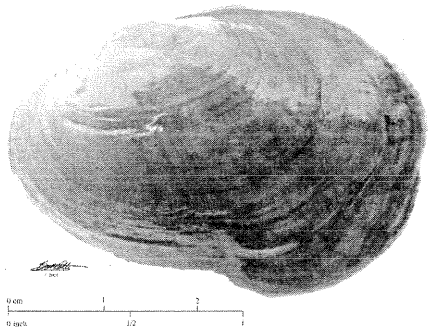
Oyster Mussel
(*Epioblasma capsaeformis*, Lea, 1831)

5-Year Review:
Summary and Evaluation



U.S. Fish and Wildlife Service
Southeast Region
Cookeville Ecological Services Field Office
Cookeville, Tennessee

5-YEAR REVIEW
Oyster Mussel (*Epioblasma capsaeformis*)

I. GENERAL INFORMATION

A. Methodology used to complete this review

This review was completed by the U. S. Fish and Wildlife Service's Cookeville Field Office. All literature and documents on file at the Cookeville Field Office were used for this review. The primary source of information used in this analysis was the final recovery plan (Service 2004). Public notice of this review was given in the *Federal Register* on September 20, 2005 (70 FR 55157) and a 60-day comment period was opened. During this comment period, we obtained additional information on the status of this species from several experts and our State partners. This review was also sent to three mussel experts for peer review (Appendix A).

B. Reviewers

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C. Background

1. **FR Notice citation announcing initiation of this review**
   September 20, 2005; 70 FR 55157

2. **Species status:** Stable (2009 Recovery Data Call). Population monitoring demonstrated that this species remained stable in the Clinch River. Jeff Garner, ALDCNR, reports that the Wilson Dam tailwater NEP population is decreasing due to predation. The Kentucky Department of Fish and Wildlife Resources translocated 97 individuals from the Clinch River to the Big South Fork of the Cumberland River in June 2008. We do not have monitoring data from 2009 for assessing population trends, but we are not aware of any threats that would have affected the species' status during the past year.

3. **Recovery achieved:** 1 = 0%-25% recovery objectives achieved

4. **Listing history**
   Original Listing
   FR notice: 62 FR 1647
   Date listed: January 10, 1997
   Entity listed: species
   Classification: endangered

5. **Associated actions**
   Designation of critical habitat for five endangered mussels (including the oyster mussel) in the Tennessee and Cumberland River basins (69 FR 53136).

   Establishment of nonessential experimental population status for 16 freshwater mussels (including the oyster mussel) and 1 freshwater snail in the free-flowing reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties in Alabama (66 FR 32250).

   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 52434).

6. **Review History**
   Recovery Data Call: 2009, 2008, 2007, 2006, 2005, 2004, 2003, and 2002 through 1998
   Recovery Plan for Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot

7. **Species' Recovery Priority Number at start of review (48 FR 43098):** 5 (degree of threat is high, potential for recovery is low, and the taxonomy is the species level)

8. **Recovery Plan or Outline**
   Name of plan: Recovery Plan for Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot.
   Date issued: May 4, 2004

II. REVIEW ANALYSIS

A. **Application of the 1996 Distinct Population Segment (DPS) policy:** Not applicable. The oyster mussel is an invertebrate, and therefore, not covered by the DPS policy, and the other DPS questions 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. **Does the recovery plan contain recovery (i.e., downlisting or delisting) criteria?** Yes.

3. **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?** Yes.

   b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threats)?** Yes.

4. **Recovery criteria**

   a. Criteria for downlisting to threatened status
   Through the protection of extant stream populations (e.g., continuing to use existing regulatory mechanisms, establishing partnerships with various stakeholders, using BMPs, minimizing or eliminating threats), discovery of currently unknown stream populations, and/or reestablishment of historical stream populations, there exists at least six distinct viable stream populations of the oyster mussel in the Cumberland River system, upper Tennessee River system, and/or lower Tennessee River system. This will be accomplished by:

   1. **Protecting all extant populations (i.e., lower Clinch River, Nolichucky River in the upper Tennessee River system, and Duck River in the lower Tennessee River system) and ensuring that all these streams have viable population status.**
      While we have not met this criterion yet, we are working with our State and Federal partners and The Nature Conservancy (TNC) to protect all three extant populations of the oyster mussel. The Tennessee Wildlife Resources Agency has purchased the Kyles Ford tract on the lower Clinch River using a Recovery Land Acquisition grant under section 6 of the ESA. This is one of the most important mussel shoals in Tennessee and the oyster mussel is abundant at this site.

      In response to increasing concern over impacts to freshwater

mussels from coal mining in the Clinch River watershed, Regions III and IV of the USEPA, Tennessee Department of Environment and Conservation, Virginia Department of Environmental Quality, and Virginia Department of Mines, Minerals, and Energy signed an Memorandum of Understanding (MOU) to establish a working group for improving communications and coordinating efforts to protect and restore the Clinch and Powell Rivers. These agencies and others have demonstrated an interest in working together to accomplish common goals of reducing human impacts associated with coal mining and processing, agriculture, urbanization, and the development of transportation corridors.

In 2008, a Clinch-Powell Clean Rivers Initiative (CPCRI) Group was developed to carry out the goals stated in the MOU. As part of their efforts, the CPCRI has prepared a preliminary and draft "Biodiversity Conservation Science Plan for the Clinch-Powell River System, Virginia – Tennessee, USA" for the Clinch-Powell Symposium Steering Committee and the Clinch-Powell MOU Working Group. The plan proposes to generate scientific information that can be used to aid biodiversity conservation in the Clinch-Powell system. Specifically, studies to characterize and quantify contaminant levels in the Clinch and Powell rivers will help landowners, land managers, and regulatory agencies to make decisions regarding the conservation of federally listed and other sensitive species.

Coal mining activity has increased in the Clinch River watershed in recent years, and coal fines in the upper river are moving downstream into Tennessee. Agriculture also continues to threaten the watershed. The Service along with The Nature Conservancy (TNC), local Soil Conservation Districts, the Natural Resources Conservation Service, Farm Service Agency, Clinch-Powell Resource Conservation and Development Council, and many State agencies and local partners are working together to protect aquatic biodiversity in the Clinch-Powell watershed by providing monetary assistance to facilitate the protection and recovery of riparian corridors and the reduction and prevention of non-point source pollution on private lands. In 2008, the Partners for Fish and Wildlife program began a landscape-level conservation project in the watershed.

The Nature Conservancy established an office near the Duck River in 1999 and has been working with local communities and government agencies to ensure long-term protection of the river's water quality and ecological integrity. Through their Landowner Incentive Program, TNC has provided monetary and technical

assistance to facilitate the protection of riparian corridors to prevent non-point pollution from private lands.

2. **Reestablishing three viable stream populations in any of the following streams: (a) Cumberland River system (e.g., Rockcastle River, Buck Creek, Big South Fork, Little South Fork, Red River); (b) upper Tennessee River system (e.g., upper Clinch River, Powell River, upper Holston River/North Fork Holston River, lower Holston River, French Broad River); and/or (c) lower Tennessee River system (e.g., Paint Rock River, Elk River, Tennessee River at Muscle Shoals, Shoal Creek, Bear Creek, Buffalo River).**
This criterion has not been met. We have initiated efforts to reestablish oyster mussels in the Tennessee River below Wilson Dam. For example, we have moved 200 oyster mussels from the Duck River to the non-essential experimental population (NEP) area below Wilson Dam in the Tennessee River in Alabama. The Alabama Department of Conservation and Natural Resources reports that the translocation of these individuals was not very successful due to predation (Jeff Garner, personal communication, 2009).

   In 2006, the relocation of 200 oyster mussels per year was funded for three years from the lower Clinch River in Tennessee to the upper Clinch River in Virginia. The Virginia Cooperative Fish and Wildlife Research Unit of the United States Geological Survey at Virginia Tech (VT) move this species and monitor both the originating and receiving sites to ensure survival. The Virginia Department of Game and Inland Fisheries and Virginia Tech both conduct captive propagation of oyster mussel using Clinch River stock. Since 2004, captive bred juveniles have been released at several sites in the Clinch River in Tennessee and Virginia.

   The Service also finalized a NEP for the lower French Broad and lower Holston Rivers that would include the oyster mussel and allow for establishment of at least two other populations. Tennessee Technological University plans to begin work propagating juveniles for introduction to the lower French Broad/Holston Rivers NEP in the fall of 2009.

   In 2008, the Kentucky Department of Fish and Wildlife Resources (KDFWR) translocated 97 oyster mussels from the Clinch River to the Big South Fork Cumberland River. Follow up surveys later that year revealed very little mortality. The KDFWR is also conducting captive propagation using Clinch River mussels. They

plan to start reintroductions using propagated juveniles in the fall of 2009.

3. **One distinct naturally reproduced year class exists within each of the viable populations. The year class must have been produced within 5 years prior to the time the species are reclassified from endangered to threatened. Within 1 year before the delisting date, gravid females of the mussels and their host fish must be present in each viable population.** This criterion has not been met. There are presently only three extant populations (Clinch River, Nolichucky River and Duck River). The Clinch and Duck Rivers meet this criterion (Jones 2005, Ahlstedt et al. 2005, Ahlstedt et al. 2004, and Ahlstedt et al. 1997). The remaining extant population (Nolichucky River) is small and of doubtful viability (Service 2004). Only a single live specimen was found during sampling at 20 sites in 2000 (Tennessee Valley Authority 2002). In 2008, Brett Ostby (personal communication, Virginia Tech University, 2009) found 4 live males and 1 live female in the Nolichucky River. The range of sizes found (23-42 mm for the males and 42 mm for the female) indicates recent recruitment. Mean density of oyster mussel was 0.22 per square meter, but additional sampling is needed to reach a lower confidence interval. The recently reintroduced population below Wilson Dam in the lower Tennessee River does not meet this criterion.

4. **Research studies of the mussels' biological and ecological requirements have been completed and any required recovery measures developed and implemented from these studies are beginning to be successful (see Recovery Tasks 1.4.1, 1.4.2, 1.4.5, and 1.4.6), as evidenced by an increase in population density of approximately 20 percent and/or increase in the length of the river reach of approximately 10 percent inhabited by the species as determined through biennial monitoring (see Recovery Task 5).**
Recovery task 1.4.1 involves conducting life history research on the oyster mussel. Seven native fish species have been identified as hosts: wounded darter (*Etheostoma vulneratum*), redline darter (*E. rufilineatum*), bluebreast darter (*E.* camarum), dusky darter (*Percina sciera*), banded sculpin (*Cottus carolinae*), black sculpin (*C. baileyi*) and mottled sculpin (*C. bairdi*) (Service 2004). Jones et al. 2004 found that glochidia of oyster mussels in the Clinch River transformed in the greatest numbers on the greenside darter (*Etheostoma blennioides*) and glochidia of oyster mussels in the Duck River transformed in the greatest numbers on the fantail darter (*Etheostoma flabellare*). Jones et al. 2004 also found that

the mantle-pads and micro- lures of female oyster mussels were distinct between the Clinch River population and the Duck River population. No additional life history research has occurred since the Recovery Plan was approved in May 2004.

Recovery task 1.4.2 involves characterizing the species' habitat for all life history stages. No additional work has occurred on this task since the Recovery Plan was approved.

Recovery task 1.4.5 deals with investigating the need for management, including habitat improvement.
No additional work has occurred on this task since the Recovery Plan was approved.

Recovery task 1.4.6 involves determining the number of individuals and the sex ratio required to maintain long-term viable natural populations. No additional work has occurred on this task since the Recovery Plan was approved.

5. **No foreseeable threats exist that would likely impact the survival of any of the species over a significant portions of their ranges (see Recovery Tasks 1.4.3 and 1.4.4).**
Recovery task 1.4.3 involves addressing present and foreseeable threats. Agriculture continues to threaten the Duck, Nolichucky, and Clinch River watersheds. The Service along with The Nature Conservancy (TNC), local Soil Conservation Districts, the Natural Resources Conservation Service, Farm Service Agency, Clinch-Powell Resource Conservation and Development Council, and many State agencies and local partners are working together to protect aquatic biodiversity in the Clinch-Powell watershed by providing monetary assistance to facilitate the protection and recovery of riparian corridors and the reduction and prevention of non-point source pollution on private lands. In 2008, the Partners for Fish and Wildlife program began a landscape-level conservation project in the Clinch watershed. State and Federal partners are also actively working with private landowners to protect the Duck and Nolichucky River watersheds.

   Coal mining activity has increased in the Clinch River watershed in recent years, and coal fines in the upper river are moving downstream into Tennessee. Natural gas activities are also anticipated to increase in the watershed. A coal powered electric generation facility has also been proposed along the Clinch River in Virginia City, Virginia. Effluent discharge, runoff from fly ash storage, and other sources related to the operation of the facility present a foreseeable threat to the oyster mussel.

No other threats have been addressed since the Recovery Plan. Also, see Section C.2.A.

Recovery task 1.4.4 deals with determining contaminant sensitivity for each life history stage. We have an ongoing project that is looking at sediment toxicity in the Clinch, Powell and Big South Fork systems. The results of this study are not available yet.

6. **Within larger streams (e.g., Clinch River, Duck River, Powell River), the species is distributed over a long enough reach that a single catastrophic event is not likely to eliminate or significantly reduce the entire population in that stream to a status of nonviable (see Recovery Task 4.1).**

   Recovery task 4.1 involves refining techniques and methodologies for propagating and translocating mussels as a prelude to potential augmentation and reintroduction efforts. VT is at the forefront of this work, having propagated and released juvenile mussels from 25 species, including 12 that are federally listed. VT has released 74,570 juvenile oyster mussels into the Clinch and Powell rivers between 2004 and 2008. The States of Kentucky, Tennessee, and Virginia are also working on refining mussel propagation techniques and methodologies. Between 2004 and 2008, Virginia has released 25,061 juvenile oyster mussels into the Clinch River, Tennessee and Virginia. Kentucky and Tennessee have not released any oyster mussels to date. The Cumberlandian Region Mollusk Restoration Committee (2009) has developed a comprehensive plan for controlled propagation, augmentation and reintroduction of freshwater mollusks in the Tennessee and Cumberland watersheds.

7. **Biennial monitoring of the five species yields the results outlined in "criterion 1 and 2" over a 10-year period (see Recovery Task 5).**

   Biennial monitoring has not occurred to date, primarily due to insufficient funds. Some yearly monitoring does occur by our partners on a site-by-site basis. Additionally, monitoring has occurred on the Clinch and Powell Rivers at 5 year intervals since the late 1970s.

b. Criteria for delisting

Through the protection of extant stream populations (e.g., continuing to use existing regulatory mechanisms, establishing partnerships with various stakeholders, using BMPs, minimizing or eliminating threats),

discovery of currently unknown stream populations, and/or reestablishment of historical stream populations, there exists at least **nine** (six for downlisting) distinct viable stream populations of the oyster mussel in the Cumberland River system, upper Tennessee River system, and Duck River in the lower Tennessee River system. **Two** (one for downlisting) distinct naturally reproduced year classes exist within each viable population. All other downlisting criteria remain the same for the delisting criteria.

All the work to-date for this species has been described above under the "Criteria for downlisting." There are presently only three extant populations of the Oyster mussel.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance/population trends: The oyster mussel population in the lower Clinch River appears to have increased dramatically in recent years with conservative estimates at 250,000+ individuals based on 2004 and 2005 quadrat data from VPI (Jones 2005). The Nolichucky River population is small and of doubtful viability. Only a single live specimen was found during sampling at 20 sites in 2000 (Tennessee Valley Authority 2002). Ostby (pers. comm. 2009) located 5 individuals during quantitative sampling and 2 during qualitative sampling on the Nolichucky River in 2008. The population appears to be small, but shows evidence of recruitment. The Duck River population appears to be doing well in the lower portion of this river (Ahlstedt 2004).

b. Genetics: Based on extensive molecular, morphological and life history data, the population of *Epioblasma capsaeformis* from the Duck River in Tennessee has been proposed as a separate species from the *E. capsaeformis* in the upper Tennessee watershed (Jones et al. 2006). The proposed taxonomic changes would reduce the *E. capsaeformis* populations to two extant locations in the upper Tennessee watershed. The new species in the Duck River would have only one known extant location.

c. Taxonomic classification or changes in nomenclature: The Duck River population of *Epioblasma capsaeformis* has been proposed as a separate species. The estimated date for publication of the new classifcation is 2010.

d. Spatial distribution: Changes will have to be made to the historical range of the oyster mussel. The proposed taxonomic

changes would make the *E. capsaeformis* restricted to the upper Tennessee and Cumberland watersheds. The lower Tennessee watershed will contain a separate species.

e. **Habitat or ecosystem conditions:** The oyster mussel in the Powell River was thought to have disappeared because of coal mining throughout the watershed. This same phenomenon could be taking place in the Clinch River in Virginia and coal fines are showing up in increasing amounts in the lower Clinch River in Tennessee. There is a concern among the mussel experts that this may lead to a crash in the mussel populations similar to what occurred in the Powell River. Unfortunately, we do not understand what effects these coal fines may or may not have on the mussel populations. Studies are underway to try to understand this issue and its potential effects on mussel populations before the mussels start to disappear. The habitat in the lower French Broad and Powell Rivers appears to be improving to the point that we can reintroduce oyster mussels back into these areas in hopes of developing a viable population.

2. **Five Factor Analysis (threats, conservation measures and regulatory mechanisms).**

Factor A. The present or threatened destruction, modification, or curtailment of its habitat or range:

As indicated in the Recovery Plan (USFWS 2004), impoundments, channelization, mineral extraction, gravel mining, contaminants, toxic chemical spills, and sedimentation remain threats to the oyster mussel. Additional, ongoing threats to the mussel include increased urbanization, streambank erosion, water withdrawals, and agricultural practices.

Physical habitat destruction resulting from a variety of human-induced impacts such as siltation, disturbance of riparian corridors, and changes in channel morphology continues to plague the Nolichucky, Clinch and Duck river watersheds. The most significant of these impacts is siltation caused by excessive releases of sediment from activities such as agriculture, resource extraction (e.g., coal mining, silviculture), road construction, and urban development (Waters 1995). Activities that contribute sediment discharges into a stream system change the erosion or sedimentation pattern, which can lead to the destruction of riparian vegetation, bank collapse, excessive instream sediment deposition, and increased water turbidity and temperatures. The effects of these types of threats will likely increase in the Clinch and Duck river watersheds in response

to human demands for water, housing, transportation, and places of employment as human populations grow.

Non-point source pollution from land surface runoff can originate from virtually any land use activity (such as coal mining and agricultural activities) and may be correlated with impervious surfaces and storm water runoff from urban areas. Pollutants entering the Nolichucky, Clinch and Duck rivers may include sediments, fertilizers, herbicides, pesticides, animal wastes, pharmaceuticals, septic tank and gray water leakage, and petroleum products. These pollutants tend to increase concentrations of nutrients and toxins in the water and alter the chemistry of affected streams such that the habitat and food sources for species like the oyster mussel are negatively impacted.

Common land uses within the Clinch River watershed include urban, industrial, commercial, and residential development; livestock production; agricultural cropping including tobacco and corn; coal mining, reclaimed coal mined lands, and "abandoned" coal mined lands (i.e., lands affected by mining prior to the federal law that were not reclaimed properly); road and railroad networks; and forests (US EPA 2002). These land use activities act as sources of stress to the oyster mussel by contributing sediment and contaminants into the watershed.

Coal mining activity has increased in the Clinch River watershed in recent years, and coal fines in the upper river, Virginia, are moving downstream into Tennessee. A 585-megawatt coal powered electric generation facility is expected to be constructed along the Clinch River in Virginia City, Wise County, Virginia. Effluent discharge, run-off from fly ash storage, and other sources related to the operation of the facility represent new threats, and may result in further impacts to the oyster mussel populations in Tennessee.

Oil, gas, and coal exploration and development are on the increase in the upper Clinch River watershed (J. Jones, U. S. Fish and Wildlife Service biologist, personal communication (pers. comm.) 2006) and the New River watershed (Steve Bakaletz, National Park Service biologist, pers. comm., 2006). The largest oyster mussel populations occur in the lower Clinch River and coal fines are already being found in increasing amounts in these populations (D. Hubbs, Tennessee Wildlife Resources Agency biologist, pers. comm., 2006). The New River is a major tributary to the Big South Fork that influences the quality of the oyster mussel habitat. The potential negative impacts to mussels and their habitat will have to be monitored closely as exploration and development increase. We

have an ongoing project that is looking at the sediment toxicity in the both systems. The results of this study are not available yet.

Factor B. Overutilization for commercial, recreational, scientific or educational purpose: The overutilization for commercial, recreational, scientific or educational purposes was not considered to be a limiting factor in the Recovery Plan. We have no new information to indicate that this has changed.

Factor C. Disease and predation: The Recovery Plan stated that there is little data indicating that disease or predation are limiting factors for this species. The level of depredation by muskrats on oyster mussels has declined dramatically in the Clinch River, presumably due to the introduction of river otters. Any negative effect from depredation on adult mussels has been ameliorated by the presence of river otters. We have no other information on disease or predation of the oyster mussel. We continue to believe that disease and/or predation are not limiting factors for this species.

Factor D. Inadequacy of existing regulatory mechanisms: The oyster mussel and its habitats are afforded limited protection from water quality degradation under the Clean Water Act of 1977 (33 U.S.C. 1251 et seq.) and the Tennessee Water Quality Control Act of 1977. However, these laws focus on point-source discharges, and many water quality problems are the result of non-point source discharges. Therefore, these laws and corresponding regulations have been inadequate to halt population declines and degradation of habitat for the oyster mussel.

In addition to the Federal listing, the oyster mussel is listed as Endangered by the State of Tennessee. Under the Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974 (Tennessee Code Annotated §§ 70-8-101-112), "...it is unlawful for any person to take, attempt to take, possess, transport, export, process, sell or offer for sale or ship nongame wildlife, or for any common or contract carrier knowingly to transport or receive for shipment nongame wildlife." Further, regulations included in the Tennessee Wildlife Resources Commission Proclamation 00-15 Endangered Or Threatened Species state the following: except as provided for in Tennessee Code Annotated, Section 70-8-106 (d) and (e), it shall be unlawful for any person to take, harass, or destroy wildlife listed as threatened or endangered or otherwise to violate terms of Section 70-8-105

(c) or to destroy knowingly the habitat of such species without due consideration of alternatives for the welfare of the species listed in (1) of this proclamation, or (2) the United States list of Endangered fauna. Potential collectors of this species would be required to have a state collection permit.

Since listing, section 7 of the Act has required Federal agencies to consult with the Service when projects they fund, authorize, or carry out may affect the species. However, the lack of Federal authority over the many actions likely impacting oyster mussel habitat has become apparent. Many of the threats (including those identified at the time of listing, during recovery planning, and since development of the Recovery Plan) involve activities that likely do not have a Federal nexus (such as water quality changes resulting from development, water withdrawals, or indiscriminate logging) and, thus, may not result in section 7 consultation. Although the take prohibitions of section 9 of the Act do apply to these types of activities and their effects on the oyster mussel, enforcement of the section 9 prohibitions is difficult, at best. The Service is not informed when many activities are being considered, planned, or implemented; therefore, we have no opportunity to provide input into the design of the project or to inform project proponents of the need for a section 10 permit.

Factor E. Other natural and manmade factors affecting its continued existence: The Recovery Plan listed the presence or potential introduction of alien species (especially zebra mussels and black carp), insufficient densities of host fish species, inbreeding depression and other genetic considerations, and possible weak links in the species' life cycles. We have no new information on any of these issues related to the oyster mussel.

D. Synthesis

The oyster mussel was historically one of the most widely distributed Cumberlandian mussel species. Its range historically included four physiographic provinces (Interior Low Plateau, Cumberland Plateau, Ridge and Valley, and Blue Ridge) and six States (Alabama, Georgia, Kentucky, North Carolina, Tennessee, and Virginia). In the Cumberland River, it occurred from the base of Cumberland Falls, McCreary and Whitely Counties, Kentucky, downstream to Stewart County, Tennessee. In the Tennessee River, it occurred throughout the main stem, downstream to Colbert and Lauderdale Counties, Alabama. Dozens of tributaries in the Cumberland and Tennessee River systems also harbored this species historically. The oyster

mussel is now considered extirpated from the entire Cumberland River system. Oyster mussels have also been eliminated from the entire Tennessee River main stem and numerous tributaries. The remaining extant populations occur in the Clinch River in Scott County, Virginia, and Hancock County, Tennessee; Nolichucky River in Cocke and Hamblen Counties, Tennessee; and Duck River in Marshall County, Tennessee. The Duck River population has been determined to be a separate species and the name change should be published sometime in 2010. This would result in only two extant populations of the true oyster mussel, *Epioblasma capsaeformis*. The Clinch River populations are thriving, with an estimated population of 250,000+ individuals. The Nolichucky population is small and of questionable viability.

The Recovery Plan listed excessive sedimentation (primarily resulting from nonpoint-source loading), coal mining, gravel mining, reduced water quality below existing dams, developmental activities, water withdrawal, impoundments, and alien species as threats to the oyster mussel and its habitat. Due to the restricted range of the remaining three extant populations, toxic spills are also a threat that could wipe out an entire population. All of these threats remain. As discussed above in Section C, the Clinch River watershed is also experiencing an increase in oil, gas, and coal exploration and development. The effects of an increase in these activities on the oyster mussels and its habitat are unknown at this time.

The recovery criteria listed in Section B above have not been met for delisting or downlisting the species. Because of the oyster mussel's limited distribution and continued threats to the three extant populations, it remains in danger of extinction throughout all or a significant portion of its range. Therefore, the status of the oyster mussel should remain as endangered.

At the time of listing (USFWS 1997), this species had a high degree of threat and a low recovery potential, which results in a Recovery Priority Number of 5 for the taxonomic level of species. The Recovery Plan (USFWS 2004) also describes this species as having a high degree of threat and a low recovery potential. Oil, gas, and coal exploration and development are an increasing threat in the upper Clinch River watershed. Pollution and sedimentation continue to be threats to all the extant populations. A detailed description of the past and present threats to this species can be found in the Recovery Plan. We continue to believe that the threats to this species remain high and that the recovery potential remains low. Therefore, a change to the existing Recovery Priority Number is not necessary.

III. RESULTS

A. **Recommended Classification:** No change is needed for the existing classification of endangered.

B. **New Recovery Priority Number:** No change is needed for the existing Recovery Priority Number of 5.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Continue to refine propagation technology for both laboratory culture and streamside infestation activities.
- Using refined propagation techniques, continue efforts to augment and expand the range of extant populations to ensure their viability. For example, the following Cumberlandian Region streams were recommended by the Cumberlandian Region Mollusk Restoration Committee (CRMRC) (2009): Tennessee River system – upper Clinch, VA; Nolichucky, TN. Cumberland River system – Big South Fork, TN/KY.
- Reestablish viable populations in other streams within the historical range that have suitable habitat and water quality. For example, the following Cumberlandian Region streams were recommended by the CRMRC (2009): Tennessee River system – Tennessee main stem tailwaters: Wilson, AL, Pickwick Landing, TN, Bear Creek, AL; Tennessee tributary tailwaters: lower French Broad/Holston, TN, Elk, AL; Paint Rock, AL; Copper Creek, VA; Emory, TN; upper North Fork Holston, VA; upper French Broad, TN; lower Pigeon, TN; Hiwassee, TN; Estill Fork, AL; upper Holston, TN; Little Pigeon, TN; Bear Creek, AL/MS; Buffalo, TN; Shoal Creek, TN/AL. Cumberland River system – Rockcastle, KY; Buck Creek, KY; Little South Fork, KY.
- Determine the degree of threat that increased coal mining, and oil and gas drilling may have on this species.
- Protect habitat through acquisitions and easements.
- Assess the effects from the findings of the genetic study that found the Duck River oyster mussel (lower Tennessee watershed) should be a separate species from the Clinch and Nolichucky oyster mussels (upper Tennessee watershed) on the Recovery Plan.
- Continue efforts to monitor existing populations; pursue long-term monitoring efforts in the Duck and Nolichucky rivers. Include a quantitative component to monitoring that provides basic population size estimates and a sampling design specifically for finding juveniles to facilitate the assessment of recruitment of each population.
- Continue to educate the public about water quality and freshwater mussels.
- Establish Species Specific Protective Measures to satisfy Term and Condition #1 of the 1996 Biological Opinion, titled "Section 7 Formal Consultation and Conference Report on Surface Coal Mining and Reclamation Operations Under the Surface Mining Control and Reclamation Act of 1977", or reinitiate formal Section 7 consultation to incorporate new information on listed species and the impacts of

coal mining and reclamation activities and reevaluate the adequacy of the Terms and Conditions.

V. REFERENCES

Ahlstedt, S. A., and J. D. Tuberville. 1997. Quantitative reassessment of the freshwater mussel fauna in the Clinch and Powell Rivers, Tennessee and Virginia. Pages 72-97 in K. S. Cummings, A. C. Buchanan, C. A. Mayer, and T. J. Naimo, eds. Conservation and management of freshwater mussels II: initiatives for the future. Proceedings of a UMRCC symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of **Oyster Mussel (*Epioblasma capsaeformis*)**

Current Classification: Endangered
Recommendation resulting from the 5-Year Review:

X No change is needed

Review Conducted By: Stephanie Chance

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve [signature] Date 11-5-09

REGIONAL OFFICE APPROVAL:

Acting
Lead Regional Director, Fish and Wildlife Service

Approve [signature] Date 12-7-09

Cooperating Regional Director, Fish and Wildlife Service

X Concur Do Not Concur

Signature [signature] Date 3/12/10

Acting Regional Director

APPENDIX A: Summary of peer review for the 5-year review of the oyster mussel (*Epioblasma capsaeformis*)

A. Peer Review Method: Letters were sent to Don Hubbs (TWRA), Dr. Dick Neves (VPI), and Steve Ahlstedt (USGS retired) requesting that they peer review the scientific portions of the oyster mussel 5-year review document. Peer reviewers were given 30 days to complete the review.

B. Peer Review Charge: A letter was sent to each peer reviewer along with the biological portion of the 5-year review and a list of the literature cited. We explained to the peer reviewers that in order to support the Service's interest in making its decision based on the best available science, portions of the draft review need to be subjected to an appropriate level of peer review. They were told that due to their expertise regarding this species, we requesting that they peer review the enclosed portion of the document.

C. Summary of Peer Review Comments/Report: We received comments from all three peer reviewers within the 30 day timeframe. The majority of the comments related to updating the literature cited portion of the document. One peer reviewer recommended some minor changes to the biological portion of the document.

D. Response to Peer Review: All the peer review comments were incorporated into the 5-year review document.