Altamaha spinymussel
(Elliptio spinosa)

5-Year Review:
Summary and Evaluation

Photo by Jason Wisniewski, GADNR

U.S. Fish and Wildlife Service
Southeast Region
Georgia Ecological Services Field Office
Coastal Georgia Suboffice
Townsend, Georgia

5-YEAR REVIEW

Altamaha spinymussel (*Elliptio spinosa*)

I. GENERAL INFORMATION

A. Methodology Used to Complete the Review: Public notice of this review was given in the *Federal Register* and a 60-day comment period was opened (83 FR 16734). This review was conducted by the species' recovery lead biologist in the U.S. Fish and Wildlife Service's (Service) Georgia Ecological Services Field Office's Coastal Suboffice (Coastal Suboffice). Pertinent information was obtained from the Listing and Critical Habitat Rule for the Altamaha spinymussel (*Elliptio spinosa*) (ASM), public comments, published literature, species experts with the Georgia Department of Natural Resources (GADNR), local conservation groups, and industrial entities with operations in the vicinity of ASM critical habitat. Projects entered into the Service's Tracking and Integrated Logging System (TAILS) since the ASM's listing that identified the ASM as a species considered during project review were evaluated to determine if any adverse impacts to the ASM or its critical habitat were expected, and to determine if any ASM survey efforts were conducted. The GADNR's Environmental Protection Division's (EPD) water quality database was accessed to determine if significant water quality changes have been observed in any parts of ASM critical habitat and the United States Geological Survey's National Water Information System database was accessed to determine if extreme flow/discharge was observed in ASM critical habitat. No part of the review was contracted to an outside party. Public comments received were considered in this 5-yr review and are summarized in Appendix A.

B. Service Reviewers

Lead Region – Southeast Regional Office, Kelly Bibb, 404-679-7132

Lead Field Office – Georgia Ecological Services, Coastal Georgia Suboffice, Anthony Sowers, 912-832-8739, Ext. 3

C. Background

1. ***Federal Register* Notice Citation Announcing Initiation of This Review:** August 6, 2018, 83 FR 16734.

2. **Species' Status:** The 2012 International Union for Conservation of Nature (IUCN) Red List of Threatened Species designates the ASM as endangered with a decreasing population trend (Cummings and Cordeiro 2012). At the time of the Service's listing of the ASM in 2011, it had been observed to have a decreasing population throughout its historic range based on comparisons between historic and more recent survey results. No comprehensive survey efforts across the ASM's historic or current range have been conducted since its listing to determine the current population status.

3. **Recovery Achieved:** N/A (No recovery objectives have been established).

4. **Listing History:**
   Original Listing
   FR notice: 76 FR 25539
   Date listed: October 11, 2011
   Entity listed: Species
   Classification: Endangered

5. **Associated Rulemakings:**
   Critical Habitat; 76 FR 25539, October 11, 2011.

6. **Review History**:
   This is the first 5-year review for the ASM.

7. **Species' Recovery Priority Number at Start of Review**: 5

8. **Recovery Plan:**
   No recovery plan has been developed for the ASM.

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) Policy: The ASM is an invertebrate and therefore is not covered by the DPS policy. Other DPS questions will not be addressed in this review.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** No recovery plan has been developed for the ASM.

C. Updated Information and Species' Current Status

1. **Biology and Habitat**

   a. **Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:**

   While the life history characteristics of other mussels in the *Elliptio* genus have been studied, at the time of listing very little was known regarding the specific life history and demographic features of the ASM. The ASM is believed to reproduce in late spring, with glochidia release occurring by May or June. Between 1990 and the time of listing for the ASM (2011), no juvenile ASMs were observed during survey efforts, suggesting a lack of recruitment for the ASM.

The specific host fish for the ASM is not known. Johnson et al. (2012) conducted host fish trials for the ASM with glochidia collected from a gravid female in 2009 using ten southeastern fish species. ASM glochidia morphology was described for the first time as part of the study. No host fish was identified for the ASM as no metamorphosed juveniles were observed, but four ASM glochidia remained attached to the lake sturgeon, *Acipenser fulvescens*, and five ASM glochidia remained attached to the redbreast sunfish, *Lepomis auritus*, until five days after initial attachment. No other new information regarding the life history or other demographic features of the ASM has become available.

The status of the ASM across its historic range is discussed below by waterbody:

Ocmulgee River:

The Ocmulgee River contains a designated critical habitat unit for the ASM. The critical habitat unit begins at the confluence of the Ocmulgee River with House Creek and continues downstream to the Altamaha River at the confluence of the Ocmulgee and Oconee Rivers. This critical habitat unit is believed to encompass the historic range of the ASM in the Ocmulgee River. Survey results available at the time of listing suggested that the ASM population in the Ocmulgee River declined significantly between the 1960's and 2004 throughout this range.

A review of Service projects in TAILS and discussions with Service biologists in the Coastal Suboffice revealed that three projects reviewed by Service biologists that included ASM survey efforts occurred in the Ocmulgee River within ASM critical habitat.

Survey efforts were conducted at Barr's Bluff Landing in Coffee County as part of a boat landing reconstruction project in 2018. The habitat surveyed included a stagnant oxbow off of the Ocmulgee River. No live or relict ASMs were found over an approximately 30-meter stretch (20 meters downstream and 10 meters upstream of the project, including the project footprint). The surveyor also noted that the habitat being surveyed was not likely to be suitable ASM habitat as it was predominantly mud/muck.

Survey efforts were also conducted at Rocky Hammock Landing in Jeff Davis County as part of a boat landing reconstruction project in 2018 along the main stem of the Ocmulgee River. The habitat surveyed included an approximately 30-meter stretch (20 meters downstream and 10 meters upstream of the project, including the project footprint). No live or relict ASMs were found.

Survey efforts were also conducted at a boat ramp construction project site in Horse Creek Wildlife Management Area in Telfair County in 2015 along the main stem of the Ocmulgee River. The habitat surveyed included an approximately 60-meter stretch (50 meters downstream and 10 meters upstream of the project, including the project footprint). No live or relict ASMs were found. The surveyor also noted that suitable ASM habitat was not present at the site.

Altamaha River

The Altamaha River contains two designated critical habitat units for the ASM. The upper Altamaha River critical habitat unit occurs from the confluence of the Ocmulgee and Oconee Rivers downstream to the confluence of the Altamaha and Ohoopee Rivers, minus a 1.7-mile section of the Altamaha River adjacent to the Edwin I. Hatch Nuclear Plant. The excluded section of the river does not contain all critical habitat primary constituent elements due to dredging activities, which impact sediment stability and quality, and thermal discharges, which impact water quality. The middle Altamaha River critical habitat unit occurs from the confluence of the Altamaha and Ohoopee Rivers downstream to where U.S. Route 301 crosses the Altamaha River near Jesup, Georgia. Survey results available at the time of listing suggested that the ASM population in the Altamaha River declined significantly between the 1960's and 2004.

A review of Service projects in TAILS and discussions with Service biologists in the Coastal Suboffice revealed that two projects reviewed by Service biologists that included ASM survey efforts occurred in the Altamaha River within ASM critical habitat.

Survey efforts were conducted in the vicinity of where State Road 4/US 1 crosses the Altamaha River in Appling and Toombs Counties as part of a bridge replacement project conducted by the Georgia Department of Transportation. No live or relict ASMs were found during surveys in 2010, 2011, and 2014.

Survey efforts were conducted in the vicinity of where State Road 135 crosses the Altamaha River in Jeff Davis and Montgomery Counties as part of a bridge replacement project conducted by the Georgia Department of Transportation. No live or relict ASMs were found during surveys in 2016 and 2017.

Rayonier Performance Fibers, Jesup Mill Site, conducted a mussel study in 2018 to fulfill a requirement in its National Pollution Discharge Elimination System (NPDES) permit (CCR 2019). The Jesup Mill Site is located at the lower extent of ASM critical habitat in the Altamaha River. The results of the study did not indicate that there are significant differences in the abundance or diversity of mussels above and below the Mill's effluent discharge sites. The mussel survey results were also determined to be consistent with previous surveys in the vicinity of the Jesup Mill Site in terms of mussel abundance and diversity. No ASM were detected during the 2018 survey efforts.

Ohoopee River:

The Ohoopee River contains a critical habitat unit for the ASM. This critical habitat unit includes a section of the Ohoopee River beginning nine miles upstream of the confluence of the Ohoopee and Altamaha Rivers and ending at the confluence. Survey results available at the time of listing suggested that the ASM population in the Ohoopee River declined significantly between the early

1980's and early 2000's. No additional survey work is known to have been conducted in the Ohoopee River since the early 2000's.

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

The Service's 2011 listing of the ASM identified inbreeding and reduced genetic diversity as factors that may affect the continued existence of the ASM due to low numbers of individuals at fragmented sites. No new information has become available relating to the current genetic diversity of the ASM.

Perkins et al. (2017) conducted a molecular systematics study of the three known freshwater spinymussel species: the ASM, the Tar River spinymussel (*Elliptio steinstansana*), and the James River spinymussel (*Pleurobema collina*), to determine their evolutionary relationships. Molecular loci, two from mtDNA and one from nDNA, were sequenced and used to conduct phylogenetic reconstructions and divergence time estimates for the spinymussel species and other related taxa. The results of this study suggest that the Tar River and James River spinymussels form a monophyletic clade that is distinct from both the *Elliptio* and *Pleurobema* genera. The authors describe a new genus, *Parvaspina*, for both the Tar River and James River spinymussels. In contrast, the results of the study indicate that the ASM does not fall within the monophyletic clade and newly described genus of the other spinymussels. The mtDNA and nDNA markers for the ASM both indicate that the ASM is genetically divergent from the other spinymussels, suggesting that the ASM's spines may have evolved independent of the other spinymussel species and that management strategies based on the life histories of the Tar River and James River spinymussels may not be appropriate for or relevant to the ASM. The mtDNA and nDNA markers also produced conflicting results when conducting phylogenetic reconstructions for the ASM. While both markers indicate that the ASM is genetically divergent from the other spinymussels, the mtDNA markers show similarities with other *Elliptio* species, while the nDNA markers do not support this relationship and associate the ASM more closely to *Fusconaia* species, suggesting that the ASM is not a true *Elliptio* species. Considering that much of the life history of the ASM is not well known or documented, management strategies based solely on known *Elliptio* species life histories may not be optimal.

Small et al. (2012) conducted an evaluation of genetic structure in three *Elliptio* species in the Altamaha River basin, but the ASM was not among those species and the results of the study do not provide any insight into the current genetics of the ASM. If additional genetics work is conducted on the ASM in the future, the data generated by Small et al. (2012) may prove useful for investigating the ASM's evolutionary relationship with the *Elliptio* genus, particularly considering the questions raised above by Perkins et al. (2017).

c. Taxonomic classification or changes in nomenclature:

There has been no change in the classification or nomenclature of this species (ITIS 2019).

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

No new information has become available that indicates there has been any change in the spatial distribution of the ASM. No comprehensive survey efforts have been conducted across the expected current and/or historic range of the species. As noted above in Section C.1.a., minimal survey efforts have been conducted in relation to proposed bridge and boat landing/ramp projects and NPDES permit requirements within ASM critical habitat. No positive ASM detections occurred during these efforts.

Archambault et al. (2018) conducted an analysis of species occurrence and life history traits for mussel species residing in either glaciated or unglaciated river systems. Glaciated river systems were covered with ice during the Last Glacial Maximum. Species that currently reside in the glaciated river systems were able to colonize/re-colonize these systems following the Last Glacial Maximum, indicating resilience and the ability to shift distribution following climatic changes. The analysis attempted to establish relationships between species occurrence in glaciated or unglaciated river systems and larval brooding duration, host fish specificity, host infection strategy, and body size (maximum length). The ASM was included in the analysis and was assumed to be a short-term brooder with host fish specificity and a non-attracting host infection strategy. ASM body size was not included in the analysis. The assumption that the ASM is a short-term brooder with a non-attracting host infection strategy is based on general *Elliptio* life history traits. As detailed above in Section C.1.b., the appropriateness of assuming the ASM follows general *Elliptio* traits may be questionable.

Archambault et al. (2018) found significant relationships between host fish specificity and brooding duration with mussel distribution in glaciated and unglaciated river systems. A higher proportion of host fish generalists and long-term brooders were found in glaciated river systems than unglaciated river systems indicating that these traits may be important for a mussel species to shift its distribution under changing climatic conditions. While these results do not inform the current distribution of the ASM, they do suggest that the assumed short-term brooding strategy and host fish specificity of the ASM may limit its ability to shift its distribution under changing conditions in the future.

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

The Rayonier mussel study report referenced above states that historic low flows were observed in the Altamaha River in 2011 and are believed to have caused a mussel kill in the vicinity of the Jesup Mill Site due to emersion and hypoxia. Data from the United States Geological Survey's (USGS) National Water Information System for two monitoring stations (USGS02225000 - Altamaha River near Baxley, Georgia and USGS02226000 - Altamaha River at Doctortown, Georgia) in the Altamaha River was accessed to further evaluate low flow conditions. The Baxley station is located near the Edwin I. Hatch Nuclear Plant marking the separation between the upper and middle Altamaha River critical habitat units. The Doctortown station is located near the Rayonier, Jesup Mill Site at the lower extent of the middle Altamaha River critical habitat unit. Data from both stations indicate that daily mean gage height (feet) and daily mean discharge (cubic feet per second) displayed minimum values, over the entire period of record for each parameter, in 2012. At the Baxley station, 19 years of gage height data and 50 years of discharge data was available at the time of this evaluation. At the Doctortown station, 28 years of gage height data and 87 years of discharge data was available at the time of this evaluation. It's unclear what impact such extreme low flow conditions may have had on the ASM across its range, as no ASM kills are known to have occurred/been reported and no comprehensive survey efforts have been conducted since this extreme event.

The EPD's water quality database was accessed to determine if any documented changes in water quality within ASM critical habitat has occurred. The 2010 305(b)/303(d) lists of waterbodies were compared to the currently available draft 2018 305(b)/303(d) lists. The 305(b) list contains waterbodies in the state of Georgia that have been determined to be supporting their designated uses by meeting specific water quality criteria. The 303(d) list contains waterbodies that have been determined to not be supporting their designated due to exceedances of specific water quality criteria.

The Ocmulgee River critical habitat unit was determined to be supporting its designated use of fishing in both the 2010 305(b) list and the draft 2018 305(b) list indicating that no water quality declines to the point of impairing the designated use of the Ocmulgee River critical habitat unit have been documented. A Total Maximum Daily Load (TMDL) for mercury in fish tissue was established in 2002 for the Ocmulgee River critical habitat unit indicating that mercury contamination was a previously recognized issue.

The Altamaha River critical habitat units were determined to be supporting their designated use of fishing in both the 2010 305(b) list and the draft 2018 305(b) list indicating that no water quality declines to the point of impairing the designated use of the Altamaha River critical habitat units have been documented. A TMDL for mercury in fish tissue was established in 2002 for the Altamaha

River critical habitat units indicating that mercury contamination was a previously recognized issue.

The Ohoopee River critical habitat unit was determined to not be supporting its designated use of fishing in both the 2010 303(d) list and the draft 2018 303(d) list due to mercury contamination in fish tissue. The same TMDL that was applied in the Ocmulgee River and the Altamaha River for mercury was also applied to the Ohoopee River critical habitat unit in 2002. Despite the TMDL, mercury contamination in fish tissue is still preventing the Ohoopee River critical habitat unit from meeting its designated use.

2. Five-Factor Analysis

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

The Service's 2011 listing of the ASM identified sedimentation as a threat to ASM habitat. A significant source of excess sediment was believed to have originated from historic agricultural practices in the region and to still be migrating through the river systems. Such legacy sediment may still pose a threat to ASM habitat. In addition to historic agricultural practices, present-day agriculture, silviculture, and mining operations are also still potential threats that may be contributing excess sediment to the river systems with potential ASM habitat.

Contaminants associated with agricultural runoff and industrial and municipal effluents, including unpermitted discharges, were identified as potential threats during the 2011 listing of the ASM. As stated above in Section C.1.e, no significant changes in water quality within ASM critical habitat have been documented by the EPD since the ASM's listing. Such evaluations by EPD are limited to a defined list of contaminants; therefore the threat from unregulated contaminants is largely unknown. Sediment-based contamination is not addressed through the EPD's process as only aqueous concentrations of contaminants are considered; therefore the threat from sediment contamination is still largely unknown across the potential range of the ASM. Unpermitted discharges that may not be identified also remain a potential threat to ASM habitat.

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

Overutilization for commercial, recreational, scientific, or educational purposes was not identified as an issue for the ASM during its 2011 listing. No new information is available that indicates overutilization as a threat.

c. Disease or predation:

Disease and/or predation were not identified as significant threats for the ASM during its 2011 listing. No new information is available that indicates disease or predation as a threat.

d. Inadequacy of existing regulatory mechanisms:

The ASM is listed as endangered by the State of Georgia under Georgia's Endangered Wildlife Act (EWA). Protection under the EWA restricts intentional capture or killing of the ASM. However, this designation does not protect ASM habitat from activities, such as construction, that may lead to habitat degradation and/or unintentional impacts to the ASM.

Activities that may pose a threat to the ASM or its critical habitat that have a federal nexus (i.e. federal permit or authorization required) are subject to section 7 of the Endangered Species Act of 1973 (Act) which requires federal agencies to consult with the Service for actions that may adversely affect the ASM or its critical habitat. Activities with no federal nexus are not subject to section 7 of the Act and generally proceed with no consultation with the Service. Such non-federal activities may impact the ASM or its critical habitat unbeknownst to the Service.

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

The reproductive viability of the ASM is a concern. The most recent comprehensive survey efforts, which occurred prior to the 2011 listing, have shown small, fragmented populations of the ASM across its range at numbers below historic survey observations. The probability of successful reproduction in a broadcast spawner such as the ASM is reduced as the number of reproductive-age individuals decreases. Also, as described in Section C.1.a, no juvenile ASM individuals have been observed during survey efforts beginning in 1990 to the present, also indicating that reproductive viability is under question. A loss of genetic diversity is also a concern for small, fragmented populations of a species.

The Service's 2011 listing of the ASM indicated that all-terrain and four-wheeled vehicle use along river margins during low flow conditions was a threat to the stability of potential ASM habitat. This activity remains a threat to ASM habitat.

The specific host fish for the ASM has not been identified. This lack of information limits the Service's ability to evaluate both the status of the host fish and potential threats to the host fish. Identification and implementation of host fish-based conservation actions are not possible.

D. Synthesis

Survey efforts conducted prior to the ASM's listing as endangered indicated that population numbers had declined from historic numbers across the ASM's range. No comprehensive survey efforts for the ASM across neither its historic range, nor its critical habitat have been conducted since prior to its 2011 listing, providing no evidence that the status of the ASM has improved during that time period. During the most recent ASM surveys, conducted prior to listing, the existing populations of the ASM were small and fragmented and no juvenile recruitment had been observed since prior to 1990. Potential threats to the ASM and its critical habitat that were identified in the ASM's 2011 listing are still viable threats. Based on the information presented in this 5-year review, the Service believes the ASM still meets the definition of endangered.

III. RESULTS

A. Recommended Classification:

__X__ No change is needed.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

A. A final, approved recovery plan with measurable criteria for the ASM should be developed.

B. Comprehensive survey efforts across ASM critical habitat should be conducted to adequately determine the current status of the ASM. Such surveys would provide updated occurrence and demographic (e.g. presence/absence of juveniles) data that could then be used to inform the other recommended future actions below.

C. Host fish identification efforts should be considered. If survey efforts reveal a stable population, the potential for conducting additional host fish trials should be explored. Additionally, using available fish occurrence data coupled with ASM historic and new survey data, the potential for drawing correlations between fish and ASM occurrence, or disappearance, at particular sites/river reaches should be explored.

D. Habitat quality, including substrate, temperature, and flow should be evaluated throughout ASM critical habitat. Where possible, current habitat quality data coupled with current ASM survey data should be evaluated to determine if any correlations exist between specific habitat quality parameters and ASM occurrence to further refine the expected ideal ranges of habitat quality parameters for the ASM.

E. Additional genetic analysis should be conducted to further explore the evolutionary history of the ASM and its phylogenetic relationships to other species to better inform management decisions and potential conservation actions.

V. REFERENCES

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U.S. Geological Survey. 2019. National Water Information System. USGS station 02226000, Altamaha River at Doctortown, Georgia. https://nwis.waterdata.usgs.gov/nwis

U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW OF THE ALTAMAHA SPINYMUSSEL

Current Classification: Endangered.

Recommendation resulting from the 5-Year Review:

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

Review Conducted By: Anthony Sowers, Georgia Ecological Services Field Office's Coastal Suboffice, Townsend, GA.

FIELD OFFICE APPROVAL:

Donald Imm, State Supervisor/Project Leader, Georgia Ecological Services Field Office, Athens, GA

Approve _____ Date _7/15/2019_____

The lead field office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.

APPENDIX A
PUBLIC COMMENTS

Two public comments were received following the announcement of this 5-year review. One public comment emphasized a general need for protecting all species included in the 5-year review announcement to ensure diversity for future generations. The second public comment stated opposition to any status change for the five endangered species in Georgia that were included in the 5-year review announcement, including the Altamaha spinymussel. This commenter stated that no new information has become available that would support a change in status.

The recommendation made in this 5-yr review to maintain an endangered classification for the Altamaha spinymussel is consistent with the public comments received.