that have limited capability to dilute and assimilate sewage, agricultural runoff, and other pollutants. In addition, the species is affected by hydrologic and water quality alterations resulting from the operation of impoundments such as Green River Reservoir, Pickwick Lake, Wilson Lake, Guntersville Lake, and Cordell Hull Reservoir. The presence of impoundments may have ameliorated the effects of downstream siltation on the species, but these structures also control river discharges, and the many environmental parameters influenced by discharge, which may profoundly affect the ability of these populations to occupy or successfully reproduce in downstream habitats.

A variety of instream activities (*e.g.*, sand and gravel dredging, road construction) continue to threaten rough pigtoe populations. Protecting these

populations from the direct physical disturbance of such activities depends on accurately identifying the location of the populations, which is difficult with a cryptic species such as the rough pigtoe. The indirect effects of altering the streambed configuration may cause changes in previously suitable habitat some distance from the disturbance.

Coal, oil, and natural gas resources are present in some of the watersheds known to support rough pigtoe mussels, especially the Green, Barren, and Clinch Rivers. Exploration and extraction of these resources can result in increased siltation and an altered hydrograph and water quality, even at some distance from the mine or well field.

Land-based development near occupied habitats, including residential development and agriculture, often results in loss of riparian habitat, increased stormwater runoff due to increased impervious surfaces, increased sedimentation due to loss of streamside vegetation, and subsequent degradation of stream banks.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

The rough pigtoe mussel is not a commercially valuable species; however, as was noted in the recovery plan, this species was part of the historic mussel harvest (USFWS 1984). The rough pigtoe is more likely to occur in harvests from brailing than diving, since brailing is relatively indiscriminate with regard to the mussel species it takes. This threat may have diminished in recent years since brailing is on the decline in most of the species' range, including the Tennessee River downstream of Pickwick Landing Dam. Overutilization for recreational, scientific, or educational purposes was not considered to be a threat in the recovery plan. We have no new information to indicate this has changed. Currently, there is no mussel propagation facility holding individuals of rough pigtoe in captivity.

c. Disease or predation:

This species has a number of natural predators, including muskrats, raccoons, otters, fish, and some invertebrates. Such predation could locally reduce populations of the rough pigtoe, but the overall impact of this threat is considered to be low. There is no evidence that predation is a significant threat to the species. Information on specific diseases in freshwater mussels is limited. We do not have any information to indicate disease is a threat to this species at this time.

d. Inadequacy of existing regulatory mechanisms:

This species and its habitats are afforded some protection from water quality and habitat degradation under the Clean Water Act of 1977 (33 U.S.C. 1251 et seq.) and a variety of state laws and regulations. The species is also afforded protection by the Endangered Species Act (Act) of 1973, as amended (87 Stat.

884, as amended: 16 U.S.C. 1531 *et seq*), which requires Federal agencies to consult with the Service when activities they fund, authorize, or carry out may affect a listed species. The Act requires Federal permits and/or incidental take authorization for any activity that may result in "take" of a listed species.

Coal, oil, and gas resources are present in a number of the basins (e.g., Green River, Barren River, Clinch River) where rough pigtoe mussels occur, and extraction of these resources is considered a continuing threat. Although these resource extraction activities generally occur away from the river, extensive road and pipeline networks are required to access sites. These road 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 brine (saline water). Point source discharges are typically regulated; however, non-point inputs such as silt and other contaminants may not be sufficiently regulated, particularly those originating some distance from a waterway.

Regulated point sources may adversely affect the rough pigtoe. Freshwater mussels appear to exhibit more sensitivity to some pollutants than do the organisms typically used in toxicity testing. As a result, some of the water quality criteria established by the U.S. Environmental Protection Agency to protect aquatic life may not be protective of mussels. For example, Augspurger *et al.* (2003) found that the current EPA numeric criteria for ammonia may not protect mussels. Consequently, even those sewage treatment plants that comply with their ammonia effluent limits at all times may still be discharging water that is toxic to unionids. Few substances have been tested for their toxicity to mussels, and none have been tested on rough pigtoe mussels. Therefore, safe concentrations for this species are not yet known.

Agriculture and suburban and urban land uses continue to expand in many watersheds within the current range of the rough pigtoe. These land use changes alter runoff patterns and flow in this species' habitat, and the consequences of such changes to these remaining populations are not known. Few regulatory mechanisms exist to address land use changes that may indirectly affect stream habitat far from the source of disturbance.

e. Other natural or manmade factors affecting its continued existence:

Zebra mussels have continued to spread in North American waterways since their accidental introduction in the 1980s. Large zebra mussel populations in Lake St. Clair, the Detroit River, and Lake Erie appear to have eliminated most native mussels from the areas colonized, although the species may persist in refugia where habitat is less suitable for zebra mussels. Presently, zebra mussel populations do not appear to be having any negative impact on known rough pigtoe populations; however, this could change in the future. Zebra mussels could also influence recovery actions to benefit this species, by limiting locations in which to start new populations and/or impacting newly started populations. It is also possible that drought, floods, or stochastic events play a role in the continuing existence of this species.

D. Synthesis

Populations of the rough pigtoe currently exist in portions of the Clinch, Tennessee, Cumberland, Green, and Barren Rivers. Each of these populations is susceptible to single damaging events. This includes both natural stochastic events, such as floods, and anthropogenic threats, such as toxic spills. Although the rough pigtoe was observed in the East Fork White River in Indiana in 1992, this occurrence may not be evidence of a self-sustaining population. Evidence of successful recruitment has been reported only from portions of the Clinch River and Green River.

Although specific events can be cited as causing negative impacts to the rough pigtoe, in many cases, diverse freshwater mussel populations persist where rough pigtoe mussels have not. Consequently, this species may be more sensitive to environmental perturbations than other mussel species. This may be because its life history traits make recovery from a disturbance less likely than with other mussels, or because this species is more sensitive to silt and contaminants.

Rough pigtoe mussels typically do not exist in populations that are large enough for adult mussels to be translocated to multiple sites so that the recovery actions described in the recovery plan can be implemented. However, enough adults do currently exist to utilize in propagation facilities to produce juvenile mussels for recovery actions; therefore, future enhancement and translocations of individuals will most likely be accomplished through introductions of captively-propagated juveniles. For this to be successful, the fish host will need to be identified and/or juveniles produced using the in-vitro method bypassing the need for a fish host. At this time, we are not aware of any propagation/culture facility holding this species and/or successfully propagating or culturing this species to the juvenile stage.

The rough pigtoe mussel should continue to remain listed as endangered because the species has continued to decline, threats have not been ameliorated, and the criteria for delisting have not been met. Numerous threats persist for rough pigtoe populations, including invasive species, habitat alteration, land-use changes, and point and non-point source pollution. The life history and environmental sensitivity of this species is poorly known, increasing the threat that previously unidentified activities could cause a precipitous decline of one or more of the remaining populations. These unknowns also make it unlikely that the species can be delisted in the near future.

III. RESULTS

A. Recommended Classification:

_X_ No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Recommendation: Revise the recovery plan.

The rough pigtoe recovery plan is 24 years old and in need of revision. A revised plan will assist local and State entities in planning watershed and ecosystem actions to recover habitat needed for eventual relocation efforts.

Recommendations for specific recovery actions:

The following recovery actions should be made a priority over the next five years:

1) Conduct additional surveys of known populations to monitor their status and viability.

2) Determine the fish host(s). This would facilitate the propagation and culture of the species and help inform agencies on site selection to restore populations in other rivers. Because this species is rare to uncommon in both the Green and Clinch Rivers, and occurs in somewhat specific or difficult to sample habitats, a focused effort is needed to collect and aggregate mature females to obtain glochidia

3) Develop 'in vitro' transformation of the glochidia using artificial propagation techniques.

4) Determine sensitivity of each life stage for selected contaminants that are likely to be found in streams in which this species exists and at potential augmentation and reintroduction sites.

5) Additional studies should be conducted on existing populations in the Clinch River and Green River to determine if possible differences exist in life history parameters. If such biological studies were to confirm the finding of the existing genetics study, there would be no reason to restrict inter-basin transfers or restrict the mixing of individuals from these two populations into other rivers to achieve recovery of the species.

6) Captive holding of rough pigtoe mussels may provide additional options for the species' recovery and re-establishment into historic habitat. Captive husbandry methods should be developed.

7) An assessment of historic habitat should be completed to identify sites where rough pigtoe mussel augmentation and re-establishment can be achieved.

8) Identify and map activities or practices within each river ecosystem that may affect the rough pigtoe mussel and its host fish at known sites, and at potential augmentation or reintroduction sites.

9) Age and growth analyses should be conducted to determine mean age-at-length and longevity of the species. This would help us understand the recruitment rates needed to sustain viable populations.

10) Answer questions about each remaining population, such as: Is the population showing evidence of recruitment and how recently? What length of stream is currently occupied and how vulnerable is the population? What is preventing population expansion in currently occupied habitat? Are there opportunities to expand population ranges within occupied rivers through active management, such as through propagation and translocation? What are the top 1 or 2 streams, outside of the Clinch and Green rivers, that have the ecological conditions needed to establish a new rough pigtoe population?

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Rough pigtoe (*Pleurobema plenum*)

Current Classification: Endangered.

Recommendation resulting from the 5-Year Review:

_____ **Downlist to Threatened**
_____ **Uplist to Endangered**
_____ **Delist**
__X__ **No change needed**

Review conducted by: Leroy Koch, Kentucky Ecological Services Field Office, Frankfort, Kentucky

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Virgil Lee Andrew Date 8/19/13

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date _____

Cooperating Regional Director, Fish and Wildlife Service, Northeast Region

_____Concur _____ Do Not Concur

Signature_____Date_____

Cooperating Assistant Regional Director, Fish and Wildlife Service, Midwest Region

_____Concur _____ Do Not Concur

Signature_____Date_____

APPENDIX A: Summary of peer review for the 5-year review of *Pleurobema plenum*

Reviewers: Steve Ahlstedt, retired U.S. Geological Survey biologist, telephone 865-545-4140 ext. 17; Dr. Monte McGregor, Kentucky Department of Fish and Wildlife Resources, telephone 502- 573-0330 ext.221; Mr. Don Hubbs, Tennessee Wildlife Resource Agency, telephone 731-584-9032.

A. Peer Review Method: A draft 5-year review of *P. plenum* was sent to each of the three reviewers requesting their review and any other comments or additions that should be included in the document. All three reviewers have extensive knowledge of this species and have worked with the species in field conditions.

B. Peer Review Charge: Reviewers were charged with providing a review of the document including any other comments and/or additions appropriate to include.

C. Summary of Peer Review Comments/Report: Reviewers responded verbally and/or by email with responses placed in the file record. All reviewers thought the information in the draft 5-year review of *P. plenum* provided to them was accurate. They did provide some additional references and recommendations that were incorporated into the 5-year review as appropriate.

D. Response to Peer Review: Recommendations from the reviewers were included in the document.