

**Armored Snail**  
**(*Marstonia pachyta*)**

**5-Year Review:**  
**Summary and Evaluation**



Photograph Credit: Dr. Thomas M. Haggerty

**U.S. Fish and Wildlife Service**  
**Southeast Region**  
**Alabama Ecological Services Field Office**  
**Daphne, Alabama**

## **5-YEAR REVIEW**

*Armored Snail / Marstonia pachyta*

### **I. GENERAL INFORMATION**

#### **A. Methods used to complete the review:**

This review was completed by the Alabama Ecological Services (ES) Field Office, Daphne, Alabama (Anthony Ford and Jeffrey Powell). The primary sources of information used in this analysis were the 2000 final listing rule (65 FR 10033), peer-reviewed reports; unpublished survey data and reports, and personal communication with recognized experts. All literature and documents used for this review are on file at the Alabama ES Field Office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the armored snail. Comments and suggestions regarding this review were received from peer reviewers from outside the Service (see Appendix A). No part of the review was contracted to an outside party. In addition, this review was announced to the public on August 2, 2007 (72 FR 42425) with a 60-day comment period. Comments received were evaluated and incorporated as appropriate.

#### **B. Reviewers**

**Lead Region:** Southeast Region: Kelly Bibb (404) 679-7132

**Lead Field Office** – Alabama Ecological Services Field Office, Daphne, AL:  
Anthony Ford (251) 441-5838  
Jeffrey Powell (251) 441-5858

#### **C. Background**

**a. FR Notice citation announcing initiation of this review:** 72 FR 42425, August 2, 2007.

**b. Listing history:**

Original Listing

FR notice: 65 FR 10033

Date listed: February 25, 2000

Entity listed: Species

Classification: Endangered

**c. Review History:**

Recovery Data Call: 2010, 2009, 2008, 2007, 2006, 2005; 2004, 2003, 2002, 2001, and 2000

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

## **II. REVIEW ANALYSIS**

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

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

### **B. Recovery Criteria**

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

No. A technical draft recovery plan was prepared for the armored snail in 1994 (prior to the snail's listing in 2000), but did not provide criteria for the recovery of the species. As such, a priority should be made to complete and finalize a recovery plan for this species.

### **C. Updated Information and Current Species Status**

- a. **Biology and Habitat**

- a) **Biology and Life History:**

The armored snail is a small hydrobiid snail (usually less than 4 mm in length) (Thompson 1977 and Garner 2004a), with relatively little known about its life history and ecology. The armored snail is assumed to be an annual species like other similar hydrobiid species (P.D. Johnson, Alabama Department of Conservation and Natural Resources (ADCNR), pers. comm., 2008).

The armored snail is currently only known from Limestone and Piney Creeks, Limestone County, Alabama (Figure 1), and appears to be most abundant in submerged root masses and bryophytes (non-vascular land plants, e.g. mosses) along the creek edges, but also may occur on rocks and leafy/woody debris, and on other aquatic macrophytes (aquatic plants) (Garner 2004a, Haggerty and Garner 2007, 2008).

**b) Abundance/population trends, demographic features or trends:**

While Haggerty and Garner (2008) only collected qualitative samples during their latest status survey (August-September 2006, January 2007) in Limestone and Piney Creeks, they did roughly estimate catch per unit effort, and found the armored snail in relatively good numbers if suitable habitat was present. Of the 13 Limestone Creek sites surveyed during that study, nearly 70% (n=9) had the snail present, while Piney Creek had armored snails present at 3 of the 10 (30%) sites surveyed. All sites where snails were present contained approximately 10 to 50+ individuals (Haggerty and Garner 2007) and a mean catch per unit effort of 34 individuals/hour/observer (Haggerty and Garner 2008).

Haggerty and Garner (2008) did expand the number of collection locations considerably from what was reported by Garner (1993). In Limestone Creek, Haggerty and Garner (2008) found armored snails at two sites where Garner (1993) did not find it, and found six additional occupied sites not surveyed by Garner (1993); also, they discovered the snail at one additional site in Piney Creek.

In 2007, AST Environmental Group (AST) was contracted by Athens Utilities to perform a protected species / biological assessment consisting of 10 survey reaches in Piney Creek and Piney Creek tributaries, including French Mill Creek (a 2<sup>nd</sup> order tributary to Piney Creek) (AST 2007). In August and September of 2007, they collected armored snails within five of six Piney Creek sites and two of four French Mill Creek locations. Numbers of armored snails collected were similar to those of Haggerty and Garner (2008), with all sites containing approximately 10 to 50+ individuals.

**c) Genetics, genetic variation, or trends in genetic variation:**

No genetic work is known to have been conducted for the armored snail.

**d) Taxonomic classification or changes in nomenclature:**

The armored snail is a small snail of the family Hydrobiidae with the type locality for the species coming from Limestone Creek, 0.7 miles east of Mooresville, Limestone County, Alabama (Thompson 1977).

Thompson (1977) first described the armored snail as *Marstonia pachyta*, and distinguished this species of *Marstonia* from others in the genus by the characteristics of both its verge (male copulatory organ) and shell. The armored snail has two apical glands on the verge, where other closely related *Marstonia* (i.e., *Marstonia arga*) have a single apical gland (Haggerty and Garner 2008). The shell is readily identified by its ovate-conical shape, its shell thickness, and complete peristome (lip around the aperture of the shell). Other conical *Marstonia* tend to have a thinner and almost transparent shell, usually with an incomplete peristome (Thompson 1977, Hershler 1994). Hershler and Thompson (1987) reassigned the armored snail to the genus *Pyrgulopsis*, only to reverse that decision, after a subsequent study showed that eastern and western species assigned to *Pyrgulopsis* were generically separable based on anatomical characters to *Marstonia* (e.g. *Marstonia pachyta*) (Thompson and Hershler 2002).

The armored snail is also commonly referred to as armored marstonia and thick-shelled marstonia (Garner 2004a).

**e) Spatial distribution, trends in spatial distribution, or historic range:**

The armored snail has not been reported outside of Limestone or Piney Creek drainages and is believed to be endemic to the system (Haggerty and Garner 2008). Within Limestone Creek, the snail occurs within the lower 21 unimpounded kilometers (13 miles) (Figure 1), in total Limestone Creek is approximately 72 kilometers (44.7 miles long). Within Piney Creek, the armored snail is known to inhabit the lower 13 kilometers (8 miles) (Figure 1) of Piney Creek's 62 total kilometers (38.5 miles) (Garner 2004a, Haggerty and Garner 2007). While the snail remains viable in both Limestone and Piney Creeks, they appear to be more widely dispersed in Limestone Creek (Haggerty and Garner 2008).

In August and September of 2007, biologists with AST Environmental, collected armored snails from Piney Creek as well as French Mill Creek (a 2<sup>nd</sup> order tributary of Piney Creek), during a survey for Athens Utilities (AST 2007). AST reported finding armored snails in Piney Creek and French Mill Creek south of Highway 72 in Limestone County, Alabama (AST 2007). The population within French Mill Creek would be considered a new range extent, with armored snails inhabiting the lower 2.4 kilometers (1.5 miles) of the creek.

It has also been reported that the armored snail may also occur within Beaverdam Creek, Limestone County, Alabama. Dr. Stephanie Clark (Chicago Academy of Sciences, pers. comm., 2008) reported that Hydrobiid specimens that she collected from Beaverdam Creek (Clark 2007) may be a new population of the armored snail. Beaverdam Creek would have been confluent with Limestone Creek prior to the impoundment of Wheeler Reservoir. This record may prove to be an important range expansion, and should be examined further.

**f) Habitat or ecosystem conditions:**

The armored snail is found and appears to be most common in submerged roots, leaves, and bryophytes along the edges, submerged bryophytes growing on rocks in moderate current, and in water willow. They are also found in areas of slow to moderate flow in the submerged detritus, leaves, and tree rootlets along pool edges (Thompson 1974, FWS 1994, Haggerty and Garner 2007, 2008).

Limestone and Piney Creek lie within the Tennessee Valley District of the Interior Low Plateau Physiographic Province. The underlying geology in the two watersheds is primarily dominated by Tuscumbia Limestone in the lower reaches, and Fort Payne Chert in the middle and upper reaches (Figure 2). Some of the upper reaches within Limestone Creek also have exposed sediments of the Ordovician System (Haggerty and Garner 2008).

Haggerty and Garner (2007) attempted to roughly characterize and compare the general habitat conditions used by the armored snail in both creeks with the following 11 physical and chemical measurements: stream width, stream depth, stream velocity, temperature, dissolved oxygen, dissolved oxygen percent saturation, specific conductance, total hardness, calcium hardness, magnesium hardness, and pH. The mean depth ( $13.9 \pm 6.6$ ,  $13.4 \pm 4.7$  cm), width ( $0.77 \pm 0.5$ ,  $0.64 \pm 0.4$  m), and stream velocity ( $0.35 \pm 0.39$ ,  $0.18 \pm 0.30$  m/s) were similar between Limestone and Piney Creek, respectively. The water chemistry was also similar, with mean temperature ( $27.7$ ,  $26$  °C), dissolved oxygen ( $6.4$ ,  $4.2$  mg/l), dissolved oxygen percent saturation ( $77.3$ ,  $45.7$  %), pH ( $7.9$ ,  $7.5$  units), specific conductance ( $137$ ,  $128$   $\mu$ S/cm), total hardness ( $58$ ,  $59$  ppm), calcium hardness ( $43$ ,  $47$  ppm), and magnesium hardness ( $16$ ,  $12$  ppm), between Limestone and Piney Creek, respectively. Haggerty and Garner (2007) noted that a much more thorough analysis of the physiochemical parameters of the streams

throughout the year is needed, as well as specific measurements of the microhabitat.

#### **D. Five-Factor Analysis**

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

Human-related activities and development within the basin has continued to strain the snail's habitat and resources. Some of the threats include: habitat modification from increased development (commercial and residential), indiscriminate logging, agriculture (row crops and livestock), withdrawal of water, road and bridge construction, open cut trenching, and various other point and nonpoint pollution discharges. These impacts continue to increase as human activities expand outward from the cities of Huntsville, Madison, Decatur, and Athens into the Limestone and Piney Creek watersheds.

During the fiscal years 2006-2008, the Service consulted informally on 13 projects and formally on 1 project within the Limestone Creek drainage basin. The projects included: new cell phone towers, water/sewer line crossings, fill activities, stream relocation (tributary), a new residential subdivision, and an industrial development.

For example, the Army Corps of Engineers, recently, formally consulted with the Service on a Section 404 permit for a utility company, where the project called for 11 open-trench crossings in armored snail and slender campeloma (*Campeloma decampi*) habitat (i.e., Piney Creek, French Mill Creek) to install a series of water and sewer pipelines. The project did not rise to the level of jeopardy under the Endangered Species Act and resulted in the permitted take of 365 linear feet of habitat, though measures were taken to minimize impacts to the species.

The area surrounding Limestone and Piney creeks remains heavily agricultural (Figure 3) (e.g., cotton production, livestock, sod farming), potentially making the armored snail susceptible to pollution from agricultural pesticides and fertilizers, excessive irrigation, and sedimentation (Garner 1993, 2004b, Haggerty and Garner 2007). Cattle production may be the source of water impairment and pathogens (fecal coliform) in French Mill Creek (ADEM 2006).

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

The armored snail is not known to have any commercial value and overutilization has not been a problem. Based on the best available data,

overutilization is not believed to be a threat at this time. However because this snail potentially only lives one year and generally occurs in specific habitat, collection in general could be a threat to the small populations and could disturb natural reproduction. Therefore, we will continue working with partners in evaluating this threat.

**c. Disease or predation:**

Diseases of aquatic snails are for the most part unknown. No predators are currently reported or known for the armored snail, though some fish, like redear sunfish and freshwater drum, that coexist with the armored snail are known to predate on snails, and as such, may also forage on the armored snail.

**d. Inadequacy of existing regulatory mechanisms:**

The armored snail is afforded protections against take under Section 9 of the Endangered Species Act (ESA), and is also protected by the State of Alabama under their Invertebrate Species Regulation (Alabama Administrative Code 220-2-.98). While the armored snail may have species protections afforded it by both state and Federal governments, the majority of the people are unaware of its presence and protected status within the Limestone Creek drainage and fail to exercise any additional precautions.

Section 7 of the ESA requires Federal agencies to ensure that their activities, in consultation with the Service, are not likely to jeopardize the continued existence of listed species or adversely modify designated critical habitats. Even when Section 7 review is initiated on a Federal action, and the status and presence of the armored snail is identified prior to construction; measures are usually not taken unless the action rises to the level of formal consultation, which means that the action “may adversely affect” the species. One inadequacy of the ESA is that it does not restrict encroachment by development until the continued existence of the species is jeopardized, though multiple smaller actions may collectively magnify into larger problems.

The Clean Water Act (CWA) is the primary Federal law in the United States governing water pollution. One primary role of the CWA is to regulate the point source discharge of pollutants to surface waters. This is regulated by the permit process with a permit from the National Pollutant Discharge Elimination System (NPDES). The NPDES permit process in Alabama has been delegated by the Environmental Protection Agency to the Alabama Department of Environmental Management (ADEM). Currently ADEM requires that discharges not exceed state water quality standard (Alabama Administrative Code, Title 22, Section 22-22-1 et seq.)



Since there is no information on the species' sensitivity to common pollutants, Federal (e.g., CWA) and state water quality laws may or may not be protective of the armored snail.

Section 303d of the CWA requires each state to list its polluted water bodies and to set priorities for their clean up with a watershed restoration action plan called a "Total Maximum Daily Load" (TMDL) for each impaired water body. Currently portions of Limestone Creek and French Mill Creek (a tributary to Piney Creek) have been identified as impaired for water quality under Section 303d under the Clean Water Act. Limestone Creek has had total maximum daily loads (TMDLs) developed for low dissolved oxygen and siltation impairment and French Mill Creek has a TMDL for pathogens (fecal coliform) associated with pasture grazing.

Section 404 under the Clean Water Act regulates the discharge of dredged or fill material into waters of the United States, including wetlands. Any activities in waters of the United States are regulated under this program, and often include fill related to development, such as water resource projects, infrastructure development, and mining projects.

Section 26a of the TVA Act requires TVA's approval be obtained prior to the construction, operation, or maintenance of any dam, appurtenant works, or other obstruction affecting navigation, flood control, or public lands or reservations along or in the Tennessee River or any of its tributaries. Within the Limestone Creek drainage, TVA's Section 26a permits are usually applied for concurrently with the Army Corps of Engineers Section 404 permits.

While a single project (e.g., Section 404 or Section 26a permit) will usually not jeopardize the continued existence of armored snails, the collective encroachment on the armored snail's finite habitat may have a larger impact and is difficult to assess on a permit-by-permit case.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is intended to protect against "unreasonable human health or environmental effects." While pesticides are usually tested on standard biological test media (e.g., honey bees, daphnia, bluegill sunfish, rainbow trout, mice) for toxicity testing, this toxic information may not relate well to the armored snail. Commercial applicators must also be tested and permitted on the proper application of pesticides, but applicators may not necessarily be aware of the presence of the armored snail.

Regardless of the Federal or state regulatory mechanism, enforcement of these regulations is necessary to provide the intended protections. Quite often enforcement is inadequate.

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

Natural factors such as drought can potentially threaten the continued existence of the armored snail. Natural droughts can potentially have negative impacts on water quality (e.g. dissolved oxygen) and waste dissemination of point source discharges. Droughts may also reduce the amount of habitat available to the snail by dewatering habitat, and may also lead to direct mortality by stranding snails. Drought may also isolate sections of stream into stagnate pools.

Human-induced random events such as toxic spills within the drainage could also jeopardize the armored snail if pollutants are spilled within the drainage. The range of the armored snail is already reduced to two main creeks. A kill associated with a spill could potentially reduce the occupied range by half.

**E. Synthesis**

The existence of the armored snail continues to be threatened by its limited range and continued impacts to its habitat. Its range is limited to the Limestone Creek drainage, occupying the lower 21 kilometers of Limestone Creek, the lower 13 kilometers of Piney Creek, and has been recently discovered in the lower 2.4 kilometers of French Mill Creek (a tributary of Piney Creek). It may also occur within Beaverdam Creek, which was formerly confluent to Limestone Creek prior to the impoundment of Wheeler Reservoir, but this discovery is in the process of being confirmed. Because the armored snail is geographically isolated to the Limestone Creek drainage, catastrophic events such as spills or natural events (e.g. drought) could greatly reduce the geographic or genetic viability of the snail.

Habitat destruction or modification is presently the largest threat to this species. Agriculture and development continue to impact the quality of the stream as evidenced by sections of the range being listed as impaired under Section 303d of the Clean Water Act for low dissolved oxygen, pathogens (associated with pasture grazing), and sediment. The threat of development and the associated point and non-point discharges increase within the basin as human activities migrate out from the growing cities of Huntsville, Madison, Decatur, and Athens. Presently forested lands and agriculture (present and historic) fields are increasingly becoming converted to commercial or residential developments.

Based on the preceding information in this review, we believe that downlisting the armored snail from endangered to threatened, or reassigning a new recovery priority number is not warranted at this time. This is based on our limited knowledge of the species' life history, its limited distribution, and potential threats to its habitat.

### III. RESULTS

**A. Recommended Classification:** No change is needed

### IV. RECOMMENDATION FOR FUTURE ACTIONS

More frequent monitoring of this species and habitat conditions should be performed. Prior to the status survey of Haggerty and Garner (2007, 2008), no extensive surveys had been conducted in more than a decade. More surveys (outside and inside of the basin) are needed to search for new populations or habitat. Surveys of tributaries of both Limestone and Piney Creeks may identify important source populations if a species kill should occur within either of the two creeks.

Genetic analyses need to be conducted on the armored snail and with other closely related species within Limestone and Piney Creeks and adjacent drainages.

A outreach program aimed at educating farmers, developers, and other landowners along Limestone and Piney creeks about good land use practices and water conservation should be implemented (Garner 2004a).

Specific life history and habitat needs for the armored snail have not been well documented. More research is needed to document life history and habitat needs, including toxicological information on similar species, as the creeks may face more pollution as humans encroach upon the habitat.

Future recommended actions include:

- a) Complete and finalize a recovery plan for this species.
- b) Conduct quantitative surveys within known habitats; survey the tributaries of both Limestone and Piney creeks for occurrences, and survey additional creeks within northern Alabama for additional populations.
- c) Develop a contingency plan for response to a spill or natural disaster within occupied snail habitat.
- d) Develop partnerships and utilize conservation initiatives with landowners along the riparian habitats and within the recharge zone of the Limestone and/or Piney Creek basins.
- e) Conduct genetic work to draw comparisons between closely related species within the known range of the armored snail, and examine the genetics of the *Marstonia* species within the adjacent Beaverdam Creek.

- f) Provide public outreach and education in regards to the armored snail to property owners and farmers along the creeks.
- g) Pursue opportunities including land acquisition, conservation easements, etc. to secure creek habitat.
- h) Conduct a detailed analysis of habitat requirements, including physicochemical parameters of the stream and more specific measurements of the microhabitat used by the snail.
- i) Develop propagation techniques.
- j) Conduct life history studies.

## V. REFERENCES

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**Peer-Reviewers**

Mr. Jeffrey T. Garner  
Alabama Department of Conservation and Natural Resources (ADCNR), Florence, AL

Mr. Chuck Howard  
TVA, Knoxville, TN

Dr. Stephanie Clark  
Chicago Academy of Sciences, Chicago, IL

Dr. Paul D. Johnson  
ADCNR, Alabama Aquatic Biodiversity Center, Marion, AL

**Provided new/updated information**

Mr. Jeffrey T. Garner  
Alabama Department of Conservation and Natural Resources, Florence, AL

Dr. Thomas Haggerty  
University of North Alabama, Florence, AL

Dr. Stephanie Clark  
Chicago Academy of Sciences, Chicago, IL

Dr. Paul D. Johnson  
ADCNR, Alabama Aquatic Biodiversity Center, Marion, AL

Mr. Jeff Selby  
AST Environmental Group, LLC, Decatur, AL

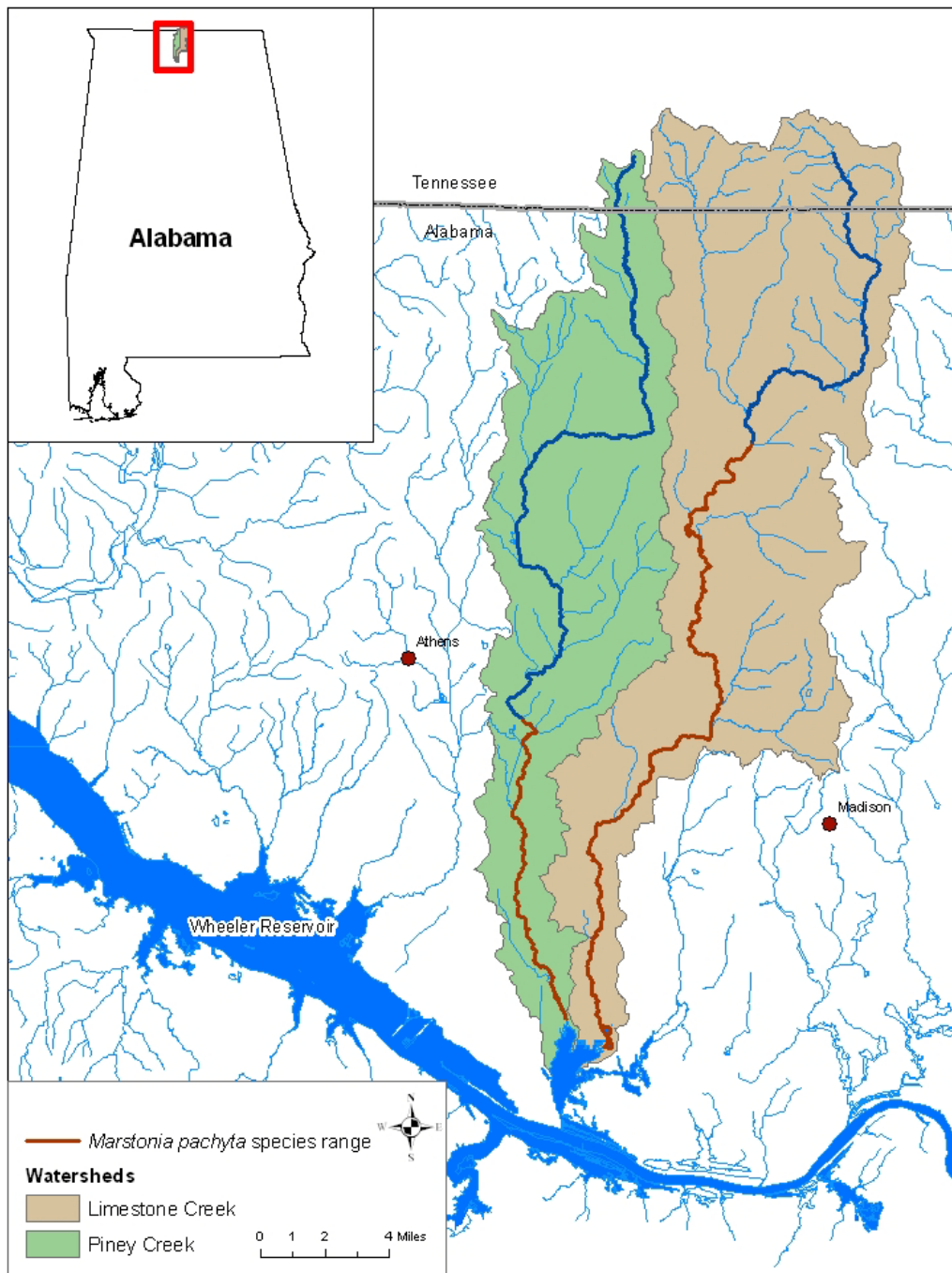


Figure 1: Range of the armored snail (*Marstonia pachyta*). Map created by U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama.

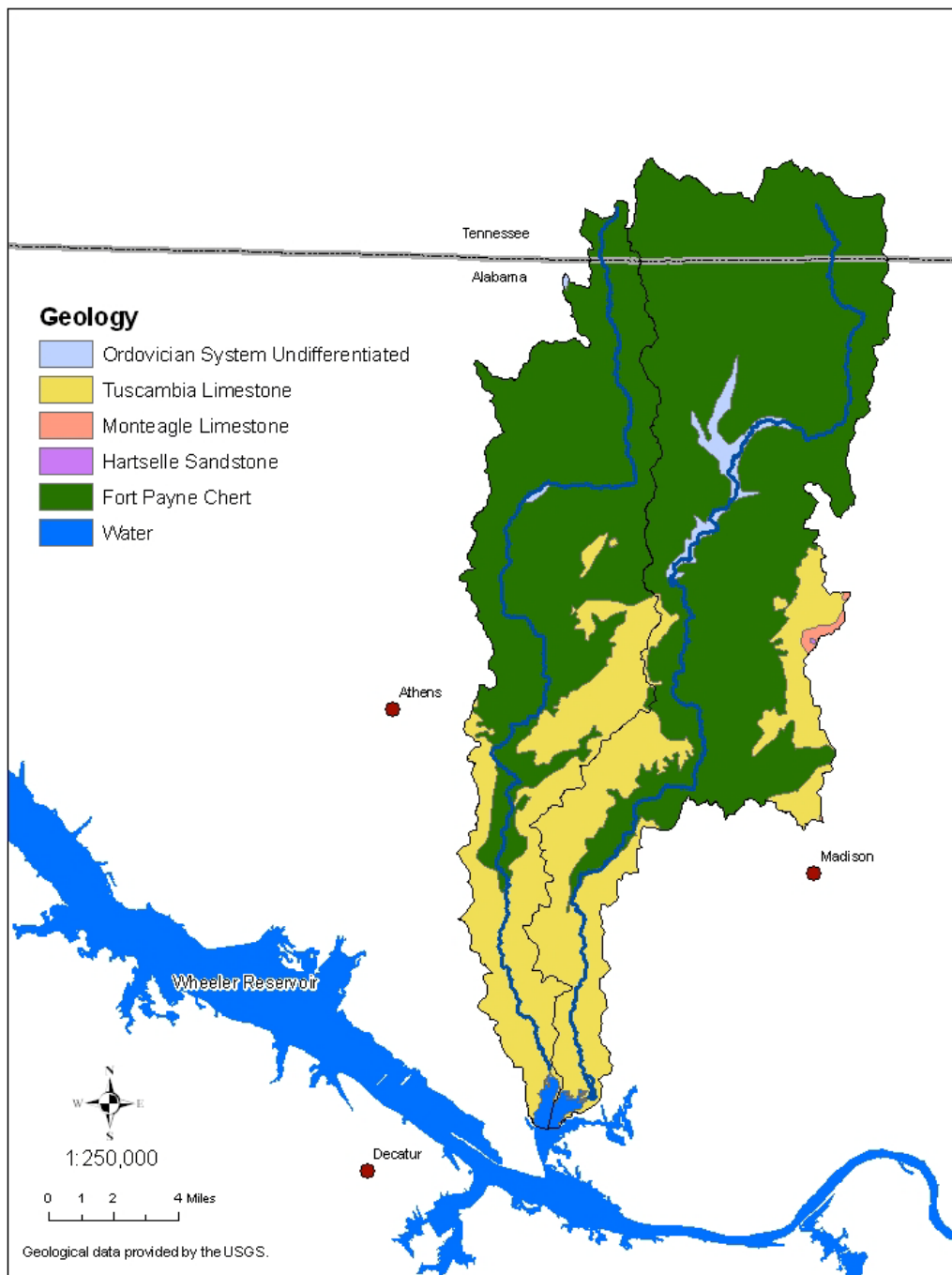


Figure 2: Geology within Limestone and Piney Creek Drainages, Alabama. Map created by U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama.



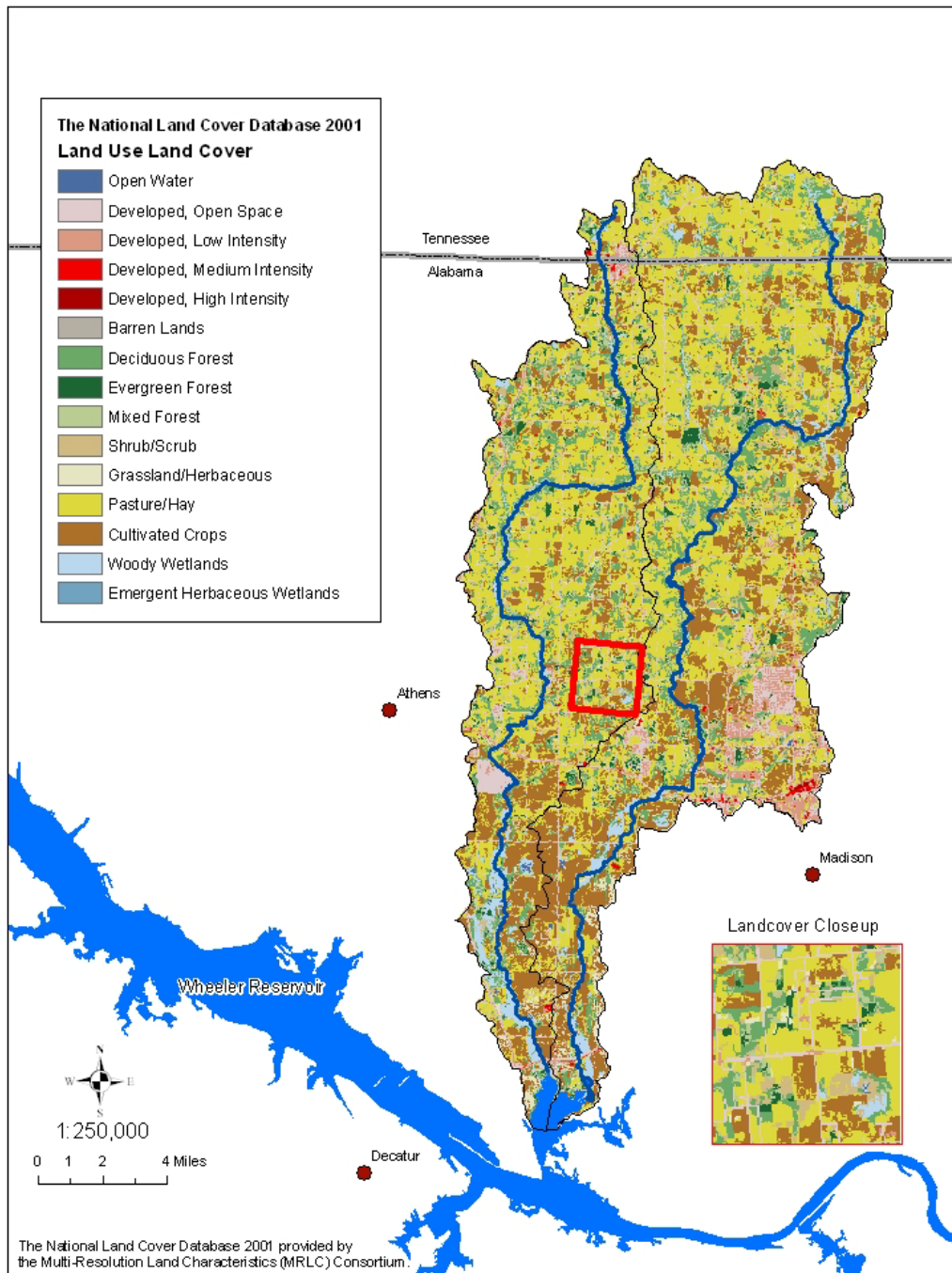


Figure 3: Land-use cover (2001 data) within the Limestone and Piney Creek Drainages, Alabama. Map created by U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama.

**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of the Armored Snail (*Marstonia pachyta*)**

**Current Classification:** Endangered

**Recommendation resulting from the 5-Year Review:**

  X   No change needed

**Review Conducted By:** Anthony D. Ford and Jeffrey R. Powell, Alabama Field Office

**FIELD OFFICE APPROVAL:**

**Lead Field Supervisor, Fish and Wildlife Service**

Approve  Date 9/20/2010

*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.*

**REGIONAL OFFICE APPROVAL:**

*The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.*

<sup>for</sup>  
**Lead Regional Director, Fish and Wildlife Service**

Approve  Date 9-22-10

*The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. Written concurrence from other regions is required.*

## **APPENDIX A: Summary of peer review for the 5-year review of the Armored Snail (*Marstonia pachyta*)**

**A. Peer Review Method:** see below

### **B. Peer Review Charge:**

Requests were made to peer reviewers on the 5-year review via personal phone conversation (Ms. Peggy Shute, TVA, Knoxville, TN and Mr. Jeff Garner, ADCNR, Florence, AL) and email request (Dr. Stephanie Clark, Chicago Academy of Sciences, Chicago, IL and Dr. Paul Johnson, ADCNR, Marion, AL). Peggy Shute assigned responsibilities of the peer review to TVA Heritage Program, malacologist, Mr. Chuck Howard.

We chose peer reviewers based on the expertise that each of them possess and the broad ranging knowledge that they could offer in giving a complete and thorough review. Each reviewer was asked to give a complete review with focus on areas of personal expertise.

Mr. Garner is the mussel management supervisor and malacologist for ADCNR and has direct survey experience and expert knowledge of the armored snail. Mr. Howard is a malacologist with TVA's Heritage Program. TVA is a Federal resource agency with expertise of the Tennessee River basin and they also maintain an extensive database on the natural history and species occurrences. Dr. Johnson is the program supervisor of the ADCNR's Alabama Aquatic Biodiversity Center (AABC) and is a recognized snail expert. Dr. Johnson also has broad ranging knowledge and experience in snail propagation and reintroduction. Dr. Clark is an experienced malacologist with expertise working with species in the family Hydrobiidae, in particular Alabama species. Dr. Clark is currently with the Chicago Academy of Sciences, but previously worked at the University of Alabama with snails of the state.

### **C. Summary of Peer Review Comments/Report**

Mr. Jeff Garner, ADCNR, Florence, AL: Majority of comments were editorial corrections/suggestions.

Dr. Paul Johnson, ADCNR, Marion, AL: Dr. Johnson supported the assumption that the armored snail is an annual species by saying that other Hydrobiids he worked with die soon after egg laying with few individuals surviving more than one year. Dr. Johnson also supported (and suggested elevating the priority of) development of a contingency plan for a spill, and further suggested that it be incorporated into the recovery plan. Dr. Johnson also suggested additional editorial corrections/suggestions.

Dr. Stephanie Clark, Chicago Academy of Sciences, Chicago, IL: Dr. Clark remarked that she thinks that a population of armored snail likely occurs in Beaverdam Creek and should be included in the possible range of the species. Dr. Clark supports this by referencing the *Marstonia* localities surveyed for the Hydrobiidae report (Clark 2007) for

Alabama. She also suggested that a future action for the armored snail needs to be genetic surveys for comparisons of closely related species.

Mr. Chuck Howard, Tennessee Valley Authority, Knoxville, TN: Mr. Howard verified the current and historical range was complete and had no additions to the texts.

#### **D. Response to Peer Review**

Mr. Jeff Garner, ADCNR, Florence, AL: Agreed with all comments and incorporated.

Dr. Paul Johnson, ADCNR, Marion, AL: Evaluated all comments received in relation to the status review / threat evaluation for the armored snail, and incorporated those where appropriate.

Dr. Stephanie Clark, Chicago Academy of Sciences, Chicago, IL: While we do not currently list Beaverdam Creek as a range extension for the armored snail, we agree that this record should be further investigated, and additional surveys and genetic work should be performed. We agreed with other comments and incorporated.

Mr. Chuck Howard, Tennessee Valley Authority, Knoxville, TN: No response is required as no additions/comments were suggested to the text.