

# **A PLAN FOR THE POPULATION RESTORATION AND CONSERVATION OF FRESHWATER MOLLUSKS OF THE MOBILE RIVER BASIN**

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The Mobile River Basin Mollusk Restoration Committee represents a group of state, federal, and non-governmental natural resource organizations that developed this document over a period of several years. The committee grew out of a corps group of individuals that attended the annual Alabama Department of Conservation and Natural Resources and the Tennessee Wildlife Resource Agency rare mollusk recovery meetings.

## TABLE OF CONTENTS

Introduction	1
Goals and Objectives	2
Justification for Controlled Propagation, Reintroduction, and Augmentation	3
Partners	4
Definitions	4
Protocols of Controlled Propagation	5
Population Reintroduction or Augmentation	6
Species prioritization	6
Species accounts	7
Population R/A opportunities	7
Permits	7
Site R/A plan	7
Stream selection	8
Source population selection	9
Monitoring	9
Reporting	10
Disposition of Excess Progeny From Research Activities	10
Regulatory and Voluntary Options	10
Experimental population designation	10
Safe harbor agreements	11
Plan Review	11
Literature Cited	12
Appendix I: Recovery Partner Contacts	13
Appendix II: Mobile River Basin Priority Mollusk Species	16

Appendix III: Mobile River Basin Priority Mollusk Species Accounts	18
Mussel Species Accounts	22
Snail Species Accounts	48
Appendix IV: List of Priority Reintroduction Localities	78
Appendix V: Example Site Plan	83
Appendix VI Recovery Activity Reporting Form	86
Appendix VII: Considerations in the Development of a Genetics Plan	89
Appendix VIII: State requirements for R/A activities	91

## **PLAN FOR THE POPULATION RESTORATION AND CONSERVATION OF FRESHWATER MOLLUSKS OF THE MOBILE RIVER BASIN**

### **INTRODUCTION**

The Mobile River Basin (MRB) historically supported the most diverse freshwater mollusk assemblage in the western hemisphere, if not the world (Neves et al., 1997, U.S. Fish and Wildlife Service {FWS}, 2000b, Mobile River Basin Aquatic Ecosystem Recovery Plan, Atlanta, GA, Williams et al., 2008). In an extinction event unparalleled in the history of the United States, many of these endemic mussels and snails have disappeared within the past few decades. At least 17 mussels and 37 aquatic snails that once occurred in the MRB are presumed extinct. Unfortunately, the faunal decline continues as another 17 mussels and 7 snails in the MRB are listed as endangered or threatened under the Endangered Species Act (ESA) of 1973, as amended (Appendix IIA and IIB), and an additional 35 snails and mussels (mollusks) are species of concern that may require the protection of the Act in the near future (FWS 2000b, 2005). Because engineering changes to the MRB prevent natural avenues of immigration and emigration, many mollusks will require population management and manipulation to prevent extinction, return genetic flow between isolated populations, and reintroduce species to restored or recovered habitats. The FWS policy regarding controlled propagation of listed species under the ESA requires the development of a reintroduction plan prior to the release of propagated endangered and threatened species into the wild (FWS 2000a - 65 FR 56916).

This plan details initial actions and efforts necessary for conducting reintroduction and augmentation activities with 26 species of freshwater mussels and 30 species of freshwater snails in the MRB. This number includes 21 federally listed and candidate mollusks (13 mussels and 9 snails) deemed imperiled within the MRB. The total comprises many extant species endemic to the MRB but omits some widespread species that may be regionally imperiled but appear secure in other portions of their range.

The FWS has recently implemented Strategic Habitat Conservation (SHC) to effectively manage federal trust resources and their habitats at the landscape scale. The five elements of conservation biology that collectively comprise SHC include biological planning, conservation design, conservation delivery, assumption-based research and outcome-based monitoring. Although the Plan addresses issues under each of the facets of SHC, a companion document is

being prepared by partners to specifically apply imperiled mollusk population restoration in the Basin within the components of SHC.

## **GOAL AND OBJECTIVES**

The goal of this plan is to provide a framework for the restoration of freshwater mollusk resources and their ecological functions to appropriate reaches of the MRB through the reintroduction, augmentation (R/A) and controlled propagation of priority mollusks. The Plan prioritizes conservation, propagation, and R/A activities for MRB mollusks and provides guidelines for resource managers and recovery partners. The plan is not a legal document and does not replace or supersede any published recovery plans for listed mollusks.

*The objectives of this plan are to:*

- 1) Comply with the FWS controlled propagation policy for federally listed species (FWS & NMFS 2000a)
- 2) Establish basic protocols for propagating imperiled mollusks
- 3) Ensure communication and coordination among partners prior to R/A actions
- 4) Recommend a prioritization of mollusk species for R/A actions
- 5) Recommend priority R/A and related conservation actions for these species
- 6) Identify and prioritize stream reaches where potential exists for successful restoration actions
- 7) Identify existing federal and state requirements for permitting R/A actions
- 8) Consider and identify alternative R/A activities involving federally listed mollusks (i.e. *alternative analysis*, FWS & NMFS 2000a)

*Specific activities that are not covered under this plan:*

- 1) The document is not intended to be a formal recovery plan and does not carry legal status. Periodic updates to the plan will be required as species and habitat status in the MRB change (approximately every 5 years).
- 2) The plan is not intended to provide technical guidance for propagation and R/A activities.
- 3) The plan cannot answer all specific management needs for each species. Management guidelines will develop as propagation, R/A activities, and basic research progress. Specific management objectives for each R/A locality will begin to be addressed in the site plan.

## **JUSTIFICATION FOR CONTROLLED PROPAGATION, REINTRODUCTION, AND AUGMENTATION OF FRESHWATER MOLLUSKS**

The Mobile River Basin Aquatic Ecosystem Recovery Plan (Basin Recovery Plan) (FWS 2000b, 2005) summarizes threats to aquatic species of the MRB and outlines recovery tasks necessary to protect and recover them. The major obstacle to recovery of mollusks and other imperiled fauna in the MRB is the fragmentation of riverine habitats by dams and impounded waters. Most imperiled mollusks now occupy a few localized stream reaches and are sometimes restricted to a single site. Some isolated stream reaches where mollusks were extirpated due to historic pollution events or other causes have improved to a degree that mollusks may now persist. However, dams and impoundments prevent re-colonization and gene-flow through the processes of immigration and emigration. In addition, some species have become exceedingly rare, with low reproductive and recruitment success. These species often require extensive efforts to locate in the wild for recovery efforts. Isolated mollusk populations are also threatened by inbreeding depression and stochastic events. Other complications include lack of knowledge concerning the life history requirements of mollusks, particularly mussel host fishes. Because of these conditions human intervention is required to manage, and restore populations of imperiled mollusks in the MRB, including:

1. Develop technology and culture facilities for holding endangered and threatened mollusks
2. Produce individuals through captive propagation for research and technology development
3. Produce individuals for reintroduction of species into restored or recovered habitats
4. Maintain captive populations of critically endangered mollusks
5. Produce individuals for augmenting existing populations
6. Translocation of adults for R/A

Since the mid 1990's, the FWS has been working with state and private partners to locate populations of imperiled mollusks in the MRB, and develop appropriate protocols and facilities for holding and propagation. As a result, progeny of several federally protected and other imperiled mollusks are being produced in culture facilities in sufficient quantities to initiate limited, controlled releases of propagated species into improved riverine habitats.

## **PARTNERS**

State and federal agencies and private conservation partners have been cooperating in developing holding and propagation technology for several imperiled species (a list of mollusk conservation partners can be found in Appendix I). Basin mollusks are currently held and propagated for research and recovery efforts at facilities in accordance with various recovery plan objectives and FWS controlled propagation policy for federally protected species (FWS 2000a, FWS 2000b). Participation by state natural resource agencies in the restoration of federally listed species in state waters is established under current Section 6 agreements with the FWS. In addition to existing FWS policy, some states may also have additional requirements for working with imperiled mollusks. A summary of these state requirements are listed in Appendix VIII.

## **DEFINITIONS**

*Alternatives Analysis* – A consideration of recovery options (e.g., direct translocation, controlled propagation, do-nothing, habitat restoration) prior to initiating R/A actions.

*Ark Population* - A temporary or permanent population of a species established for the purpose of preserving genetic stock. Such a population could be captive or maintained in the wild.

*Augmentation* – Addition of individuals to an existing population. Augmentation potentially increases the likelihood of population success for reproduction, host infection (mussels) and ultimately successful recruitment within sparsely occupied habitat. It may be used to expand the range of a species within habitats accessible to existing populations, reducing the likelihood of extirpation due to localized catastrophic events.

*Brood stock* – Adult mollusks from which juveniles are propagated.

*Controlled propagation* - The production of individuals within a managed environment. Propagated individuals can be used for research purposes or for *reintroduction* or *augmentation* to support recovery efforts.

*Recruitment* - Incorporation of juveniles into a population as a result of successful reproduction.



*Reintroduction* - The release of mollusks into a historically-occupied stream reach where the species no longer occurs, and where natural immigration from extant populations is unlikely to occur. Reintroductions may be accomplished by translocation of adults from extant populations or through the release of hatchery-propagated individuals. Reintroductions should be supplemented for multiple years to determine if conditions are appropriate for survival, reproduction and recruitment. A reintroduction will be considered successful only if natural recruitment occurs. As defined herein, a reintroduction may include the introduction of adults or progeny into a stream for which there is no prior record of the species' occurrence as long as the stream is located within historical range.

*Source population* - Origin from which translocated mollusks or brood stock originate.

*Species complex* - A morphologically, ecologically, and/or biologically variable "species" that putatively consists of more than one species.

*Translocation* - Moving individuals from one site to another.

## **PROTOCOLS OF CONTROLLED PROPAGATION**

Any parties wishing to conduct controlled propagation of imperiled mollusks should present a detailed plan to the FWS and/or the appropriate state agency(ies) outlining their expertise, facilities and methodology, species to be propagated, brood stock source, disposition of progeny, etc.(such a plan is mandatory for federally protected species and should comply with the FWS Policy for Controlled Propagation of Species Listed Under the Endangered Species Act (65 FR 183: 56917)), and include the following:

1. Justification for the work, including benefits
2. All necessary state and federal permits
3. All necessary precautions to prohibit the potential introduction or spread of diseases and parasites into controlled environments or suitable habitat
4. All activities should be conducted in a manner that will prevent the escape or accidental introduction of individuals outside of their historical range
5. A certain number of propagated individuals should be preserved for genetic analyses

6. Detailed notes and records should be kept of life history observations, fecundity, survival and mortality, water chemistry, seasonality, and any other conditions/observations important to successful propagation of these species

### **POPULATION REINTRODUCTION OR AUGMENTATION**

R/A is accomplished through the release of cultured progeny from the closest genetic stock or through the translocation of adults (see *brood stock* and *source population* selection criteria below and genetics considerations – Appendix VII). Such activities have not been conducted for many of these species, and are considered individual experiments.

*Reintroduction* is intended to reestablish populations, provide genetic refugia, and reduce the potential of extinction due to catastrophic events. The potential for genetic swamping is also less of an issue in reintroductions.

*Augmentation* may be appropriate when necessary to maintain a population at a given location. Augmentation carries some risk of disease introduction (an unknown but apparently low risk with mollusks – Grizzle and Brunner 2007) and/or possible genetic swamping (Appendix V).

The ability to propagate any species will always be resource limited (e.g., time, money, brood stock availability, space). Reintroduction will be the preferred recovery option for most species because:

- 1) Augmentation does not increase the number of populations and therefore is less likely to move a federally protected species towards downlisting or delisting
- 2) Augmentation will not address recruitment failure if driven by habitat loss
- 3) Reintroduction carries little apparent risk to existing populations
- 4) Success of effort is easier to document for reintroductions than with augmentations

### ***Species Prioritization***

Species have been prioritized for R/A according to degree of imperilment, distribution, and magnitude and imminence of threats (Appendix II). These prioritizations are subjective based on current understanding of the following factors. Categories are defined as:

**Tier 1:** Taxa facing imminent extinction or extirpation from the MRB. These generally included 1) critically imperiled federally listed species endemic to the MRB and 2) taxa reduced to a few ( $\approx 5$  or fewer) populations globally.

**Tier 2:** Taxa threatened with extinction or extirpation from the MRB. These generally include 1) a mix of federally listed species and MRB endemics reduced to a few populations ( $\approx$  10 or fewer), 2) species that may be jeopardized by significant habitat degradation.

**Tier 3:** Taxa that have experienced significant known decline in range and abundance or are threatened with extirpation from the MRB. These generally include 1) endemic species 2) wide ranging species that are peripheral and/or declining or extirpated from the MRB and 3) species declining due to habitat degradation.

### ***Species accounts***

Appendix III contains individual species accounts for each tier of imperiled species prioritized herein. These accounts include information specific to propagation and translocation options. An explanation of information fields within each species account is defined in the first pages of Appendix III.

### ***Population R/A opportunities***

Currently, there appear to be a limited number of streams in the MRB that are apparently suitable for population R/A efforts. The best options are prioritized in the Species Accounts section (Appendix III). These priority streams were selected with various goals and criteria established in individual species accounts. Additional streams may become physically capable of supporting imperiled populations in the future. Mollusk populations in some stream reaches may require augmentation to reach critical levels required for reproduction and recruitment. A comprehensive list of priority reintroduction localities is summarized in Appendix IV.

### ***Permits***

The ESA requires individuals to acquire Section 10 Recovery Permits in order to collect, propagate, or conduct research, including R/A activities on federally protected species. Other federal agencies may also require Special Use permits prior to collecting on their lands and consultation with these agencies (i.e. USFS, NPS) when conducting R/A activities with federally listed species. State permits are also required to collect any native species or conduct R/A activities. Permit requirements and contacts for various MRB states are provided in Appendix VIII.

**Site R/A plan**

Partners wishing to plan, sponsor, or conduct specific R/A actions with federally protected species will produce a R/A plan (site plan) prior to conducting any activities. Site plans for potential R/A activities will be developed and distributed to the appropriate FWS and state offices at least 20 days prior to release. It is understood that collection of gravid females, successful production of progeny, number of progeny produced, etc. is difficult to predict. Site plans should include as much information as possible, including:

1. Species priority
2. The location where animals are to be introduced
3. Status of the target species at the site, and why R/A is necessary
4. *An Alternatives Analysis*
5. Relationship of the R/A site to other populations of the target species
6. Current habitat conditions at the R/A site
7. Possible limiting factors at the R/A site
8. Source of the animals for R/A (adults, juveniles, hatchery-produced, or wild)
9. Source of the stock (location and drainage)
10. Monitoring plan and responsibilities
11. Cooperating and responsible partners
12. Copies of all appropriate permits, and other pertinent information

An example of a completed site plan is presented in Appendix IV. Site plan information should be summarized in the Mollusk Propagation, Reintroduction, Augmentation Reporting form provided in Appendix V.

**Stream selection**

Streams for augmentation activities or reintroduction should be selected based on consideration of historical and current distribution of the species; habitat conditions; past, present or future threats; and ongoing habitat conservation efforts in the drainage. All R/A efforts for a species within a particular drainage should be focused on limited sites until conditions adequate for survival are verified. If habitat is found to be adequate for survival, the population should be augmented and monitored for a period of 10 years or until there is evidence of natural recruitment. Concentrating efforts at fewer sites will reduce risks, monitoring efforts, and will facilitate genetic modeling. See monitoring section for minimum monitoring recommendations.

**Source population selection:**

Source populations for brood stock or translocation for R/A activities should be carefully considered if more than one population is available. To the greatest extent feasible, animals used in R/A activities should come from or be progeny of brood stock from a population nearest in drainage distance to the R/A site. Selection should follow these priorities:

1. A population in the same stream/tributary system in the same physiographic province
2. A population in an adjacent stream/tributary system in the same physiographic province
3. A population in an adjacent stream/tributary system in an adjacent physiographic province
4. No more than 5% of the source population should be removed for translocation

Proper consideration of genetic impacts on recipient and donor populations should be made prior to any R/A activities (Jones et al. 2006 – see summary table in Appendix VII). Very little is known of genetic differences among mollusk populations across drainages as they relate to expressions in morphology, behavior, and other forms of habitat adaptation. In order to avoid potential inbreeding effects, it is preferred that propagated juveniles from an individual female mussel be used only once per site. Gravid mussels used to produce juveniles for stocking will be uniquely marked and returned to the point of capture or other approved release sites. Subsequent releases should come from appropriate wild mussel stock whenever possible. Snail brood stock should be used only for a single breeding season, marked, and returned to point of capture. Subsequent adult snail breeding stock will be selected from a different shoal, if possible.

**Monitoring**

The party conducting the release is responsible for implementing a monitoring schedule, which is specified in the site plan. Because R/A strategies are under development, routine monitoring is critical to determine success. The following are minimum recommendations since each R/A activity and may require tailored monitoring plans. Monitoring reports will be prepared and distributed to appropriate state and federal agencies

1. Mussels – annual monitoring for 3 years beginning the 3<sup>rd</sup> year after release, triennially thereafter for 6 years
2. Snails - annual monitoring for 3 years after release and again during year 5

If it is determined the survival of a population is precluded by current habitat conditions, the R/A should be discontinued and appropriate agencies notified. If an alternate site is available, a new site plan should be modified accordingly.

### ***Reporting***

Recovery partners conducting propagation studies, R/A releases, or monitoring studies will provide an annual report of activities to the FWS and appropriate state agencies, including:

1. A brief description of their propagation and/or R/A program, including objectives and status
2. List of cooperators
3. Activities conducted, research accomplished, propagation or reintroduction efforts achieved
4. A brief description of the status of R/A populations
5. A completed R/A activities form(s) as presented in Appendix IV

In the future, data will be compiled in an R/A data repository and made available to all partners.

### **DISPOSITION OF EXCESS PROGENY FROM RESEARCH ACTIVITIES**

Propagation efforts or host fish trials may result in excess juvenile mussels or snails. Excess cultured offspring should be considered for:

1. R/A releases (with appropriate site plan)
2. Toxicity testing
3. Other existing experimental needs
4. Archival at an appropriate institution for future genetic analyses

### **REGULATORY AND VOLUNTARY OPTIONS**

#### ***Experimental population designation***

Section 10(j) of the ESA requires the Service to designate the release of any population of a listed species outside of its current range as either an essential or non-essential experimental population if the location of release is wholly separate geographically from existing populations. Due to their small geographic range and the contiguous nature of the riverine ecosystem, all reintroductions conducted within the drainages where listed mollusks historically occurred are considered within their current geographical range and are not appropriate for an experimental designation. Experimental population designation will only be considered if releases are

proposed outside the historical range of the species. No such reintroductions are currently being considered.

***Safe harbor agreements***

Safe Harbor Agreements (SHA) are voluntary arrangements between the FWS and cooperating non-Federal landowners intended to promote voluntary management for listed species on non-Federal property. Under a SHA, the landowner must conduct activities or manage lands in such a way as to provide a net conservation benefit to listed species; in return, the participating landowner is assured that no additional future regulatory restrictions will be imposed. A SHA results in the issuance of a permit to the landowner authorizing any necessary future incidental take that may occur as a result of their conservation actions. Also, the permit allows the landowner to take any covered species that are above the baseline as an incidental consequence of otherwise lawful activity. At this time, most, if not all foreseeable R/A activities will occur within State-owned waters where current land use activities are compatible with survival of mollusk species.

**PLAN REVIEW**

This plan is a working document subject to modification based on results of current and future research, survey, and recovery activities involving mollusk propagation, augmentation, or reintroduction. Recovery partners will review the Plan as needed and incorporate new information, protocols, etc. as they become available for species herein included (provide comments to Paul Hartfield, FWS, Jackson, MS or Paul Johnson, ADCNR, Marion, AL). Current contact information for partners is presented in Appendix I, and regulatory requirements for each state are presented in Appendix VIII.

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**Appendix I.** A list of current federal, state, and private Mobile River Basin mollusk conservation and recovery partners.

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**Appendix II-A.** List of mussels considered to be conservation priorities in the Mobile River Basin. Tier assignments generally reflect the degree of immediate imperilment for each taxon. Taxon with high R/A potential are denoted with an asterisk (\*).

#	Taxon	G Rank	Federal Status
<b>Tier 1:</b>			
1.	<i>Epioblasma penita</i> , Southern Combshell	G1	Endangered
2.	<i>Ligumia recta</i> , Black Sandshell	G4	
3.	<i>Margaritifera marrianae</i> , Alabama Pearlshell	G1	Candidate
4.	<i>Medionidus parvulus</i> , Coosa Moccasinshell	G1	Endangered
5.	<i>Pleurobema atearni</i> , Canoe Creek Pigtoe	G1	
6.	<i>Pleurobema hanleyianum</i> , Georgia Pigtoe	G1	Candidate
7.	<i>Pleurobema rubellum</i> , Warrior Pigtoe	G1	Endangered
8.	<i>Pleurobema taitianum</i> , Heavy Pigtoe	G1	Endangered
<b>N = 8</b>			
<b>Tier 2:</b>			
9.	<i>Elliptio arca</i> , Alabama Spike	G2	
10.	<i>Elliptio arctata</i> , Delicate Spike	G2	
11.	<i>Medionidus acutissimus</i> , Alabama Moccasinshell *	G2	Threatened
12.	<i>Obovaria jacksoniana</i> , Southern Hickorynut	G2	
13.	<i>Obovaria unicolor</i> , Alabama Hickorynut	G1	
14.	<i>Pleurobema georgianum</i> , Southern Pigtoe	G1	Endangered
15.	<i>Ptychobranhus foremanianus</i> , Alabama Kidneyshell	G1	
16.	<i>Ptychobranhus greenii</i> , Triangular Kidneyshell *	G1	Endangered
17.	<i>Strophitus connasaugaensis</i> , Alabama Creekmussel *	G3	
18.	<i>Toxolasma corvunculus</i> , Southern Purple Lilliput *	G1	
<b>N = 10</b>			
<b>Tier 3:</b>			
19.	<i>Amblema elliottii</i> , Coosa Fiveridge	G3	
20.	<i>Anodontoides radiatus</i> , Rayed Creekshell *	G3	
21.	<i>Hamiota altilis</i> , Finelined Pocketbook *	G2	Threatened
22.	<i>Hamiota perovalis</i> , Orangenacre Mucket *	G2	Threatened
23.	<i>Lasmigona etowaensis</i> , Southern Toesplitter *	G2	
24.	<i>Pleurobema decisum</i> , Southern Clubshell	G2	Endangered
25.	<i>Pleurobema perovatum</i> , Ovate Clubshell	G1	Endangered
26.	<i>Potamilus inflatus</i> , Alabama Heelsplitter *	G1	Endangered
<b>N = 8</b>			

The following MRB federally listed mussels were not included in this prioritization because they are likely extinct.

*Epioblasma metastrata*, Upland Combshell, *Epioblasma othcaloogensis*, Southern Acornshell  
*Pleurobema curtum*, Black Clubshell, *Pleurobema marshalli*, Flat Pigtoe, *Quadrula stapes*, Stirrupshell

**Appendix II-B.** List of snails considered to be conservation priorities in the Mobile River Basin. Tier assignments generally reflect the degree of immediate imperilment for each taxon. Taxon with high R/A potential are denoted with an asterisk (\*).

#	Taxon	G Rank	Federal Status
	<b>Tier 1:</b>		
1.	<i>Antrorbis breweri</i> , Manitou Cavesnail	G1	
2.	<i>Clappia cahabensis</i> , Cahaba Pebblesnail *	G1	
3.	<i>Elimia bellacrenata</i> , Princess Elimia *	G1	
4.	<i>Elimia cochliaris</i> , Cockle Elimia *	G1	
5.	<i>Elimia crenatella</i> , Lacy Elimia	G1	Threatened
6.	<i>Elimia lachryma</i> , Teardrop Elimia	G1	
7.	<i>Elimia vanuxaminana</i> , Cobble Elimia	G1	
8.	<i>Leptoxis foremani</i> , Interrupted Rocksnail	G1	Candidate
9.	<i>Leptoxis plicata</i> , Plicate Rocksnail	G1	Endangered
10.	<i>Lepyrium showalteri</i> , Flat Pebblesnail *	G1	Endangered
11.	<i>Lioplax cyclostomaformis</i> , Cylindrical Lioplax	G1	Endangered
12.	<i>Marstonia</i> sp., Cahaba Pyrg	G1	
13.	<i>Pleurocera foremani</i> , Rough Hornsnail *	G1	Candidate
14.	<i>Pseudotryonia grahamae</i> , Salt Spring Hydrobe	G1	
15.	<i>Rhodacme elatior</i> , Domed Ancyloid	G1	
16.	<i>Stiobia nana</i> , Sculpin Snail	G1	
	<b>N = 16</b>		
	<b>Tier 2:</b>		
17.	<i>Elimia melanoides</i> , Black Mudalia	G2	
18.	<i>Elimia ornata</i> , Ornate Elimia	G1	
19.	<i>Elimia striatula</i> , File Elimia *	G1	
20.	<i>Leptoxis taeniata</i> , Painted Rocksnail *	G1	Threatened
21.	<i>Marstonia herschleri</i> , Coosa Pyrg	G1	
	<b>N = 5</b>		
	<b>Tier 3:</b>		
22.	<i>Elimia ampla</i> , Ample Elimia	G2	
23.	<i>Elimia annettae</i> , Lilyshoals Elimia *	G2	
24.	<i>Elimia hydei</i> , Gladiator Elimia *	G2	
25.	<i>Elimia showalteri</i> , Compact Elimia *	G2	
26.	<i>Elimia varians</i> , Puzzle Elimia	G2	
27.	<i>Elimia variata</i> , Squat Elimia	G2	
28.	<i>Leptoxis ampla</i> , Round Rocksnail *	G2	Threatened
29.	<i>Leptoxis picta</i> , Spotted Rocksnail	G2	Candidate
30.	<i>Tulotoma magnifica</i> , Tulotoma *	G2	Endangered
	<b>N = 9</b>		

\* Proposed June 29, 2009 (74 FR 123:31114)

**APPENDIX III**  
**Mobile River Basin Species Accounts**

**Explanation of Format Used In Accounts**

**(Number) Scientific name – Common Name**

**Prioritization:** Tier [1 – 3]

**Global status:** NatureServe status [G1 – G5]

**Conservation Status:**

Federal: endangered, threatened, candidate, none

AFS: for non-federally listed species only on Williams et al. (1993): endangered (E), threatened (T), and vulnerable (V), none (currently stable) or not determined (ND).

State: only those conservation categories pertaining to species covered in the plan are included.

AL - based on Mirarchi et al. (2004): extirpated (EX); extirpated, conservation action underway (EXc); highest conservation concern (P1); high conservation concern (P2); none

GA – based on GADNR State Wildlife Rankings endangered (E), threatened (T), none

MS - based on MDWFP (2000): endangered (E), threatened (T), none

TN - same as federal status

**Streams with extant occurrences:** Based on approximately post-1980 occurrences. Some streams may represent population segments (contiguous streams without dispersal barriers) but are listed here separately.

**Population status:** Summary of overall status and characteristics (e.g. size, recruitment) for R/A actions. References to five-year reviews (5YR) conducted by the FWS for federally protected species are noted where applicable. Recovery criteria (i.e., number of streams with viable populations needed for downlisting (E to T) or delisting (T to recovered)) are generally not specified in published recovery plans for MRB federally protected species.

**Habitat restoration and threats:** A summary of habitat recovery activities and threats is included here but excluded from individual species accounts since much of this information does not apply specifically to R/A activities. Language on beneficial habitat related activities and threats that pertain to multiple species in specific watersheds (in parentheses) are listed

here: 1) ADCNR, ADEM, EPA, FWS, GADNR, GAEPD, TNC, GSA, MSDWF&P, MDEQ, TDEC, TWRA, USACE, USFS, WWF, grassroots watershed groups, landowners and other partners are involved in habitat restoration through various landowner programs (e.g., ACWP, CWA, Farm Bill, Landowners Incentive Program, Partners for Fish and Wildlife), land purchases and educational outreach (Basin wide); 2) ADEM, FWS, GAEPD, MDEQ, NCDWQ, TDEC, and USACE are involved in regulatory actions (e.g., permitting pollution discharge, instream aggregate mining) to protect habitat and water quality (Basin wide), 3) improved water quality/quantity releases from FERC (e.g., Weiss bypass) and regulated reservoirs and 4) threats assessments are being conducted by FWS, GSA, TNC, USGS and various state resource agencies. The following general threats potentially affect all species in the MRB: chemical contaminants, agricultural and silvicultural runoff, lack of riparian buffers, sedimentation, urbanization and other developmental activities, hydrological alterations and the potential for toxic spills. More watershed-specific threats include: 1) coal mining activities (e.g., Locust Fork, Cahaba River, Buttahatchee River); 2) oil and gas exploration (e.g., Cahaba River, Big Canoe Creek); 3) water withdrawal (i.e., Altoona, Locust Fork, Cahaba, upper Coosa River basin,); 4) hypolimnetic discharges (e.g., Altoona, Carters, Henry Neely, Martin, Thurlow, Yates); 5) poor water quality due to insufficient releases from dams (e.g., all MRB tail waters); 6) instream aggregate mining (e.g., lower Alabama River) and 7) navigation channel maintenance activities (e.g., Alabama River, Tombigbee River basin). Most threats have the potential to hinder R/A efforts.

**Potential augmentation streams:** A list of populations that may currently be considered for augmentation. In general augmentation is considered the lesser restoration option to reintroduction (see above text).

**Potential reintroduction streams:** A list of streams for each species that may currently provide suitable habitat for a reintroduction attempt. Reintroductions are generally the preferred restoration option over augmentation (see above text). Relative prioritization of potential reintroduction sites are not ranked for MRB mollusks, but in general the first stream listed is considered the highest priority site. As ongoing habitat and water quality monitoring is completed by GSA across the MRB, these new data may alter preferred sites. Streams in multiple states (i.e., Conasauga River – TN and GA) may be assigned different prioritizations. Federally protected species having streams designated as CH are noted. A list of high priority

streams for reintroduction options in the Region and their priority species is presented in Appendix IV.

**Reproductive biology:** Summary of life history data primarily as it relates to R/A actions.

**Propagation difficulty:** Relative prioritization of difficulty in culturing (high, medium, low) based on ease in procuring brood stock, bradyticty versus tachyticty, unknown host species, risk of aborting, low fertilization rate, survivorship in the lab, grow out potential and other factors.

**Recommended priority actions:** Specific translocation related activities needed for recovery, of some species and are excluded from individual species accounts. In general remaining populations of imperiled mussels in the MRB are too small for consideration of translocation efforts. The following list of priority actions for mussels and snails should be considered for nearly every species:

**Mussels:** 1) determine period of reproductive viability, 2) determine suitable glochidial hosts, 3) develop or improve juvenile propagation technology, 4) develop artificial culture medium, 5) determine nutritional requirements for juveniles and adults, 6) determine habitat requirements, 7) develop grow-out methods to sub-adult age, 8) attempt streamside host infestations, 9) reintroduce populations and/or augment extant populations, 10) search for additional unknown populations 11) establish and maintain ark population(s) when necessary and 12) rescue and salvage individuals when necessary to save the species from extinction or a population from extirpation.

**Snails:** 1) develop and/or improve juvenile propagation technology for R/A activities, 2) evaluate taxonomic and systematic relationships for some priority species, 3) determine habitat requirements, 3) reintroduce populations and/or augment extant populations, 4) search for additional unknown populations, 5) establish and maintain ark population(s) when necessary and 6) rescue and salvage individuals when necessary to save the species from extinction or a population from extirpation.

Recommended priority actions do not necessarily align with prioritized recovery tasks in recovery plans for federally listed species. Agencies and other entities that are propagating species covered in the Plan or are otherwise involved in some aspect of implementation of



these actions include AABC, ACWP, ADCNR, APC, AU, CFI, FWS, GADNR, GSA, MSDWF&P, USFS, USGS, TWRA, and UA.

**Recovery potential:** Relative prioritization (high, moderate, low) in the MRB based on several factors (e.g., degree of imperilment, ease of finding brood stock, availability of sizable source populations, knowledge of life history, knowledge of culture difficulty, quality of potential R/A streams). The species having high R/A potential are highlighted in Appendix II

**NOTE:** Literature citations and personnel communications have been intentionally omitted from the species accounts.

**CODES:** AABC = Alabama Aquatic Biodiversity Center, ACWP = Alabama Clean Water Partnership, ADCNR = Alabama Department of Conservation and Natural Resources, AFS = American Fisheries Society, APC = Alabama Power Company, AU = Auburn University, AUM Auburn University Museum and Natural History Learning Center, CWA = Clean Water Act, EA = Environmental Assessment, EPA = U.S. Environmental Protection Agency, ESA = Endangered Species Act, FERC = Federal Energy Regulatory Commission, FLMNH = Florida Museum of Natural History, GADNR = Georgia Department of Natural Resources, GSA = Geological Society of Alabama, LIP = Landowner Incentives Program, MDWF&P = Mississippi Department of Wildlife Fisheries and Parks, NPS = National Park Service, NRCS = Natural Resources Conservation Service, OSUM = Ohio State University Museum of Biological Diversity, PFW = Partners for Fish and Wildlife, TDEC = Tennessee Department of Environment and Conservation, TNC = The Nature Conservancy, TTU = Tennessee Technological University, TVA = Tennessee Valley Authority, TWRA = Tennessee Wildlife Resources Agency, UA = University of Alabama, USACE = U.S. Army Corps of Engineers, USFS = U.S. Forest Service, USFWS = U.S. Fish and Wildlife Service, USGS = U.S. Geological Survey, WWF = World Wildlife Fund.

## **I. MUSSELS**

### **1. *Epioblasma penita* – Southern Combshell**

**Prioritization:** Tier 1; **Global Status:** G1; **Conservation status:** Federal - E; AFS – E;  
**State:** AL – P1 (extirpated); GA – None; MS – E; TN - NA

**Streams with extant occurrences:** Currently restricted to less than 15 km of shoal habitat in the lower Buttahatchee River, Lowndes and Monroe Cos., MS.

**Population status:** Endemic to the MRB several individuals per hour have been encountered on several shoals during recent surveys. There is evidence of recent recruitment at some of the sites, but population numbers are insufficient to support any translocation effort.

**Potential augmentation streams:** None. Due to ongoing head-cutting from the Tombigbee Waterway in Mississippi and water quality problems in Alabama augmentation is not warranted at this time.

**Potential reintroduction streams:** Lower Bull Mountain Creek (Monroe Co., MS), Cahaba River, Bibb and Perry Cos., AL. Additional reintroduction locality may be the Weiss Reservoir bypass Cherokee Co., AL pending flow restoration.

**Biology:** *Epioblasma penita* is bradyctictic, with females gravid October to May. Females are known to entrap host fishes as part of the natural infestation process after mid-March. The primary host fish of is *Percina kathae*. *Percina nigrofasciata* serves as a secondary host.

**Propagation difficulty:** Moderate to easy if gravid female(s) can be obtained. Acclimatizing and holding large numbers of *P. kathae* in captivity can be challenging. Maintaining juveniles appears moderately difficult.

**Recommended priority actions:**

1. Initiate a captive propagation program and establish an ark population
2. Evaluate potential reintroduction sites and produce an R/A plan for each site
3. Carry out reintroductions if suitable sites are located
4. Periodically evaluate existing population
5. Augment existing populations if warranted

**Recovery potential:** Moderate if brood stock continues to be available in the lower Buttahatchee River. However, quality large river reintroduction sites are limited. The fish-host capture requirement of the female mussel, make this species very susceptible to rapid changes in river levels, during reproductive season. Current strip mine activities adjacent to Buttahatchee River in Alabama, and ongoing head-cutting from the Tombigbee Waterway present a threat to the Buttahatchee River in Mississippi.

## **2. Ligumia recta – Black Sandshell**

**Prioritization:** Tier 1; **Global status:** G5; **Conservation status:** Federal - None; AFS – V;  
**State:** AL – P2; GA – None; MS – None; TN - NA

**Streams with extant occurrences:** Restricted to lower Sipsey (Pickens Co.) and possibly the lower Cahaba (Perry Co.) rivers in AL. The species is also known to occur in the East Fork of the Tombigbee River (Itawamba Co., MS).

**Population status:** A few individuals were found at a few stations in lower Sipsey River (Pickens Co., AL) and a single fresh dead shell was collected from lower Cahaba River (Perry Co., AL), in the early 1990's. Live collection of a few individuals was made in the East Fork of the Tombigbee River (Itawamba Co., MS) in 2007.

**Potential augmentation streams:** East Fork of the Tombigbee River Itawamba Co., MS may warrant augmentation pending further evaluation.

**Potential reintroduction streams:** Lower Choccolocco (Calhoun and Talladega Cos., AL), lower Big Canoe Creek (Etowah & St. Clair Cos., AL) and Hatchet creeks (Coosa Co., AL), probably offer the best reintroduction opportunities. Additional reintroduction locality may be the Coosa River at the Weiss Reservoir bypass (Cherokee Co., AL) and below Jordon Dam (Elmore Co., AL) pending flow restoration. Cahaba River stock if available is preferable for reintroductions in the Alabama River basin. Reintroduction into the Tensaw River and/or Alabama River in Claiborne, R.F. Henry and Millers Ferry dam tail waters may be an option.

**Biology:** *Ligumia recta* is bradytactic and females are gravid from late fall to the following summer, but viability is best from March to May. Although Mississippi River Basin populations have been transformed on a broad range of hosts, no formal trials have been completed with MRB specimens. It appears likely MRB *L. recta* relied heavily on Walleye (*Sauger vitreus*) which is nearly extirpated from the MRB. Remaining populations of both species in the MRB are sympatrically distributed.

**Propagation difficulty:** Low to moderate, depending on availability of brood stock. Individuals from Mississippi Basin populations have spawned in captivity, suggesting a successful ark population could be maintained.

### **Recommended priority actions:**

1. Collect brood stock from East Fork of the Tombigbee, Sipsey and/or Cahaba River
2. Carry out life history studies of MRB population
3. Initiate a captive breeding program
4. Complete genetics evaluation between MRB and Mississippi Basin populations
5. Evaluate potential reintroduction sites and produce an R/A plan for each site
6. Carry out reintroductions if suitable sites are located
7. Periodically evaluate existing population
8. Augment existing populations if warranted

**Recovery potential:** Moderate if brood stock can be located and host fish stabilized since adequate reintroduction habitat is available in the MRB.

### 3. *Margaritifera marrianae* – Alabama Pearlshell

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal - C; AFS – E; **State:** AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Hunter, Jordan and Little Cedar creeks in Murder Creek system, Escambia River drainage, Conecuh Co., AL.

**Population status:** *Margaritifera marrianae* is endemic to a small area of south-central Alabama, which lies within the Alabama and Escambia River drainages. The species was known historically from the Limestone and Big Flat Creek, drainages in Monroe Co., AL. However, it has not been recently collected and may be extirpated from the MRB. This species may be the most imperiled freshwater mussel in Alabama, and remaining populations are too small to support translocation efforts.

**Potential augmentation streams:** *Margaritifera marrianae* appears extirpated from the MRB, precluding augmentation.

**Potential reintroduction streams:** Recent observations of a considerable mussel community in Big Flat Creek, Monroe Co., AL suggests that reintroduction of this species may be feasible. Habitat in the Limestone Creek (Monroe Co., AL) should be evaluated for the possibility of an *M. marrianae* reintroduction attempt.

**Biology:** *Margaritifera marrianae* is believed tachytictic and its host fishes are unknown.

**Culture difficulty:** High, due to difficulties in obtaining gravid females and a lack of life history information. Also, other Margaritiferidae mussels are notoriously difficult to culture.

**Recommended priority actions:**

1. Complete life history studies
2. Complete status review of remaining populations
3. Initiate a captive propagation program and establish an ark population
4. Have FWS pursue formal listing of the species
5. Intensively survey Big Flat and Limestone creeks for presence of *M. marrianae* prior to consideration of MRB reintroduction with Escambia basin stock
6. Evaluate potential reintroduction sites and produce an R/A plan for each site
7. Carry out reintroductions if suitable sites are located

**Recovery potential:** Unknown due to lack of life history information and captive propagation experience.

#### **4. Medionidus parvulus - Coosa Moccasinshell**

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal - E; AFS – E;  
**State:** AL – P1 (extirpated); GA – E; MS – NA; TN - E

**Streams with extant occurrences:** This species is currently restricted to a 3 km reach of Holly Creek in Murray Co., GA, and a 4 km section of Conasauga River in Polk County, TN.

**Population status:** Both Holly Creek and Conasauga River populations are small and unable to support translocation efforts. Evidence of limited recruitment was observed in Conasauga River in 2005, but recent recruitment has not been observed in Holly Creek.

**Potential augmentation streams:** Because of continuing habitat challenges in the Conasauga River basin, augmentation is not warranted at this time.

**Potential reintroduction localities:** Initial *M. parvulus* reintroduction efforts should focus on Terrapin Creek above the Alabama State Highway 9 (Calhoun and Cherokee Cos., AL), Little River (Cherokee and DeKalb Cos., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), Weiss Reservoir bypass on Coosa River pending flow restoration (Cherokee Co., AL) Shoal Creek (Cleburne Co., AL) and possibly Hatchet Creek (Coosa Co., AL).

**Biology:** *Medionidus parvulus* is bradytactic but females are gravid from late March to early May. *Etheostoma jordani* is a known host.

**Culture difficulty:** Moderate to low with the primary difficulty obtaining gravid females.

**Recommended priority actions:**

1. Complete formal life history studies
2. Initiate a captive propagation program and establish an ark population
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Carry out reintroductions if suitable sites are located
5. Periodically evaluate existing populations
6. Augment existing populations if warranted

**Recovery potential:** Moderate if brood stock can be collected for propagation of juveniles. Several restoration localities appear currently suitable (e.g. Terrapin Creek, Choccolocco Creek, and Little River) and ongoing habitat restoration efforts in Holly Creek may help improve the populations at that locality.

## 5. *Pleurobema atearni* - Canoe Creek Clubshell

**Prioritization:** Tier 1; **Global status** G1; **Conservation Status:** Federal - None; AFS – E;  
**State:** AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Big Canoe Creek, & Little Canoe Creek, St. Clair and Etowah Cos., AL.

**Population status:** *Pleurobema atearni* is apparently confined to the Big Canoe Creek drainage. A paucity of material in museum collections suggests the species was always uncommon. Densities in Big Canoe and Little Canoe creeks are too small to support translocation efforts.

**Potential augmentation streams:** *Pleurobema atearni* is extant only in Big Canoe and Little Canoe creeks. However, augmentation of either population is not believed to be warranted at this time.

**Potential reintroduction streams:** Problematic because *P. atearni* was unknown from the Coosa River and occurred in Canoe Creek drainage (Etowah & St. Clair Cos., AL). It is possible the species occurred in other middle Coosa River tributaries (e.g. Kelly Creek, Choccolocco Creek), but was never documented. Streams that may afford reintroduction opportunities include Kelly Creek and Choccolocco Creek, pending site evaluations.

**Biology:** *Pleurobema atearni* is tachytictic. A gravid female was collected in May, but glochidia were not fully developed. Host fishes are unknown, but likely include *Cyprinella* spp., which are used extensively by most MRB *Pleurobema* spp.

**Culture difficulty:** High, due to difficulty of finding and handling gravid females, as well as lack of life history information.

### **Recommended priority actions:**

1. Complete life history studies
2. Initiate a captive propagation program and establish an ark population
3. Complete formal listing of the species by FWS
4. Evaluate potential reintroduction sites and produce an R/A plan for each site
5. Carry out reintroductions if suitable sites are located
6. Periodically evaluate the Big Canoe Creek population
7. Augment existing population if warranted

**Recovery potential:** Low due to difficulty in locating gravid females, propagation, and the limited number of suitable reintroduction sites.

## 6. *Pleurobema hanleyianum* - Georgia Pigtoe

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – Proposed E; AFS – E; **State:** AL – P1; GA – E; MS – NA; TN - E

**Streams with extant occurrences:** The only known populations of *P. hanleyianum* occur in the Conasauga River, Murray and Whitfield Cos., GA, and Coosa River (Weiss bypass), Cherokee Co., AL.

**Population status:** *Pleurobema hanleyianum* persists at very low levels in both reaches where it is known to be extant. Neither population can support translocation activities.

**Potential augmentation streams:** *Pleurobema hanleyianum* is known only from the Conasauga River and the Weiss Reservoir bypass on the Coosa River. The Conasauga population appears to be the stronger of the two, but habitat and water quality declines are continuing rapidly. Therefore, consideration of augmentation should be focused on the Weiss Reservoir (Cherokee Co., AL) bypass population once a natural flow regime is reinstated and the reach stabilizes.

**Potential reintroduction streams:** *Pleurobema hanleyianum* was historically widespread in the Coosa River Basin, so could potentially be reintroduced to any of its high-quality tributaries, including Big Canoe Creek (St. Clair Co., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), Hatchet Creek (Coosa Co., AL), Terrapin Creek (Calhoun and Cherokee Cos., AL), and Weogufka Creek (Coosa Co., AL).

**Biology:** *Pleurobema hanleyianum* is presumed tachytictic and gravid in spring. Although its host fishes are unknown, *Cyprinella* spp. are likely hosts.

**Culture difficulty:** High, due to its extreme rarity, complexities of handling gravid females and a lack of life history information.

### **Recommended priority actions:**

1. Complete life history studies
2. Initiate a captive propagation program and establish an ark population
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Carry out reintroductions if suitable sites are located
5. Periodically evaluate existing populations
6. Augment existing populations if warranted

**Recovery potential:** Low due to the lack of life history information, extremely limited distribution and low population densities.

## **7. *Pleurobema rubellum* (=furvum) – Warrior Pigtoe**

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal - E; AFS – E;  
**State:** AL – P1; GA – NA; MS – E; TN - NA

**Streams with extant occurrences:** *Pleurobema rubellum* is believed restricted to headwater streams of the Sipsy Fork of the Black Warrior River, Winston Co., AL, in the Bankhead National Forest, and upper reaches of the North River drainage, Tuscaloosa and Fayette Cos., AL. Another specimen was likely sampled in upper Cahaba River (St. Clair Co., AL) in 2007, but not verified.

**Population status:** The 2000 drought caused a decline in Sipsy Fork population and several small tributary populations were eliminated. Effects of the 2006-08 droughts have not been assessed. The North River population was evaluated in 2008 and substantial habitat loss has occurred since 1993. Remaining populations are too small to support translocation efforts.

**Potential augmentation streams:** Augmentation of the North River population is not warranted at this time due to a lack of understanding of causal factors responsible for *P. rubellum* declines in the recent past. However, augmentation of Sipsy Fork headwaters populations may be a viable recovery option.

**Potential reintroduction streams:** *Pleurobema rubellum* historically occurred throughout the upper Cahaba drainage (Bibb, Jefferson, Shelby, St. Clair Cos., AL) and some basin sites may be suitable reintroduction sites. Some localities in the Locust Fork drainage (Blount Co., AL), may be suitable for reintroduction attempts. Although not habitat limited, reintroduction attempts cannot be undertaken in the Mulberry Fork (Blount and Cullman Cos., AL) pending water quality improvements.

**Potential augmentation streams:** Augmentation of the North River population is not advisable because of continuing *P. rubellum* declines in the recent past. However, augmentation of Sipsy Fork headwaters populations (Winston Co., AL) may be an option.

**Biology:** *Pleurobema rubellum* is tachytictic, with females gravid in June. *Campostoma oligolepis*, *Cyprinella callistia*, *C. venusta*, *Semotilus atromaculatus* and *Fundulus olivaceus* are known hosts.

**Culture difficulty:** High, due to its extreme rarity, complexities of handling gravid females and a limited of life history information.

### **Recommended priority actions:**

1. Initiate habitat improvement efforts to support North River population
2. Initiate a captive breeding program
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Complete site assessment in upper Cahaba to verify presence
5. Carry out reintroductions if suitable sites are located
6. Periodically evaluate existing populations
7. Augment existing populations if warranted

**Recovery potential:** Low to moderate due to limited distribution and difficulty in finding and handling gravid females.



## 8. *Pleurobema taitianum* – Heavy Pigtoe

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal - E; AFS – E;  
**State:** AL-P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** The last remaining population of *P. taitianum* exists in a short reach of the Alabama River, Dallas Co., AL. An unconfirmed remnant population has been reported in middle reaches of Tombigbee River, Choctaw and Marengo Cos., AL.

**Population status:** The status of *P. taitianum* in Alabama River has not been quantified, but densities were very low during recent qualitative searches. No evidence of recent recruitment was documented. Population densities are insufficient to support translocation efforts.

**Potential augmentation streams:** Due to the lack of information regarding the recent decline of *P. taitianum* in the Alabama River, augmentation of that population is not warranted at this time.

**Potential reintroduction streams:** A large-river species, *P. taitianum* could be reintroduced into Jordan Dam tail waters of Coosa River, Elmore Co., AL, or possibly lower Cahaba River, (Perry or Dallas Cos., AL), tail waters of Claiborne (Monroe Co., AL) and Millers Ferry (Wilcox Co., AL) dams appear suitable for *P. taitianum*.

**Biology:** *Pleurobema taitianum* is tachytictic, known to be gravid in early May. Glochidial hosts are unknown, but likely include *Cyprinella* spp.

**Culture difficulty:** High, due to its extreme rarity, complexities of handling gravid females and a lack of life history information.

### **Recommended priority actions:**

1. Complete life history studies
2. Initiate a captive propagation program and establish an ark population
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Carry out reintroductions if suitable sites are located
5. Periodically evaluate the Alabama River population to assess the need for augmentation
6. Augment existing population if warranted

**Recovery potential:** Low due to difficulties in propagating the species and the limited number of remaining suitable reintroduction sites requiring large river habitat with stable channel bottoms.

## 9. *Elliptio arca* - Alabama Spike

**Prioritization:** Tier 2; **Global status:** G2; **Conservation status:** Federal - None; AFS – T; **State:** AL – P1; GA – E; MS – E; TN - None

**Streams with extant occurrences:** *Elliptio arca* remains widespread in small isolated populations, most of questionable viability. Best remaining populations occur in the Sipsey River (Pickens and Tuscaloosa Cos., AL) and Yellow Creek (Monroe Co., MS). Other known populations are in Oostanaula River (Floyd and Gordon Cos., GA), Big Canoe (St. Clair Co., AL), Buxahatchee (Chilton Co., AL), Terrapin (Cherokee Co., AL), Kelly (Shelby and St. Clair Cos., AL), Sandy (Chambers Co., AL), and Yellowleaf creeks (Shelby Co., AL), Tallapoosa (Cleburne, Chambers and Tallapoosa Cos., AL), and Buttahatchee rivers (Lamar Co., AL, and Lowndes and Monroe Cos., MS); Sipsey Fork (Winston and Lawrence Cos., AL).

**Population status:** *Elliptio arca* is an MRB endemic and the best population remains in the Sipsey River (Pickens and Tuscaloosa Co., AL). Strong Alabama River basin populations remain only in Terrapin (Cherokee Co., AL) and Sandy (Chambers Co., AL) creeks. Population of *E. arca* in the Buttahatchee River appears stable. Other remaining populations occur at very low densities and are highly vulnerable.

**Potential augmentation streams:** Augmentation of Coosa tributary populations should be restricted to high-quality watersheds (e.g., Terrapin Creek) until factors responsible for population declines are determined.

**Potential reintroduction streams:** *Elliptio arca* could be reintroduced into Choccolocco Creek (Calhoun and Talladega Cos., AL), Hatchet and Weogufka creeks (Coosa Co., AL), and the Little River (Cherokee Co., AL). In Coosa River it could be reintroduced to Weiss Reservoir (Cherokee Co., AL) bypass and Jordan Dam (Elmore Co., AL) tail waters, pending flow modification. *Elliptio arca* could also be returned to Cahaba and Little Cahaba rivers and Six Mile Creek (Bibb Co., AL).

**Biology:** *Elliptio arca* is tachytictic and glochidial hosts include *Percina nigrofasciata*, *Etheostoma artesia* and *Ammocrypta meridiana*. Some individuals may reach reproductive maturity in 2 years and annual fecundity ranges from ~20,000 - 200,000 glochidia per individual.

**Culture difficulty:** Moderate - High, dependent on successful collection and handling of gravid females.

### **Recommended priority actions:**

1. Address concerns about genetic variation among Alabama River and Tombigbee River populations
2. Complete additional life history work with Alabama River Basin populations.
3. Establish a captive breeding program
4. Evaluate potential reintroduction sites and produce an R/A plan for each site
5. Carry out reintroductions if suitable sites are located
6. Periodically evaluate existing populations
7. Augment existing populations if warranted

**Recovery potential:** Moderate low, highly dependent on success of propagation efforts. Translocation efforts are generally not a recovery option for this species.

## 10. *Elliptio arctata* - Delicate Spike

**Prioritization:** Tier 2; **Global status:** G2; **Conservation status:** Federal - E; AFS – V;  
**State:** AL – P1; GA – E; MS – E; TN - None

**Streams with extant occurrences:** Little River (Cherokee and DeKalb Cos., AL), Hatchet (Clay and Coosa Cos., AL), Big Canoe (St. Clair Co., AL), Terrapin (Calhoun, Cherokee and Cleburne Cos., AL), Kelly (Shelby and St. Clair Cos., AL), and Clear creeks (Cullman Co., AL), Tallapoosa River (Cleburne, Chambers and Tallapoosa Cos., AL), Sandy Creek (Chambers Co., AL), Loblockee Creek (Lee and Macon Cos., AL), Choctafaula Creek (Macon Co., AL), Locust Fork (Jefferson and Blount Cos., AL), Sipsey River (Greene, Pickens, and Tuscaloosa Cos., AL), Cahaba River (Jefferson, Shelby and Bibb Cos., AL), Little Cahaba River (Bibb Co., AL), Sipsey Fork and headwater tributaries (Winston and Lawrence Cos., AL), and Alabama River, Claiborne Dam tail waters (Clarke and Monroe Cos., AL).

**Population status:** The best populations of *E. arctata* occur in the Alabama River downstream of Claiborne Dam, in some Tallapoosa River tributaries (e.g. Loblockee and Sandy creeks) and the Cahaba River (Bibb Co., AL). The Sipsey Fork populations declined during 2000 drought and some may have been eliminated. Clear Creek (Cullman Co., AL) has a localized but substantial remaining population. Effects of the 2006-08 droughts on the population have yet to be assessed. Remaining populations exist at very low densities. No populations can support translocation efforts.

**Potential augmentation streams:** No known *E. arctata* populations are believed to warrant augmentation at this time.

**Potential reintroduction streams:** Coosa River in the Weiss Reservoir bypass (Cherokee Co., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), and Jordan Dam tail waters (Elmore Co., AL) are high priority reintroduction sites. Other potential sites include Six Mile and Oakmulgee creeks (Bibb, Perry, Dallas, Cos., AL) and the lower Little Cahaba River (Bibb Co., AL) in the Cahaba River drainage.

**Biology:** *Elliptio arctata* is presumably tachytictic but glochidial hosts are unknown.

**Culture difficulty:** High due to the difficulty in finding and handling gravid females and a lack of life history information.

### **Recommended priority actions:**

1. Complete life history studies
2. Address concerns about genetic variation among Alabama River and Tombigbee River populations
3. Establish a captive breeding program
4. Evaluate potential reintroduction sites and produce an R/A plan
5. Carry out reintroductions if suitable sites are located
6. Periodically evaluate existing populations
7. Augment existing populations if warranted

**Recovery potential:** Low due to lack of life history information, few remaining large populations and difficulty in obtaining and handling gravid females.

## 11. *Medionidus acutissimus* – Alabama Moccasinshell

**Prioritization:** Tier 2; **Global status:** G1; **Conservation status:** Federal - T; AFS – T; **State:** AL – P2; GA – T; MS – T; TN - T

**Streams with extant occurrences:** *M. acutissimus* is known to inhabit Buttahatchee River (Monroe and Lowndes Cos., MS), Yellow Creek (Lowndes Co., MS), Lubbub Creek (Pickens Co., AL), Wilson Creek (Lamar Co., AL), Sipsey River (Tuscaloosa, Pickens, and Greene Cos., AL), Sipsey Fork (Lawrence and Winston Cos., AL), Hatchet Creek (Coosa Co., AL), Holly Creek (Murray Co., GA) and Conasauga River (Polk Co., TN). A small population may also remain in Trussells Creek (Greene Co., AL).

**Population status:** The Sipsey and Buttahatchee River populations are the most robust and the Sipsey River may support limited translocation efforts. The Sipsey Fork population was substantial until the 2000 drought caused extirpation of several small tributaries populations. No Coosa River basin population is robust enough to support translocation efforts.

**Potential augmentation streams:** Augmentation is not believed warranted in any population at this time. However, Lubbub (Pickens Co., AL), Hatchet (Coosa Co., AL) and Holly (Murray Co., GA) creeks and Conasauga River (Polk Co., TN) could be future augmentation sites.

**Potential reintroduction streams:** Possible streams for reintroduction of *M. acutissimus* include Terrapin Creek (Cherokee Co., AL), Big Canoe Creek (St. Clair Cos., AL), and Choccolocco Creek, (Talladega Co., AL). Weiss Reservoir bypass (Cherokee Co., AL) may be suitable for reintroduction pending flow mitigation. Some sections of Little Cahaba River (Bibb Co., AL) could also serve as priority reintroduction site.

**Biology:** *Medionidus acutissimus* is tachytictic, with females full gravid for only a few months in early spring. Known hosts include *Fundulus olivaceus*, *Ammocrypta beanii*, *A. meridiana*, *Etheostoma artesia*, *E. douglasi*, *E. jordani*, *E. nigrum*, *E. stigmaeum*, *E. rupestre*, *E. swaini*, *E. whipplei*, *Percina kathae*, *P. nigrofasciata* and *P. vigil*.

**Culture difficulty:** Moderate when brood stock is available. Brood stock is much easier to obtain from Tombigbee and Black Warrior drainages than remaining Coosa basin populations.

### **Recommended priority actions:**

1. Address concerns about possible genetic variation among Tombigbee and Alabama River populations
2. Initiate a captive breeding program
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Carry out reintroductions if suitable sites are located
5. Periodically evaluate existing populations
6. Augment existing populations if warranted

**Recovery potential:** High, due to the ease of obtaining brood stock and propagation, and the presence of multiple populations. Hydrologic stability of potential restoration sites is a concern when selecting possible reintroduction localities, with dislodgement of gravid females during spring spawning times is likely a serious threat.

## 12. *Obovaria jacksoniana* – Southern Hickorynut

**Prioritization:** Tier 2; **Global status:** G2; **Conservation status:** Federal - None; AFS – V;  
**State:** AL – P2; GA – NA; MS – None; TN - NA

**Streams with extant occurrences:** Populations are extant in Alamuchee Creek (Sumter Co., AL), Lubbub Creek (Pickens Co., AL), Yellow Creek (Lowndes Co., MS), Buttahatchee River (Lowndes and Monroe Cos., MS), East Fork Tombigbee River (Itawamba Co., MS), Sucarnoochee River (Kemper Co., MS), and Sipsey River (Tuscaloosa Co., AL).

**Population status:** The status of *O. jacksoniana* is uncertain, but it is uncommon even in the best populations. The species has declined precipitously in the Buttahatchee River over the past three decades. No populations can support translocation efforts.

**Potential augmentation streams:** The Buttahatchee River population (Lowndes and Monroe Cos., MS) may warrant augmentation.

**Potential reintroduction streams:** *Obovaria jacksoniana* was historically found throughout the Tombigbee and lower Alabama drainages, including Cahaba River (Perry and Dallas Cos., AL). The lower Cahaba River and sections of the lower Alabama River may contain the best habitat for reintroduction attempts.

**Biology:** *Obovaria jacksoniana* is presumed to be bradytictic, with females gravid from late summer or autumn to the following spring or summer. Its glochidial hosts are unknown.

**Culture difficulty:** Moderate, with the primary difficulty being collection of adequate numbers of gravid females.

### **Recommended priority actions:**

1. Complete a systematic review of *O. jacksoniana* and *O unicolor* in the MRB
2. Carry out life history studies
3. Initiate a captive propagation program
4. Establish an ark population for MRB population if necessary
5. Evaluate potential reintroduction sites and produce an R/A plan for each site
6. Carry out reintroductions if suitable sites are located
7. Periodically evaluate existing populations
8. Augment existing populations if warranted

**Recovery potential:** Moderate, dependent on collection of sufficient numbers of gravid females and successful production of adequate numbers of juveniles.

### 13. *Obovaria unicolor* – Alabama Hickorynut

**Prioritization:** Tier 2; **Global status:** G2; **Conservation status:** Federal - None; AFS: V;  
**State:** AL – P1; GA – NA; MS – None; TN - NA

**Streams with extant occurrences:** Populations are extant in Lubbub Creek (Pickens Co., AL), Yellow Creek (Lowndes Co., MS), Buttahatchee River (Lowndes and Monroe Cos., MS), East Fork of the Tombigbee River (Itawamba Co., MS), Sipse River (Tuscaloosa and Pickens Cos., AL).

**Population status:** The best remaining *O. unicolor* population appears restricted to the lower Sipse River (Tuscaloosa and Pickens Cos., AL). This species has declined precipitously in the Buttahatchee River over the past three decades. The Alabama Hickory Nut appears extirpated from the Cahaba River. The Sipse River population might support a small translocation effort.

**Potential augmentation streams:** The Buttahatchee River (Lowndes and Monroe Cos., MS) population may warrant augmentation.

**Potential reintroduction streams:** *Obovaria unicolor* was historically found throughout the coastal plain of the Tombigbee and Alabama drainages, including the lower Cahaba River. Populations could be reintroduced in lower Cahaba (Perry and Dallas Cos., AL) or Alabama rivers or their coastal plain tributaries.

**Biology:** *Obovaria unicolor* is presumed bradytictic, with females gravid from late summer or autumn to the following spring. Its glochidial hosts are unknown.

**Culture difficulty:** Moderate, with the primary difficulty being collection of adequate gravid females.

**Recommended priority actions:**

1. Complete a systematic review of *O. jacksoniana* and *O unicolor* in the MRB
2. Carry out life history studies
3. Initiate a captive propagation program
4. Evaluate potential reintroduction sites and produce an R/A plan for each site
5. Carry out reintroductions if suitable sites are located
6. Periodically evaluate existing populations
7. Augment existing populations if warranted

**Recovery potential:** Moderate, dependent on collection of sufficient numbers of gravid females and successful production of adequate numbers of juveniles. Gravid females can be collected in the lower Sipse River in sufficient numbers for culture attempts.

#### 14. *Pleurobema georgianum* – Southern Pigtoe

**Prioritization:** Tier 2; **Global status:** G1; **Conservation status:** Federal - E; AFS – E;  
**State:** AL – P1; GA – E; MS – NA; TN - E

**Streams with extant occurrences:** Populations are extant in the Conasauga River (Murray and Whitfield Co., GA; Polk Co., TN), Holly Creek (Murray Co., GA), Big Canoe Creek (St. Clair Co., AL), Hatchet Creek (Clay and Coosa Cos., AL), Terrapin Creek (Calhoun Co., AL) and Yellowleaf Creek (Shelby Co., AL).

**Population status:** Shoal Creek has the most robust population, but it is confined to a single isolated stream reach in the Talladega National Forest (Cleburne Co., AL). Populations in the remaining streams appear small, but the interstitial nature of *P. georgianum*, makes formal assessment very difficult. No populations appear robust enough to support translocation efforts.

**Potential augmentation streams:** Hatchet and Terrapin creek populations could support augmentation due to habitat quality in sections of these drainages. Augmentation in other Coosa basin tributaries is not warranted because of continuing habitat and water quality declines. However, the Holly Creek (Murray Co., GA) population may be augmented if ongoing riparian zone restoration efforts are successful.

**Potential reintroduction streams:** *Pleurobema georgianum* was historically found throughout the Coosa River basin. Reintroduction may be possible in sections of several tributaries, including Cheaha Creek (Talladega Co., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), Weogufka (Coosa Co., AL) and Yellow Leaf Creeks (Chilton Co., AL). Weiss Reservoir bypass (Cherokee Co., AL) may afford high priority reintroduction sites pending flow modifications. A fresh dead shell of *P. georgianum* was found in the Weiss Reservoir bypass in 2001, but additional specimens have not been located.

**Biology:** *Pleurobema georgianum* is tachytictic, with females gravid from April through June. Host fishes include *Cyprinella callistia*, *C. venusta* and *C. trichroistia*. Glochidia are released in orange colored elongate conglutinates.

**Culture difficulty:** High, due to its rarity and difficulty in collecting and handling gravid females and apparent low fecundity of female mussels.

**Recommended priority actions:**

1. Complete pending formal host fish trials
2. Initiate a captive propagation program
3. Evaluate potential reintroduction sites and produce an R/A plan for priority sites
4. Carry out reintroductions if suitable sites are located
5. Periodically evaluate existing populations
6. Augment existing populations if warranted

**Recovery potential:** Moderate, dependent on collection of sufficient numbers of gravid females and successful production of adequate numbers of juveniles.

## 15. *Ptychobranchnus foremanianus* – Alabama Kidneyshell

**Prioritization:** Tier 2; **Global status:** G1; **Conservation status:** Federal - E\*; AFS – E;  
**State:** AL – P1; GA – E; MS – NA; TN - E

**Streams with extant occurrences:** Cahaba River (Shelby and Bibb Cos., AL); Little Cahaba River (Bibb Co., AL); Big Canoe Creek (St. Clair Co., AL); Yellowleaf Creek (Shelby Co., AL); Conasauga River (Whitfield and Murray Cos., GA).

**Population status:** The Cahaba River (Shelby and Bibb Cos., AL) appears to support the most robust population. Qualitative sampling suggests other populations have very low densities. No populations appear robust enough to support translocation efforts.

**Potential augmentation streams:** Big Canoe Creek (St. Clair Co., AL), Yellowleaf Creek (Shelby Co., AL), and Little Cahaba River (Bibb Co., AL).

**Potential reintroduction streams:** Streams where habitat is believed to be suitable for reintroduction of *P. foremanianus* include Terrapin Creek and the Weiss Reservoir bypass pending flow restoration (Cherokee, Calhoun and Cleburne Cos., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), and Hatchet Creek (Coosa Co., AL).

**Biology:** *Ptychobranchnus foremanianus* is bradytictic producing mature glochidia primarily between March and May. Females discharge conglutinates that mimic either chironomid larvae or darter eggs. Fishes known to serve as glochidial hosts include *Etheostoma bellator*, *E. douglasi*, *E. jordani*, *Percina nigrofasciata*, and *P. kathae*.

**Culture difficulty:** Low to moderate, with the primary difficulty being collection of gravid females.

### **Method of restoration:**

1. Carry out comparative study of genetics and morphology among populations from Black Warrior/Tombigbee River drainage versus Alabama River drainage, as well as among sympatric individuals with different conglutinate forms in each basin
2. Complete pending formal host fish trials
3. Initiate a captive propagation program
4. Evaluate potential reintroduction sites and produce an R/A plan for each site
5. Periodically evaluate existing populations
6. Carry out reintroductions if suitable sites are located
7. Augment existing populations if warranted

**Recovery potential:** Moderate, dependent on location of suitable reintroduction sites.



## 16. *Ptychobranchnus greenii* – Triangular Kidneyshell

**Prioritization:** Tier 2; Global status: G1; Conservation status: Federal - E; AFS – E;  
**State:** AL – P1; GA – NA; MS – None; TN - NA

**Streams with extant occurrences:** *Ptychobranchnus greenii* is known only from the headwaters of Sipsey Fork and Flannigan Creek (Lawrence Co., AL), Capsey and Brushy creeks (Winston Co., AL) in Bankhead National Forest, and Coalfire Creek (Pickens Co., AL) and Locust Fork (Blount and Jefferson Co., AL), in the Black Warrior River drainage.

**Population status:** The Sipsey Fork population was believed healthy until the 2000 drought caused a decline in densities. Some small tributary populations may have been eliminated. Effects of the 2006-08 droughts on the population have not been assessed. The Locust Fork population is very small and likely not viable. No populations are robust enough to support translocation efforts.

**Potential augmentation streams:** Augmentation of Sipsey Fork headwater streams may be warranted pending further habitat assessment. Augmentation of the Locust Fork population is not warranted due to continuing habitat and water quality declines.

**Potential reintroduction streams:** A potential reintroduction stream is the Buttahatchee River in Lowndes and Monroe Cos., MS. Clear Creek in Cullman County, AL may also present a restoration opportunity. Although not habitat limited, reintroduction attempts can not be undertaken in the Mulberry Fork (Blount and Cullman Cos., AL) pending water quality improvements.

**Biology:** *Ptychobranchnus greenii* is bradyctictic, but conglutinates are generally mature between March and May. Glochidia are discharged bound as conglutinates that resemble dipteran larvae or darter eggs. Dipteran conglutinates are adhesive and attach to the substrate. Known fish hosts include *Etheostoma bellator*, *E. douglasi*, *Percina kathae* and *P. nigrofasciata*.

**Culture difficulty:** Moderate, the collection of gravid females for culture attempts are a limiting factor.

### **Recommended priority actions:**

1. Carry out comparative study of genetics and morphology among populations from Black Warrior/Tombigbee River drainage versus Alabama River drainage, as well as among sympatric individuals with different conglutinate forms
2. Complete population assessments in the Sipsey Fork and Locust Fork
3. Initiate a captive propagation program
4. Augmentation existing populations if warranted
5. Evaluate potential reintroduction sites and produce an R/A plan for each site
6. Periodically evaluate existing populations
7. Carry out reintroductions if suitable sites are located

**Recovery potential:** Moderate, dependent on location of suitable reintroduction sites. Additional systematic studies may reveal species complex that may compound R/A efforts. Sipsey Fork headwaters populations within the Bankhead National Forest appear secure.

## **17. Strophitus connasaugaensis – Alabama Creekmussel**

**Prioritization:** Tier 2; **Global status:** G3; **Conservation status:** Federal - None; AFS – V; **State:** AL – P2; GA – T; MS – None; TN - None

**Streams with extant occurrences:** *Strophitus connasaugaensis* is known to be extant in Conasauga River (Polk Co., TN), as well as Holly and Rock creeks (Murray Co., GA), Terrapin Creek (Calhoun and Cleburne Cos., AL), Shoal Creek (Cleburne Co., AL), Cheaha Creek (Talladega Co., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), Muddy Prong Creek (Shelby Co., AL), Hatchet Creek, (Clay Co., AL), Little Cahaba River (Bibb Co., AL), and Oakmulgee Creek (Perry and Dallas Cos., AL).

**Population status:** Apparently stable in Shoal and Cheaha creeks in the Talladega National Forest. The remaining populations are apparently at very low densities. No populations appear robust enough to support translocation efforts.

**Potential augmentation streams:** The Terrapin Creek population (Cleburne and Calhoun Cos., AL) may warrant augmentation.

**Potential reintroduction streams:** Yellowleaf Creek (Shelby Co., AL) may be suitable for reintroduction of *S. connasaugaensis*.

**Biology:** *Strophitus connasaugaensis* is tachytictic and is gravid from November through February. It is a host generalist, though banded sculpins (*Cottus carolinae*) appear to be the best host for culture efforts.

**Culture difficulty:** Low, with gravid females easily obtained from Shoal Creek and transformation success high on proper hosts. Difficulty in growing newly transformed juveniles to a size appropriate for release is unknown.

### **Recommended priority actions:**

1. Complete further systematics evaluation for *S. subvexus* and upper Coosa *S. connasaugensis*
2. Initiate a captive propagation program
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Carry out reintroductions if suitable sites are located
5. Periodically evaluate existing populations
6. Augment existing populations if warranted

**Recovery potential:** High, given its ease of culture and availability/stability in some extant populations.

## 18. *Toxolasma corvunculus* – Southern Purple Lilliput

**Prioritization:** Tier 2; **Global status:** G1; **Conservation status:** Federal - None; AFS – E; **State:** AL – P1; GA – None; MS – None; TN – None

**Streams with extant occurrences:** *Toxolasma corvunculus* is known to be extant in an unnamed tributary of Coosa River (Floyd Co., GA), Morgan Branch (Yellowleaf Creek tributary in Shelby Co., AL), Chewacla Creek (Lee Co., AL), Choctafaula Creek (Macon Co., AL), Opintlocco Creek (Macon Co., AL), Little Cahaba River between Lake Purdy and Cahaba confluence (Shelby and Jefferson Cos., AL) and Sipsey Fork and tributaries (Winston and Lawrence Cos., AL).

**Population status:** No population of *T. corvunculus* is believed robust enough to support translocation efforts. Current systematic evaluation underway suggests the Coosa, Cahaba, and Tombigbee populations could be distinct.

**Potential augmentation streams:** Little Cahaba River (Jefferson Co., AL), Chewacla Creek (Lee and Macon Cos., AL), Choctafaula Creek (Macon Co., AL) in the Tuskegee National Forest and Sipsey Fork (Lawrence and Winston Cos., AL) headwaters in Bankhead National Forest populations may warrant augmentation.

**Potential reintroduction streams:** *Toxolasma corvunculus* was historically found throughout the Mobile Basin. Possible reintroduction sites include Hatchet Creek (Coosa Co., AL), Terrapin Creek (Cherokee Co., AL), Weogufka (Coosa Co., AL), Big Canoe Creek (St. Clair Co., AL), upper Tallaseehatchee Creek (Talladega Co., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), Yellowleaf Creek (Shelby Co., AL) and the Weiss Reservoir bypass (Cherokee Co., AL) in the Coosa drainage. The Sipsey Fork and tributaries (Lawrence and Winston Cos., AL) may be an additional reintroduction site. Although not habitat limited, reintroduction attempts cannot be undertaken in the Mulberry Fork (Blount and Cullman Cos., AL) without water quality improvements.

**Biology:** *Toxolasma corvunculus* is bradyctic. Gravid females have been observed in July in upper Coosa tributaries. Glochidial hosts of *T. corvunculus* are unknown, but likely include various sunfishes (*Lepomis* spp.).

**Culture difficulty:** Moderate, with potential difficulty in obtaining brood stock and lack of information regarding glochidial hosts.

### **Recommended priority actions:**

1. Complete formal host fish trials
2. Complete genetics and systematic evaluation of remaining MRB populations (underway)
3. Initiate a captive propagation program
4. Evaluate potential reintroduction sites and produce an R/A plan for each site
5. Carry out reintroductions if suitable sites are located
6. Periodically evaluate existing populations
7. Augment existing populations if warranted

**Recovery potential:** Moderate to high, dependent on determination of glochidial hosts and success in establishing a propagation program.

## 19. *Amblema elliotii* – Coosa Fiveridge

**Prioritization:** Tier 3; **Global status:** G3; **Conservation status:** Federal – None; AFS – V; **State:** AL – P3; GA – None; MS – NA; TN - NA

**Streams with extant occurrences:** *Amblema elliotii* occurs throughout the Coosa and Cahaba rivers above the Fall Line. Tributaries with extant populations include the Conasauga and Oostanaula rivers in Georgia (Murray, Whitfield, and Gordon Cos.) and Terrapin, Hurricane (Cherokee Co., AL), Big Canoe and Kelly creeks (St. Clair Co., AL), Coosa River at the Weiss bypass (Cherokee Co., AL) and below Jordon Dam (Elmore Co., AL). The Coosa River populations appear to be the most robust. However, the exact status of *A. elliotii* in the Cahaba and Alabama River basins warrants further investigation.

**Population status:** *Amblema elliotii* is widespread but believed to be declining in many areas. Present distribution covers less than 10% of its historical range, but evidence of recent recruitment has been observed in several populations. No populations are robust enough to support translocation efforts.

**Potential augmentation streams:** Due to a lack of information concerning host fish and habitat requirements no augmentation of any *A. elliotii* population appears warranted at this time.

**Potential reintroduction steams:** Choccolocco Creek (Calhoun and Talladega Cos., AL) may prove to be a suitable stream for reintroduction of *A. elliotii*. Pending further evaluation the Little Cahaba River (Bibb Co., AL) may support a reintroduction attempt.

**Biology:** *Amblema elliotii* is tachytictic, gravid in the spring and summer but glochidial hosts are unknown.

**Culture difficulty:** High, due to a lack of information regarding glochidial hosts, as well as expected difficulties in handling and propagating tachytictic species.

### **Recommended priority actions:**

1. Complete formal host fish trials
2. Determine systematic relationship between Cahaba and Coosa drainage populations
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Initiate a captive propagation program
5. Carry out reintroductions if suitable sites are located
6. Periodically evaluate existing populations
7. Augment existing populations if warranted

**Recovery potential:** Moderate, depending on determination of glochidial hosts, success of propagation efforts, and availability of stable habitat for R/A populations.

## 20. *Anodontooides radiatus* – Rayed Creekshell

**Prioritization:** Tier 3; **Global status:** G3; **Conservation status:** Federal - None; AFS – V; **State:** AL – P2; GA – None; MS – None, TN - NA

**Streams with extant occurrences:** *Anodontooides radiatus* occurs in the Basin in localized populations below the Fall Line. In the Tombigbee River drainage, extant populations are known from Brush and Trussels (Greene Co., AL), Yellow (Noxubee Co., MS), Wilson (Lamar Co., AL), Mill (Winston Co., MS), Boughevia (Okitibbeha Co., MS), Coal Fire and Lubbub (Pickens Co., AL), Bull Mountain (Marion Co., AL), Greenwood (Itawamba Co., MS), and Sipseey creeks (Monroe Co., AL). As well as the North River (Tuscaloosa and Fayette Cos., AL), Buttahatchee River (Monroe Co., MS), Noxubee (Okitibbeha Co., MS) and Little Noxubee rivers (Winston Co., MS). In the Alabama River drainage *A. radiatus* is known to be extant in Big Flat and its tributary Robinson Branch (Monroe Co., AL), Oakmulgee (Perry and Dallas Cos., AL), Pursley (Wilcox Co., AL) and Rice creeks (Perry Co., AL). It is also extant in Opintlocco and Uphapee creeks (Macon Co., AL) in the lower Tallapoosa River drainage.

**Population status:** Populations are isolated and sporadic throughout its range. *Anodontooides radiatus* is more common in the Tombigbee drainage than in other parts of the MRB. No populations are believed robust enough to support translocation efforts.

**Potential augmentation streams:** No populations of *A. radiatus* are in need of augmentation at this time.

**Potential reintroduction streams:** A survey of potential reintroduction sites below the Fall Line is required to determine potential reintroduction sites.

**Biology:** *Anodontooides radiatus* is bradyctictic, with females gravid from September until at least March. No formal host fish trial has been completed, although glochidia are known to transform on *Lepomis machrochirus*.

**Culture difficulty:** Moderate, with difficulties including lack of complete life history information and low densities of gravid females at any given locality.

### **Recommended priority actions:**

1. Complete formal host fish trials
2. Periodically evaluate existing populations
3. Evaluate possible differences between Tombigbee and Alabama basin populations
4. Initiate a captive propagation program
5. Evaluate potential reintroduction sites and produce an R/A plan for each site
6. Carry out reintroductions if suitable sites are located
7. Periodically evaluate existing populations
8. Augment existing populations if warranted

**Recovery potential:** Medium to high, dependent on the determination of glochidial hosts and success in propagation efforts.

## 21. *Hamiota altilis* – Finelined Pocketbook

**Prioritization:** Tier 3; **Global status** G2; **Conservation status:** Federal - T; AFS – T; **State:** AL – P2; GA – T; MS – NA; TN - T

**Streams with extant occurrences:** *Hamiota altilis* remains widespread in the Mobile Basin, but populations are fragmented and usually small. It is known to be extant in the Cahaba and Little Cahaba rivers (Bibb and Shelby Cos., AL). In the Coosa drainage in Alabama it is extant in Weiss bypass of Coosa River proper (Cherokee Co., AL), Terrapin and South Fork Terrapin creeks (Cherokee and Cleburne Cos., AL), Big Canoe (St. Clair Co., AL), Cheaha (Talladega and Clay Cos., AL), Choccolocco Creek (Cleburne and Calhoun Cos., AL), Yellowleaf and its tributary Muddy Prong (Shelby Co., AL), Kelly and its tributary Shoal (Shelby and St. Clair Cos., AL), Shoal (Cleburne Co., AL), and Tallaseehatchee creeks (Talladega Co., AL). In the Coosa drainage in Georgia, *H. altilis* occurs in the Conasauga River (Murray and Whitfield Cos., GA, Polk Co., TN) and Holly (Murray Co., GA), Rock (Murray Co., GA), Duck (Walker Co., GA), Big (Haralson Co., GA), and McClendon creeks (Paulding Co., GA). In the Tallapoosa drainage it remains in Tallapoosa River proper (Cleburne Co., AL), Uphapee (Macon Co., AL), Choctafaula (Macon and Lee Cos., AL), Chewacla (Macon and Lee Cos., AL), Opintlocco (Macon Co., AL), Cane and Little Cane (Cleburne Co., AL), Sandy and Little Sandy (Chambers Co., AL), and Muscadine Creeks (Cleburne Co., AL).

**Population status:** Populations are generally small and localized and none appear robust enough to support translocation efforts.

**Potential augmentation streams:** Streams with a possible need for augmentation include the Weiss bypass (Cherokee Co., AL), Conasauga River (Polk Co., TN), Holly Creek (Murray Co., GA), Kelly Creek (Shelby and St. Clair Cos., AL), and Cahaba River (Bibb Co., AL).

**Potential reintroduction streams:** Armuchee Creek (Chattooga and Floyd Cos., GA) and Big Canoe Creek (St. Clair Co., AL), in upper and middle reaches of the Coosa drainage have potential as reintroduction sites, as does Jordan Dam (Elmore Co., AL) tail waters pending flow modification.

**Biology:** *Hamiota altilis* is bradyctictic, with females releasing glochidia either as superconglutinates, conglutinates, or demibranch display from April to June. Broad differences in host strategy suggest a possible species complex that requires evaluation and brood stock should not be mixed across drainages. *Micropterus coosae*, *M. henshalli*, *M. salmoides*, and *Lepomis cyanellus* have been identified as suitable hosts.

**Culture difficulty:** Low, with gravid females readily available and known hosts are easily maintained in aquaria.

### **Recommended priority actions:**

1. Evaluate potential population differences between Coosa and Cahaba basin populations
2. Evaluate potential reintroduction sites and produce an R/A plan for each site
3. Carry out reintroductions if suitable sites are located
4. Periodically evaluate existing populations

**Recovery potential:** High, based on availability of brood stock from widespread localities and ease of propagation.

## **22. *Hamiota perovalis* – Orange-nacre Mucket**

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal - T; AFS – T;  
**State:** AL - P2; GA – NA; MS – T; TN - NA

**Streams with extant occurrences:** *Hamiota perovalis* remains widespread in the Mobile Basin, but populations are fragmented and usually small. It is known to be extant in the Buttahatchee River (Lowndes and Monroe Cos., MS; Lamar Co., AL), East Fork Tombigbee River (Itawamba and Monroe Cos., MS), Yellow Creek (Lowndes Co., MS), Luxapalila Creek (Monroe Co., MS), Sipse River (Greene, Pickens and Tuscaloosa Cos., AL), Coalfire, Lubbub and Trussels creeks (Pickens Co., AL), North River (Tuscaloosa and Fayette Cos., AL) and its tributary Clear Creek (Fayette Co., AL), Locust and Blackburn Forks of the Black Warrior River (Blount Co., AL), Sipse Fork headwaters, including Thompson, Flannagin, Borden, Caney, North Fork Caney, Brushy, Capsey, Rush, Brown and Beech creeks (Winston and Lawrence Cos., AL), Cahaba River (Bibb, Jefferson and Shelby Cos., AL), Little Cahaba River (Bibb and Shelby Cos., AL), and Schultz Creek (Bibb Co, AL).

**Population status:** This species was considered common in the Sipse Fork headwaters, but suffered declines during the drought of 2000. Effects of the 2006-08 droughts have not been evaluated. A better population is found in Yellow Creek (Lowndes Co., MS). Other populations have low densities and the North River (Tuscaloosa and Fayette Co., AL) and Clear Creek (Fayette Co., AL) populations appear threatened with extirpation. No populations appear robust enough to support translocation efforts.

**Potential reintroduction streams:** Sucarnoochee River (Sumter Co., AL) may be suitable for reintroduction of *H. perovalis*. The upper Locust Fork (Blount Co., AL) may also be suitable for a reintroduction attempt. Although not habitat limited, reintroduction attempts can not be undertaken in the Mulberry Fork (Blount and Cullman Cos., AL) pending water quality improvements.

**Potential augmentation streams:** Populations in Buttahatchee and East Fork Tombigbee rivers (Monroe, Lowndes and Itawamba Cos., MS), and Trussels Creek (Greene Co., AL) may warrant augmentation.

**Biology:** *Hamiota perovalis* is bradyctictic, with females release glochidia bound as superconglutinates to attract potential glochidial hosts from April through early June. *Micropterus coosae*, *M. henshalli*, and *M. salmoides* have been identified as suitable hosts.

**Culture difficulty:** Low, with gravid females generally readily available from late winter to early summer and known hosts which are easily maintained in captivity.

### **Recommended priority actions:**

1. Initiate a captive propagation program
2. Evaluate potential reintroduction sites and produce an R/A plan for each site
3. Carry out reintroductions if suitable sites are located
4. Periodically evaluate existing populations
5. Augment existing populations as needed

**Recovery potential:** High, based on availability of brood stock from widespread localities and ease of propagation.

### **23. *Lasmigona etowaensis* – Southern Toesplitter**

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal - None; AFS - T; **State:** AL – P2; GA – None; MS – NA; TN - None

**Streams with extant occurrences:** *Lasmigona etowaensis* was once widespread in tributaries of the Coosa, Cahaba and Black Warrior rivers above the Fall Line. Extant populations are known from the South Fork Terrapin (Cleburne and Cherokee Cos., AL) and Spring creeks (Cherokee Co., AL). Northwestern Georgia tributaries with recent records include Poplar Spring (Whitfield County, GA), Mills Creek (Murray Co., GA), Armuchee, Cane, Teloga, West Armuchee creeks (Walker Co., GA), Chelsa, Ruff creeks (Chattooga Co., GA), Cedar, Dykes, Little Cedar, and Shoal creeks (Floyd Co., GA), Cedar Creek (Polk Co., GA), Dry, Pine Log, Little Pine Log, and Two Run creeks (Bartow Co., GA), as well as Big Spring Branch (Gordon Co., GA).

**Population status:** The specific status of *L. etowaensis* is uncertain, but population sizes are highly variable among localities. Many populations do not appear viable. Due to its habitat specificity for very small spring-fed streams, it is likely overlooked during mussel surveys. No populations are believed to be robust enough to support translocation efforts. The best populations appear to be in Little Cedar Creek in Floyd Co., GA and the South Fork of Terrapin Creek in Cleburne Co., AL. The species is believed extirpated from the upper Black Warrior and upper Cahaba river basins.

**Potential reintroduction streams:** Potential reintroduction streams include upper reaches of Yellowleaf, Kelly and Choccolocco creeks (Shelby and St. Clair Cos., AL). The Blackburn Fork of the Locust Fork (Blount Co., AL) may also support reintroduction efforts.

**Potential augmentation streams:** The Spring Creek (Cherokee Co., AL) population may warrant augmentation.

**Biology:** *Lasmigona etowaensis* is bradyctictic, gravid from December to February. It is a host generalist, though glochidia have the best transformation success on *Cottus carolinae*.

**Culture difficulty:** Low, with successful propagation accomplished for multiple years at TNARI and AABC facilities.

**Recommended priority actions:**

1. Evaluate potential reintroduction sites and produce an R/A plan for each site
2. Carry out reintroductions if suitable sites are located
3. Periodically evaluate existing populations
4. Augment existing populations if warranted

**Recovery potential:** High, considering the ease of culture, access to brood stock and the potential for further surveys to reveal previously unknown populations. Survey efforts for *L. etowaensis* should be undertaken in permanent small streams with high groundwater input.



## **24. Pleurobema decisum – Southern Clubshell**

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – E; AFS – E; **State:** AL – P2; GA – E; MS – E; TN - None

**Streams with extant occurrences:** *Pleurobema decisum* is known to be extant in East Fork Tombigbee River (Itawamba Co., MS), Buttahatchee River (Lowndes and Monroe Cos., MS), Sipsey River (Tuscaloosa and Pickens Cos., AL), Conasauga River (Murray and Whitfield Cos., GA), Choccolocco Creek (Calhoun and Talladega Cos., AL), and Coosa River, including Weiss Reservoir bypass (Cherokee Co., AL), and below Logan Martin Reservoir (Shelby and Talladega Cos., AL). Other populations are known to exist in the Cahaba River near Centreville (Bibb Co., AL), Luxapalila Creek (Lamar and Fayette Cos., AL), Bogue Chitto (Dallas Co., AL), Chewacla (Lee and Macon Cos., AL), Yellowleaf (Shelby Co., AL), Kelly (Shelby and St. Clair Cos., AL), Big Canoe (St. Clair Co., AL) and Terrapin Creek (Cherokee Co., AL).

**Population status:** Status varies among populations. The most robust population is believed to occur in the Sipsey River. The lower section of Big Canoe Creek (St. Clair Co., AL) appears to contain the best remaining Coosa River basin population. The population in the Cahaba River (Bibb Co., AL) appears small and highly localized. However, the Sipsey River (Tuscaloosa, Greene, and Pickens Cos., AL) maybe robust enough to support limited translocation efforts.

**Potential reintroduction streams:** Jordan Dam tail waters of Coosa River in Elmore Co., AL may be a suitable site pending flow modifications.

**Potential augmentation streams:** Streams that may warrant augmentation include Cahaba River (Bibb Co., AL) and the Alabama River (Dallas Co., AL).

**Biology:** *Pleurobema decisum* is tachytictic, gravid during spring and summer. Conglutinates are released from May - July. *Cyprenella venusta* has been reported as its primary host and *Luxilus chrysocephalus* is a secondary host.

**Culture difficulty:** High, based on difficulty in obtaining mature glochidia from females in the field. Additionally individual females produce relatively few mature glochidia.

### **Recommended priority actions:**

1. Complete status review of the species
2. Periodically evaluate existing populations
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Initiate a captive propagation program
5. Carry out reintroductions if suitable sites are located
6. Augment existing populations if warranted

**Recovery potential:** Reintroduction potential will be variable among sites, depending on habitat conditions. However, recovery will be dependent upon development and implementation of a successful propagation program.

## **25. Pleurobema perovatum – Ovate Clubshell**

**Prioritization:** Tier 3; **Global status:** G1; **Conservation status:** Federal – E; AFS - E;  
**State:** AL – P1; GA – NA; MS – E; TN - NA

**Streams with extant occurrences:** Extant *P. perovatum* populations are known to occur in Buttahatchee (Lowndes and Monroe Cos., MS), Sipse (Tuscaloosa, Greene, and Pickens Cos., AL), Sucarnoochee (Kemper Co., MS; Sumter Co., AL) and Cahaba rivers (Bibb Co., AL). Other extant populations are in Luxapalila (Lamar and Fayette Cos., AL), Coalfire (Pickens Co., AL), Bouge Chitto (Dallas Co., AL), Big Flat (Monroe Co., AL), Chewacla (Macon, Co., AL), Wilson (Lamar Co., AL) and Yellow creeks (Lowndes Co., MS).

**Population status:** Most populations of *P. perovatum* are believed declining and none are large. The Sipse River (Tuscaloosa, Greene, and Pickens Cos., AL) has the most robust populations where it is often found in shallow pools or along the channel margins. However, the Sipse River population will not sustain any large translocation effort.

**Potential reintroduction streams:** A potential reintroduction site may be the Little Cahaba River (Bibb Co., AL). A planned survey effort of Alabama River basin tributaries in 2009 may locate additional reintroduction sites.

**Potential augmentation streams:** The Cahaba River (Bibb Co., AL) population may warrant augmentation.

**Biology:** *Pleurobema perovatum* is tachytictic, gravid from May to July. Its glochidial hosts are unknown, but probably include cyprinids.

**Culture difficulty:** High, due to difficulty of finding and handling gravid females, as well as lack of life history information.

### **Recommended priority actions:**

1. Complete formal host fish trials
2. Initiate a captive propagation program
3. Evaluate potential reintroduction sites and produce an R/A plan for each site
4. Carry out reintroductions if suitable sites are located
5. Periodically evaluate existing populations
6. Augment existing populations if warranted

**Recovery potential:** Potential will be variable among sites, depending on habitat conditions. However, recovery will be dependent upon development and implementation of a successful propagation program.

## **26. Potamilus inflatus – Inflated Heelsplitter**

**Prioritization:** Tier 3; **Global status:** G1/G2; **Conservation status:** Federal - T; AFS – T;  
**State:** AL – P2; GA – NA; MS – T; TN - NA

**Streams with extant occurrences:** Alabama River below Claiborne Dam (Monroe Co., AL), Black Warrior (Tuscaloosa and Hale Cos., AL), Sipsey (Greene and Pickens Cos., AL), and Tombigbee rivers (Choctaw, Greene, and Marengo Cos., AL).

**Population status:** Status of each population is unknown. Populations in Alabama and Sipsey rivers may not be viable. Those in Black Warrior and Tombigbee rivers appear to be more robust. The species was never commonly sampled in any recent MRB survey efforts.

**Potential reintroduction streams:** Cahaba River below the Fall Line in Bibb, Perry, and Dallas Cos., AL, and the Coosa River at Wetumpka (Elmore Co., AL) may be suitable reintroduction sites.

**Potential augmentation streams:** The Alabama River population may be the only locality to warrant augmentation at this time.

**Biology:** *Potamilus inflatus* is bradyctictic, gravid from the fall to the following summer. It discharges glochidia in June and July. Its reported glochidial host is *Aplodinotus grunniens*.

**Culture difficulty:** Unknown, but if gravid females can be readily obtained, culture efforts should not be a limiting factor for recovery.

### **Recommended priority actions:**

1. Initiate a captive propagation program
2. Evaluate potential reintroduction sites and produce an R/A plan for each site
3. Carry out reintroductions if suitable sites are located
4. Periodically evaluate existing populations
5. Augment existing populations if warranted
6. Complete more formal life history assessment

**Recovery potential:** High, due primarily to the ability of this species to survive in soft sediments, which should prove R/A sites to be readily available. This is a species could possibly be reintroduced into shallow areas of water supply reservoirs, below the Fall Line.

## II. GASTROPODS

### 1. *Antrorbis breweri* – Manitou Cavesnail

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; state: AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** *Antrorbis breweri* is endemic to the stream inside Manitou Cave in Fort Payne (DeKalb Co., AL). The stream is a tributary of Big Wills Creek in the Coosa River Basin.

**Population status:** Although the existing population of *Antrorbis breweri* does not appear to be imminently imperiled, the snail could be negatively impacted by non-point source or other contamination problems in the Manitou Cave recharge area.

**Potential reintroduction streams:** There are no known reintroduction streams available for *A. breweri* at this time. Future evaluation of area caves may locate an additional population.

**Potential augmentation streams:** An augmentation of the Manitou Cave population does not appear warranted at this time. If the population declines in future assessments, augmentation efforts may be warranted.

**Biology:** *Antrorbis breweri* is a very small snail with a maximum shell width of about 3 mm. Despite its troglobitic nature, the snail does have some orange pigmentation. The snail relies on clean cobble-boulder substrates in the cave. The snail occupies both pool and riffle habitats in the cave stream. Increased sedimentation inside the cave is a serious threat to the population. It is likely the lifespan appears limited to 1 year although little is known of its life history.

**Culture difficulty:** Initial attempts to hold the snails in captivity were successful for several months. However, no egg laying or hatching of juveniles was observed during the short culture trial. It is likely *A. breweri* would be difficult to culture in large numbers. Collection of brood stock for future culture attempts will be moderately difficult.

**Recommended priority actions:**

1. Periodically monitor the population inside Manitou Cave
2. Complete a formal status assessment
3. Recommend formal listing as endangered by the FWS
4. Search other cave systems in the area to possible locate an additional population(s)
5. Complete life history and culture protocols
6. Initiate conservation efforts in the recharge area of Manitou Cave
7. Possibly augment the Manitou Cave population if warranted

**Recovery potential:** Low, predicated on the fact that *A. breweri* is currently known from a single location. However, this could improve if additional populations of the snail are located.

## 2. *Clappia cahabensis* - Cahaba Pebblesnail

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal - None; AFS – E; State: AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** A Cahaba River basin endemic, the species is known to occur in the Cahaba River (Bibb Co., AL), Little Cahaba River (Bibb Co., AL), and Mill Creek, inside Tannehill State Park (Tuscaloosa Co., AL).

**Population status:** Existing populations of *Clappia cahabensis* do not appear to be imminently imperiled. Some Cahaba River populations may be robust enough to support limited translocation attempts.

**Potential reintroduction streams:** Schultz Creek, Shades Creek, and possibly Six Mile Creek (Bibb Co., AL) are potential reintroduction sites. Few museum lots exist, making its precise historic distribution difficult to determine.

**Potential augmentation streams:** Extension of the range of *C. cahabensis* in the upper Cahaba River (Shelby Co., AL) and lower Cahaba River above the Fall Line (Bibb Co., AL). The lower Little Cahaba River (Bibb Co., AL) may also provide adequate habitat.

**Biology:** *Clappia cahabensis* is a species of shoal habitat, found on rocky substrates, often on the undersides of flat cobble and boulders. Females attach single eggs to rocks or shells of other individuals in the spring of the year.

**Culture difficulty:** *Clappia cahabensis* has not been cultured to date. Collection of brood stock for culture trials should not be difficult.

### **Recommended priority actions:**

1. Resolve remaining systematic and taxonomic issues
2. Complete a status review in the Cahaba River basin
3. Quantitatively sample Cahaba River population to assess viability
4. Complete life history and culture protocols
5. Carry out reintroduction attempts in suitable upper Cahaba basin tributaries
6. Periodically monitor all known populations

**Recovery potential:** Moderate to high, predicated on propagation success and ease of reintroduction of populations into additional Cahaba River basin tributaries.

### 3. *Elimia bellacrenata* – Princess Elimia

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; **State:** AL – P1; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** A Cahaba River basin endemic, the species is known to remain in a single spring adjacent to Shoal Creek near Montevallo (Shelby Co., AL).

**Population status:** *Elimia bellacrenata* was abundant in the spring in Shelby County in 2006, but the site was adjacent to a new housing development. The species relationship to *Elimia cochliaris* (below) needs to be determined prior to the initiation of any recovery activities.

**Potential reintroduction streams:** Historical collections in the Cahaba River basin placed the species at a minimum of 22 separate localities. The species appeared to occur in most springs and small streams in the Cahaba River basin above the Fall Line.

**Potential augmentation streams:** Augmentation of current site is not recommended.

**Biology:** *Elimia bellacrenata* occurs in springs with clear water and clean gravel - cobble substrates relatively free of fine sediments and filamentous algae. The reproductive biology of *E. bellacrenata* is unknown.

**Culture difficulty:** Moderate to high, although *Elimia bellacrenata* has not been cultured to date, the spring affinity of this species could pose some difficulties. Collection of brood stock for culture trials should not be difficult as long as the existing population survives.

**Recommended priority actions:**

1. Resolve systematic and taxonomy issues between *E. bellacrenata* and *E. cochliaris*
2. Complete status review of populations in the Cahaba River basin
3. Quantitatively sample existing population to assess viability
4. Quantify habitat parameters
5. Complete life history and culture protocols
6. Reintroduce into additional spring systems in the Cahaba River basin
7. Periodically monitor the known population

**Recovery potential:** Moderate to high, predicated on propagation success, and ease of location of suitable reintroduction sites. Translocation efforts may be possible, pending status of the last remaining population.

#### 4. *Elimia cochliaris* – Cockle Elimia

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; **State:** AL – P1; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** A Cahaba River basin endemic, the species is known to remain in a single spring adjacent to the Little Cahaba River (Bibb Co., AL) and in a small spring adjacent to Mud Creek next to Tannehill State Park (Tuscaloosa, AL).

**Population status:** *Elimia cochliaris* is currently stable in the spring systems where it occurs. However it has disappeared from most of its historical range. The species relationship to *Elimia bellacreata* (above) should be defined prior to the initiation of any recovery activities.

**Potential reintroduction streams:** Historical collections in the Cahaba River basin placed the species at 16 distinct localities, the majority in Jefferson Co., AL. The species appeared to be restricted to springs and small streams in the Cahaba River basin above the Fall Line.

**Potential augmentation streams:** Augmentation of current sites is not recommended.

**Biology:** *Elimia cochliaris* occurs in springs with clear water and clean sand and gravel substrates, relatively free of fine sediments and filamentous algae. Information concerning the reproductive biology of *E. cochliaris* is unknown.

**Culture difficulty:** Moderate to high, although *Elimia cochliaris* has not been cultured to date, the spring affinity of this species could pose some difficulties. Collection of brood stock for culture trials should not be difficult, pending continued existence of the natural population.

**Recommended priority actions:**

1. Resolve taxonomic / systematic issues between *E. bellacrenata* and *E. cochliaris*
2. Complete formal status review of Cahaba River basin populations
3. Quantitatively sample existing population to assess viability
4. Quantify habitat parameters
5. Complete life history and culture protocols
6. Reintroduce into additional spring systems in the Cahaba River basin
7. Periodically monitor the known populations

**Recovery potential:** Moderate to high, predicated on propagation success and ease of location of suitable reintroduction sites. Translocation efforts may be possible, pending current status assessment.

## 5. *Elimia crenatella* - Lacy Elimia

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – T; AFS – E;  
**State:** AL – E; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** A Coosa River basin endemic, the species is currently known only from Cheaha Creek (Talladega Co., AL). Although the species was collected in Emauhee and Wewoka creeks in the early 1990's, targeted surveys in those systems in 2006 failed to locate *E. crenatella*.

**Population status:** *Elimia crenatella* is stable in Cheaha Creek and the population appears large enough to attempt translocation efforts. *Elimia crenatella* has disappeared from over 99% of its historical range in the middle and lower Coosa River basin.

**Potential reintroduction streams:** Historical collections from the Coosa River basin were widely distributed however only a few higher quality streams may remain, including Kelly Creek (Shelby and St. Clair Cos., AL), Choccolocco and Tallaseehatchee creeks (Talladega Co., AL), Hatchet Creek (Coosa Co., AL), and possibly Big Canoe (St. Clair Co., AL). However, the causes of local extirpations are unknown and warrant further study.

**Potential augmentation streams:** Augmentation of the current sites in Cheaha Creek is not recommended.

**Biology:** *Elimia crenatella* occurs in calmer areas of shoals, clear water, and on clean cobble-gravel substrates relatively free of fine sediments and filamentous algae. The reproductive biology of *E. crenatella* is unknown.

**Culture difficulty:** Moderate to high, *Elimia crenatella* has not been cultured to date. Collection of brood stock for culture trials should not be difficult.

### **Recommended priority actions:**

1. Search for additional populations in the middle Coosa River basin
2. Complete status review and change conservation status to endangered
3. Quantitatively sample Cheaha Creek to assess viability
4. Complete life history and culture protocols
5. Identify potential reintroduction sites and conduct reintroduction trials
6. Periodically monitor known populations

**Recovery potential:** Moderate to high, predicated on propagation success and location of suitable reintroduction sites. Translocation efforts may be possible to other high quality Coosa River Basin tributaries.



## 6. *Elimia lachryma* - Teardrop Elimia

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; **State:** AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Coosa River in tail waters of Logan Martin Dam (Shelby and Talladega counties, and possibly St. Clair County).

**Population status:** *Elimia lachryma* was rediscovered in Logan Martin Dam tail waters in 2004. It was found only adjacent to Buzzard's Island downstream of Kelly Creek and was less common at the site than other *Elimia* spp. Additional work is required to assess its current status.

**Potential reintroduction streams:** Although outside historic range, the Coosa River below Jordan Dam tail waters (Elmore Co., AL) may be a restoration option pending adjustments to flow schedule. Restoration to Weiss Reservoir bypass (Cherokee Co., AL) may not be possible under proposed flow schedules, but reintroduction should be attempted. *Elimia lachryma* is restricted to main stem river, since it was never recorded in any basin tributary.

**Potential augmentation streams:** The population in the Logan Martin Dam tail waters although highly localized appears fairly robust, and does not currently require augmentation.

**Biology:** *Elimia lachryma* is known only from rocky substrates in riverine habitat of the Coosa River. The species was never recorded in any tributary. Nothing is known of its life history.

**Culture difficulty:** Possibly high, however culture of *Elimia lachryma* has not been attempted to date.

### **Recommended priority actions:**

1. Complete status review of Logan Martin Dam tail waters to determine extent of *E. lachryma* populations
2. Quantitatively sample Logan Martin tail water population to study population dynamics
3. Clarify systematic and taxonomic status of *E. lachryma*
4. Conduct propagation studies
5. Because the species is restricted to the main river channel, possibly pursue a candidate conservation agreement with Alabama Power Company.

**Recovery potential:** Low, as most of *E. lachryma* historical range is now impounded, little free flowing river exists for reintroduction and range expansion.

## 7. *Elimia vanuxemiana* - Cobble Elimia

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS - E;  
**State:** AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Coosa River, tail waters of Logan Martin Dam (Shelby and Talladega counties, possibly upriver to St. Clair County).

**Population status:** *Elimia vanuxemiana* was re-discovered in Logan Martin Dam tail waters in 2004. It was found adjacent to Buzzards Island downstream of Kelly Creek and was not common at the site. Additional work is required to assess its current population viability.

**Potential reintroduction streams:** Coosa River, Jordan Dam tail waters, pending adjustments to flow schedule.

**Potential augmentation streams:** The population in Logan Martin tail waters does not appear to be particularly robust and may warrant augmentation.

**Biology:** *Elimia vanuxemiana* is known only from riverine habitat in the Coosa River. The species was never recorded from any tributary. Nothing is known of its life history.

**Culture difficulty:** Possibly high, however culture attempts for *E. vanuxemiana* have not been made. The location of adequate brood stock for trials should not be difficult.

### **Recommended priority actions:**

1. Complete systematic and taxonomic review of *E. vanuxemiana* in comparison to other Coosa River basin congeners
2. Complete status review of Logan Martin Dam tail waters to determine species extent
3. Quantitatively sample Logan Martin tail water population to study population dynamics
4. Assess feasibility of reintroduction to Jordan Dam tail waters
5. Conduct propagation studies
6. Because the species is restricted to the Coosa River, possibly pursue a candidate conservation agreement with the Alabama Power Company.

**Recovery potential:** Low, most *E. vanuxemiana* historical range is impounded and probably unsuitable for reintroduction or range expansion.

## 8. *Leptoxis foremani* - Interrupted Rocksnail

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – Candidate - E; AFS – E; State: AL – P1 (extirpated); GA – E; MS – NA; TN - NA

**Streams with extant occurrences:** Oostanaula River, Floyd and Gordon Cos., GA.

**Population status:** A Coosa River basin endemic the snail is currently extirpated from Alabama. Appears to be declining on the shoals, in 2 km of channel where it remains in the Oostanaula River. A reproducing captive population has been established at AABC with multiple generations under culture.

**Potential reintroduction streams:** Coosa River, Weiss Reservoir bypass (Cherokee Co., AL), Jordan Dam tail waters pending adjustments to flow schedules, and Choccolocco Creek (Talladega Co., AL). Hatchet Creek (Coosa Co., AL) may also prove an adequate reintroduction site, but this should be attempted only after *L. taeniata* reintroduction efforts are proven successful.

**Potential augmentation streams:** Due to apparent ongoing water quality problems in the Oostanaula River, no augmentation of the remaining population is recommended.

**Biology:** *Leptoxis foremani* is a species of shoal habitat, where it is usually found on gravel or cobble substrates. In captivity females lay concentric clutches containing 5–22 eggs from January to May. Oviposition appears cued by thermal changes. Individual females are of apparent low fecundity, at least in captivity.

**Culture difficulty:** Low, *Leptoxis foremani* is fairly easy to culture, however collection of additional brood stock for recovery activities is becoming difficult. The lower fecundity of this species presents difficulty to mass culture efforts.

### **Recommended priority actions:**

1. Clarify systematic and taxonomic relationship among *L. foremani* and other MRB *Leptoxis* spp.
2. Continue captive propagation of *L. foremani* and expand the program to provide individuals for release
3. Periodically monitor last remaining population in the Oostanaula River
4. Attempt a small scale reintroduction into Choccolocco Creek to determine if this site might support *L. foremani*
5. Address ongoing water quality degradation in the Oostanaula River
6. Once flows are established in Weiss Reservoir bypass, monitor conditions to determine if reintroduction of *L. foremani* is warranted
7. Determine factors responsible for previous failure to reestablish *L. foremani* in Jordan Dam tail waters

**Recovery potential:** Moderate, culture of *L. foremani* is not difficult. However, suitable large scale reintroduction habitats are rare. Also the species does not have a high fecundity necessitating production of large numbers for reintroduction attempts.

## 9. *Leptoxis plicata* - Plicate Rocksnail

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – E; AFS – E; State: AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Locust Fork of the Black Warrior River, Jefferson Co., AL.

**Population status:** The range of *Leptoxis plicata* has been reduced to a single reach of Locust Fork. Significant declines in the range and numbers of *L. plicata* have been documented over the past decade. However, it is locally abundant and recruiting in surviving populations. A new reproducing population was established in Blount County, AL by the ABCC in 2006.

**Potential reintroduction streams:** Any remaining shallow shoal areas in the Black Warrior River (Tuscaloosa, Hale, & Greene Cos., AL). The species is dependent on shoal habitats and subsequent modification of river channel and impoundments throughout its historical range have rendered the river no longer suitable habitat. Although not habitat limited, reintroduction attempts can not be undertaken in the Mulberry Fork (Blount and Cullman Cos., AL) without water quality improvements. As this species occupies medium to larger rivers, it cannot be reintroduced into small headwater streams.

**Potential augmentation streams:** Middle reaches of Locust Fork in Blount Co., AL, where a reproducing population has been established by the ABCC.

**Biology:** *Leptoxis plicata* is a species of shoal habitat, where it is usually found on rocky substrates. Individual snails have survived more than 5 years in captivity.

**Culture difficulty:** Low, *Leptoxis plicata* is fairly easy to culture. Wild brood stock remains accessible and available to support future culture efforts.

### **Recommended priority actions:**

1. Continue captive propagation of *L. plicata* and expand the program to provide additional individuals for release
2. Continue augmentation of middle reaches of Locust Fork
3. Survey and assess historical locations for potential reintroduction sites
4. Periodically monitor known populations
5. Address ongoing water quality problems in the Mulberry Fork to provide additional habitat for reintroduction attempts

**Recovery potential:** Moderate, *L. plicata* is relatively easy to culture and maintain in captivity, however, habitat loss in the Black Warrior River basin appears limited hampering recovery efforts.

## 10. *Lepyrium showalteri* - Flat Pebblesnail

**Prioritization:** Tier 1; **Global status:** G1; Conservation status: Federal – E; AFS – E; State: AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Cahaba River above the Fall Line, and possibly lower reaches of Little Cahaba River (Bibb Co., AL).

**Population status:** *Lepyrium showalteri* appears to be common where it is found in isolated sections of shoal habitats in the Cahaba River.

**Potential reintroduction streams:** Lower Little Cahaba River (Bibb Co., AL) if the species does not already occur in the stream.

**Potential augmentation streams:** Currently augmentation is not warranted in the Cahaba River, but may be required in the Little Cahaba Rivers, pending a thorough survey. However extension of the current range may be possible, especially towards Centreville (Bibb Co., AL). Movement of rocks containing egg clutches in the spring of the year may be a viable transplantation strategy for this species.

**Biology:** *Lepyrium showalteri* is a species of shoal habitat, where it is usually found on clean rocky substrates. Eggs are laid in large capsules on hard surfaces between March and June; life span is limited to a single year for the majority of individuals in a population.

**Culture difficulty:** Medium, this species has been previously cultured at an experimental level, but will require substantial space to mass culture.

**Recommended priority actions:**

1. Quantitatively sample to study population dynamics
2. Quantitatively determine optimal habitat parameters
3. Periodically monitor known populations
4. Evaluate occurrence and range in the Little Cahaba River.
5. Expand range in the Cahaba and Little Cahaba rivers in Bibb Co., AL

**Recovery potential:** High, as brood stock is readily available and accessible and the species has been previously cultured. Suitable reintroduction sites in the Cahaba River basin could be a limiting factor to recovery.

## 11. *Lioplax cyclostomaformis* – Cylindrical Lioplax

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – E; AFS – E;  
**State:** AL – P1; GA – Extirpated; MS – NA; TN - NA

**Streams with extant occurrences:** Cahaba River above the Fall Line (Bibb and Shelby Cos.; AL) and Yellowleaf Creek, (Shelby Co., AL).

**Population status:** Formerly widespread throughout the Mobile River Basin, *L. cyclostomaformis* is currently known to occupy the Cahaba River between Helena and Centreville (Shelby and Bibb Cos., AL) and a substantial population occurs in a few km of Yellowleaf Creek in Shelby Co., AL. Pending further assessment, the Yellowleaf Creek population may be large enough to support limited translocation efforts.

**Potential reintroduction streams:** Big Canoe Creek (St. Clair Co., AL), Terrapin Creek and the Weiss Reservoir bypass (Cherokee Co., AL), Hatchet Creek (Coosa Co., AL), Choccolocco Creek (Calhoun and Talladega Cos., AL), Locust Fork (Blount Co., AL), Big Prairie Creek (Marengo Co., AL), Little Cahaba River (Bibb Co., AL), Coosa River, Jordan Dam tail waters (Elmore Co., AL). Although not habitat limited, reintroduction attempts can not be undertaken in the Mulberry Fork (Blount and Cullman Cos., AL) without water quality improvements.

**Potential augmentation streams:** No augmentations appear warranted at this time.

**Biology:** This snail is a deposit feeder but may also filter feed. Females are ovoviviparous and hatched juveniles are brooded until release size is reached (2-3 mm). Life span is apparently greater than 3 years. Most often found burrowed into fine sediments under large rocks in center channel, they maybe occasionally found in finer sediments and gravel near channel margins, where adequate water exchange exists.

**Culture difficulty:** High, requires specialized habitat conditions that prove difficult to replicate in an artificial setting. Initial culture efforts at the AABC resulted in juvenile production but no survival due to unknown feeding requirements.

### **Recommended priority actions:**

1. Determine habitat and life history requirements as related to captive culture
2. Identify suitable release sites
3. Improve juvenile culture techniques
4. Periodically monitor known populations

**Recovery potential:** Moderate, although some culture difficulties currently exist, translocation attempts may be possible in smaller streams.

## 12. *Marstonia* sp. – Cahaba Pyrg

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – None; **State:** AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Mill & Mud creeks, adjacent to and inside Tannehill State Park, Tuscaloosa Co., AL.

**Population status:** *Mastonia* sp. is currently known from a single highly localized population. The species occurs in good numbers along the banks of Mill Creek above the small Mill Dam at Tannehill State Park. This species was recently discovered and has yet to be formally described.

**Potential reintroduction streams:** Given the lack of distributional information for this species in the Cahaba and possibly the Warrior basin, no reintroduction attempts are recommended pending a formal status review. It is possible the species is confined to the Mill Creek drainage.

**Potential augmentation streams:** Augmentation of the current population is not warranted at this time.

**Biology:** This species occurs along the channel margins in Mill and Mud creeks. The species may be dependent on large volume of groundwater supply found in those systems. Nothing is known of its biology.

**Culture difficulty:** Unknown, no attempts to culture the species have been made.

### **Recommended priority actions:**

1. Complete formal description of this species
2. Complete a status review
3. Complete an assessment of the known populations
4. Periodically monitor known populations

**Recovery potential:** Moderate, given the main population already occurs inside a state park. However, changes to the watershed upstream of the park boundary could negatively impact the species inside the park.

### 13. *Pleurocera foremani* - Rough Hornsnail

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – Candidate E; AFS – E; **State:** AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Yellowleaf Creek (Shelby Co., AL) and the Coosa River, (Elmore Co., AL).

**Population status:** *Pleurocera foremani* is currently known from only two localized populations. The Yellowleaf Creek population appears healthy, but has a very limited distribution. Only a few individuals have been found in Coosa River during the past two decades. A reproducing captive population has been in holding at the AABC since 2006.

**Potential reintroduction streams:** Lower Kelly Creek, Coosa River Logan Martin tail waters, St. Clair and Talladega Cos., AL, Choccolocco Creek (Calhoun and Talladega Co., AL).

**Potential augmentation streams:** Augmentation of the lower Coosa River population below Jordon Dam may be warranted, pending flow modifications.

**Biology:** *Pleurocera foremani* is generally found in shallow areas (< 10 feet) with slow moving water or along channel margins in moderate vegetation. The species is dioecious and females lay eggs singly or in a straight band. Clutch sizes are small with 3-9 eggs per clutch. Cultured individuals do not exhibit the tubercles characteristic of this species until adult size is reached.

**Culture difficulty:** Low, *Pleurocera foremani* has been cultured, and a captive population has been maintained at AABC for multiple years. Yellowleaf Creek brood stock is easily accessible.

**Recommended priority actions:**

1. Identify additional reintroduction sites within the middle and lower Coosa River basin
2. Improve juvenile grow-out techniques
3. Complete assessment of lower Coosa River population
4. Periodically monitor known populations

**Recovery potential:** Moderate, given the species is relatively easy to propagate and adequate habitat for reintroduction appears to be currently available.



#### **14. Pseudotryonia grahamae – Salt Spring Hydrobe**

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; State: AL – P1; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** *Pseudotryonia grahamae* is endemic to Salt Creek inside the Fred T. Simpson Wildlife Refuge, Clarke Co., AL.

**Population status:** The snail is generally common in Salt Creek, except for a small pond created in the stream drainage, from which it's absent. The snail occurs in the silt habitat of the stream from it's headwaters to near the confluence with the Tombigbee River.

**Potential reintroduction streams:** No reintroduction localities are known for *P. grahamae*.

**Potential augmentation streams:** The Salt Creek population does not appear to warrant augmentation at this time.

**Biology:** *Pseudotryonia grahamae* is a small species with a maximum shell length of about 4 mm. On average female snails are apparently a little larger than males. Nothing is known of its life history.

**Culture difficulty:** Unknown, but creating required habitat conditions in a captive setting would likely present a serious challenge to culturing this species.

**Recommended priority actions:**

1. Periodically monitor the population in Salt Creek
2. Possibly recommend formal listing as endangered by the FWS
3. Search other stream systems in the area to possible locate an additional population(s)
4. Complete life history and culture protocols
5. Initiate conservation efforts in the Fred T. Simpson Wildlife Refuge
6. Possibly augment the Salt Creek population if warranted

**Recovery potential:** Moderate, predicated on the fact that *P. grahamae* occurs inside a Wildlife Refuge, so typical threats to the only existing population are likely mitigated.

## 15. *Rhodacme elatior* - Domed Ancyloid

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; State: AL – P1; GA – None; MS – NA; TN – None;

**Streams with extant occurrences:** Although *Rhodacme* spp. were once broadly distributed across the southeast, recent surveys have failed to locate these species at historical localities. Currently this genus appears restricted to the Cahaba River near Marvel (Bibb Co., AL) and Choccolocco Creek (Talladega Co., AL).

**Population status:** Unknown, although the species can be readily collected in the Cahaba River. The Choccolocco Creek population appears very small and a large sampling effort is required to find the animals. The limpets are often encountered attached to the shells of pleurocerid snails.

**Potential reintroduction streams:** Historical distribution records for this species are limited to a few museum lots. It may have been more common and widespread than historical collections indicate.

**Potential augmentation streams:** The only known populations do not warrant augmentation without further study.

**Biology:** Unknown, although it is presumed this species has a lifespan of 1 year and inhabits only continuously flowing waters.

**Culture difficulty:** Unknown, but it appears this species is positively rheotaxic and will likely respond favorably to culture attempts, as do other ancyloids (*i.e. Laevapex fuscus*).

### **Recommended priority actions:**

1. Determine systematic relationship between Cahaba River and Choccolocco Creek populations
2. Survey Cahaba River and Choccolocco Creek drainages to determine extent of *R. elatior* and search for potential reintroduction sites
3. Quantify habitat parameters and population dynamics
4. Periodically monitor known populations
5. Determine if augmentation in Cahaba River or Choccolocco Creek is warranted
6. Study life history and develop culture methods

**Recovery potential:** Unknown, but may be moderate if culture methods can be perfected.

## 16. *Stiobia nana* – Sculpin Snail

**Prioritization:** Tier 1; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; **State:** AL - P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** *Stiobia nana* is endemic to Coldwater Spring Run, Calhoun Co., AL.

**Population status:** The extent of the population in Coldwater Spring is currently unknown.

**Potential reintroduction streams:** No reintroduction localities are currently known for *S. nana*.

**Potential augmentation streams:** Pending additional assessment, the *S. nana* population in Coldwater Spring probably does not warrant augmentation.

**Biology:** *Stiobia nana* is dioecious and likely has a lifespan of about 1 year. Nothing is known of its reproductive biology. The snail can be found on clean substrates in the Coldwater Spring run. It appears to be an important food source for the federally listed Pygmy Sculpin, *Cottus paulus*.

**Culture difficulty:** Unknown, no attempt has been made to hold or culture *S. nana* in a captive setting.

### **Recommended priority actions:**

1. Periodically monitor the population in the Coldwater Spring run
2. Complete trichloroethylene toxicity trials on snail
3. Search other springs in the area to possibly locate an additional population
4. Complete life history and culture protocols
5. Possibly augment the Coldwater Spring population if warranted

**Recovery potential:** Moderate-high, given this site is a municipal water supply, and already hosts the Threatened Pigmy Sculpin (*Cottus paulus*). The spring is currently protected under an agreement between the Anniston Waterworks and the FWS. However, recent water quality monitoring in Coldwater Spring has indicated that trichloroethylene concentrations are on the rise in Coldwater Spring.

## 17. *Elimia melanoides* – Black Mudalia

**Prioritization:** Tier 2; **Global status:** G2; **Conservation status:** Federal – None; AFS – E; State: AL – P1; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** upper Locust Fork, Blackburn Fork, and Hendrick Mill Brook (Blount Co.; AL), and Gurley Creek, Self Creek (Jefferson Co.; AL). Historically collected in the upper Sipsey River (Winston Co., AL) but recent attempts failed to locate the species.

**Population status:** *Elimia melanoides* has experienced significant range contraction. Localized populations are currently known from five streams in the upper Black Warrior drainage, where it may be locally abundant.

**Potential reintroduction streams:** Unknown. Although some historical records are available, a review of museum material is needed. Small to medium tributaries with substantial groundwater flow in the upper Locust Fork may be suitable reintroduction sites. Some headwater tributaries in the Mulberry Fork may also be suitable reintroduction sites.

**Potential augmentation streams:** None of the current populations appear to require augmentation at this time.

**Biology:** *Elimia melanoides* is found on hard surfaces (gravel, cobble, bedrock, woody debris) in shoals. Life history and biology are unknown.

**Culture difficulty:** Unknown, but some populations (Locust and Blackburn forks, Blount Co., AL) may be robust enough to support translocation efforts.

### **Recommended priority actions:**

1. Determine status of extant populations
2. Systematically survey and assess historically occupied locations for potential unknown populations and identify potential reintroduction sites
3. Develop culture methods
4. Periodically monitor known populations
5. Assess possible translocations to reintroduction sites

**Recovery potential:** Moderate. *Elimia melanoides* habitat is highly fragmented but potential restoration sites are likely available.

## 18. *Elimia ornata* - Ornate Elimia

**Prioritization:** Tier 2; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; **State:** AL – NA; GA – None; MS – NA; TN - NA

**Streams with extant occurrences:** This species is endemic to the Conasauga River (Murray, Whitfield and Gordon Cos., GA).

**Population status:** *Elimia ornata* is restricted to isolated shoals in the Conasauga River from Beaverdale (Murray Co., GA) to near the Tilton Bridge (Whitfield Co., GA). Ongoing habitat degradation in the Conasauga River has caused nearly all pleurocerid snail populations to become drastically reduced in recent years. Largest remaining population of *E. ornata* was located above Tibbs Bridge crossing (Whitfield Co., GA) in 2003.

**Potential reintroduction streams:** None, *Elimia ornata* is known only from the Conasauga River.

**Potential augmentation streams:** Augmentation of currently unoccupied shoals might be possible, but only if habitat degradation issues are addressed.

**Biology:** Life history characteristics are unknown, but *E. ornata* likely lays eggs in late winter to early spring. Females attach eggs to hard, clean substrates in flowing water. The species is found most commonly on clean swept cobble – boulder substrates in shoal areas.

**Culture difficulty:** Unknown.

### **Recommended priority actions:**

1. Determine systematic relationship between *E. ornata* and *E. lecontiana*
2. Determine status of remaining populations
3. Quantify habitat parameters and population dynamics in remaining habitat
4. Periodically monitor known populations
5. Study life history and perfect culture methods

**Recovery potential:** Low, given ongoing water quality and habitat degradation in the Conasauga River basin, recovery options appear limited at this time.

## 19. *Elimia striatula* - File *Elimia*

**Prioritization:** Tier 2; Global status: G2; Conservation status: Federal – None; AFS – T; State: AL – NA; GA – None; MS – NA; TN - None

**Streams with extant occurrences:** This species is currently known only from the upper Conasauga River watershed. Historical occurrences were recorded just across the basin divide in the Hiwassee River basin in Bradley Co., TN, however these locations have not been verified. In the Conasauga River basin, *Elimia striatula* is currently known from Mills (Bradley Co., TN and Whitfield Co., GA), Sugar (Bradley Co., TN), Poplar Spring (Whitfield Co., GA), and upper Coahulla creeks (Bradley Co., TN), and Wolf Branch (Bradley Co., TN).

**Population status:** *Elimia striatula* can be locally abundant in isolated populations. An exceptional population exists around the Cohutta Fisheries Center in Whitfield Co., GA. The extent of purported occurrences of *E. striatula* in the Tennessee River basin is currently unknown.

**Potential reintroduction streams:** Unknown, as this species is represented by few historical museum collections. However, in the upper Conasauga River watershed the species was restricted to small channels in the Ridge and Valley physiographic province.

**Potential augmentation streams:** No populations appear to be in need of augmentation at this time.

**Biology:** *Elimia striatula* is dioecious with females laying eggs in concentric clutches in the spring of the year. Eggs number 5-12 per clutch and are attached to firm clean substrates, or other shells. The species often feeds in soft sediments, and is found along channel margins.

**Culture difficulty:** Unknown and no attempts to culture *E. striatula* have been made. However, given that it occupies smaller stream habitats with a large percentage of ground water input, some populations may be robust enough to support translocation efforts.

### **Recommended priority actions:**

1. Survey small streams primarily in Bradley Co., TN and Whitfield Co., GA to determine range and status of *E. striatula* populations and indentify possible restoration sites
2. Quantitatively asses habitat parameters and study population demographics in preferred habitat
3. Determine if reintroduction sites are available and whether such actions are warranted
4. Periodically monitor all known populations
5. Study life history and perfect culture of the species

**Recovery potential:** High, if adequate reintroduction habitats can be identified, *E. striatula* should be relatively easy to culture and establish new populations.

## **20. Leptoxis taeniata - Painted Rocksnail**

**Prioritization:** Tier 2; **Global status:** G2; **Conservation status:** Federal – T; AFS – E;  
**State:** AL – P2; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Buxahatchee (Shelby Co., AL), Choccolocco (Talladega Co., AL), and Ohatchee creeks (Calhoun Co., AL) and the Coosa River in the Logan Martin tail waters (Shelby and Talladega Cos., AL).

**Population status:** *Leptoxis taeniata* has been reduced to four populations. It is locally abundant in Choccolocco and Buxahatchee creeks. Density in Logan Martin Dam tail waters is very low. Current status of the Ohatchee population is unknown but habitat problems in that channel persist. The largest population occurs in Choccolocco Creek

**Potential reintroduction streams:** Coosa River, Jordan Dam tail waters pending flow modifications (Elmore Co., AL), Kelly Creek (Shelby and St. Clair Cos., AL), Big Canoe Creek (St Clair Co., AL), Yellowleaf Creek (Shelby Co., AL), Weogufka and Hatchet creeks (Coosa Co., AL).

**Potential augmentation streams:** Ohatchee Creek (Calhoun Co., AL) and Logan Martin Dam tail waters (Shelby and Tallapoosa Co's, AL).

**Biology:** *Leptoxis taeniata* occurs in shoal habitat, where it is usually found on rocky substrates. The snail is dioecious and the females lay eggs in a concentric clutch between March and May. Clutch sizes are substantially smaller (generally 5–10 eggs) than other MRB congeners (*L. foremani*, *L. picta*).

**Culture difficulty:** Moderate, initial culture of *Leptoxis taeniata* was made in 2005. The species will readily lay eggs but rearing hatched juveniles presented problems during the initial trial. More work is required but culture appears feasible. However, several localities in Choccolocco Creek (Talladega Co., AL) have large enough populations to support translocation efforts.

### **Recommended priority actions:**

1. Determine current range and abundance of *L. taeniata* in Buxahatchee and Ohatchee creeks
2. Prioritize historical stream drainages for reintroduction
3. Complete culture methods to support reintroduction
4. Periodically monitor all known populations
5. Augment existing populations if warranted

**Recovery potential:** High, as other *Leptoxis* spp. have been successfully cultured and brood stock are readily available. Several historical occupied streams may currently support reintroduction attempts (e.g., Hatchet Creek).

## 21. **Marstonia hershleri** – Coosa Pyrg

**Prioritization:** Tier 2; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; State: AL – P2; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** *Marstonia hershleri* is endemic to the lower Coosa River basin. Currently it is restricted to Coosa River in and below Lake Jordon (Elmore Co., AL). The most robust populations can be found in the Coosa River below Jordon Dam.

**Population status:** *Marstonia hershleri* is locally abundant adjacent to shoal habitat in the Coosa River below Jordon Dam.

**Potential reintroduction streams:** This species appears restricted to the lower Coosa River which limits reintroduction options. The snail has not been located in other lower Coosa River basin tributaries.

**Potential augmentation streams:** Augmentation of existing Coosa River populations does not appear to be warranted at this time.

**Biology:** *Marstonia hershleri* is usually found on vegetation or in root mats along the margin of the river channel. Its life history is unknown.

**Culture difficulty:** *Marstonia hershleri* has not been cultured to date. The Coosa River population may be robust enough to support a translocation effort, if another location proves suitable in the future. Collection of brood stock for culture attempts should not be difficult.

### **Recommended priority actions:**

1. Quantitatively study population dynamics
2. Complete formal status review
3. Determine life history requirements
4. Periodically monitor all known populations

**Recovery potential:** Moderate, given the healthy population currently maintained for below Jordon Dam in Elmore County.



## **22. Elimia ampla - Ample Elimia**

**Prioritization:** Tier 3; **Global status:** G1; **Conservation status:** Federal – None; AFS – E; **State:** AL – P2; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** *Elimia ampla* is endemic to the Cahaba River basin. Currently it is restricted to Cahaba River above Fall Line and lower Six Mile Creek (Bibb Co., AL). It is generally found in large tributaries

**Population status:** *Elimia ampla* is locally abundant on isolated shoals in the Cahaba River.

**Potential reintroduction streams:** Pending a more complete survey effort, the species could be reintroduced into the lower Little Cahaba River and possibly lower Shades Creek, (Bibb Co., AL).

**Potential augmentation streams:** Augmentation of existing Cahaba River populations does not appear to be warranted at this time.

**Biology:** *Elimia ampla* requires shoal habitat and is usually found on cobble-boulder or bedrock substrates. Its life history is unknown.

**Culture difficulty:** *Elimia ampla* has not been cultured to date. The Cahaba River population may be robust enough to support translocation efforts. Collection of brood stock for culture attempts should not be difficult.

### **Recommended priority actions:**

1. Determine systematic relationship of *E. ampla* with sympatric congeners
2. Quantitatively study population dynamics
3. Study life history and perfect culture methods
4. Periodically monitor all known populations
5. Establish additional populations in large tributaries

**Recovery potential:** Moderate, pending successful culture and location of suitable reintroduction sites.

### **23. Elimia annettae - Lilyshoals Elimia**

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – None; AFS – T; **State:** AL – P2; GA – NA; MS - NA

**Streams with extant occurrences:** Cahaba River basin above the Fall Line, lower Little Cahaba River (Bibb Co., AL), upper Little Cahaba River (Jefferson Co., AL), Shades Creek (Bibb Co., AL), Sixmile Creek (Bibb Co., AL).

**Population status:** *Elimia annettae* can be locally abundant but sporadically distributed in the Cahaba River. Tributary populations are not as robust as those in the mainstem.

**Potential reintroduction streams:** None suggested until a more complete survey of Cahaba tributaries can be carried out.

**Potential augmentation streams:** No augmentation appears warranted at this time.

**Biology:** *Elimia annettae* requires shoal habitat and is usually found on rocky substrates. Its life history is unknown.

**Culture difficulty:** *Elimia annettae* has not been cultured to date. Some extant populations (*i.e.* Cahaba River, Shades Creek) may be large enough to collection of brood stock for culture attempts.

**Recommended priority actions:**

1. Determine systematic and taxonomic relationships of *E. annettae* with other *Elimia* spp. in the Cahaba River basin
2. Study population dynamics
3. Determine general abundance and range in lower Little Cahaba River
4. Study life history and perfect culture methods
5. Periodically monitor all known populations

**Recovery potential:** High, as there are enough quality tributaries left in the middle Cahaba drainage to support reintroductions and creation of new populations.

## 24. *Elimia hydei* - Gladiator Elimia

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – None; AFS – T; **State:** AL – P2; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** Locust Fork (Blount and Jefferson Cos., AL), Black Warrior River (Tuscaloosa and Hale Cos., AL). A population of snails in the Mobile Delta (Baldwin Co., AL) is conchologically similar to *E. hydei*, but its exact status is currently uncertain.

**Population status:** *Elimia hydei* is locally common in the middle and lower reaches of Locust Fork (Jefferson and Tuscaloosa Cos., AL). Isolated populations occur sporadically in the Black Warrior River. Distribution and status of the population in the Mobile Delta is uncertain.

**Potential reintroduction streams:** Although adequate habitat exists in the Mulberry Fork (Blount and Cullman Cos., AL), reintroduction attempts cannot proceed without water quality improvements. No other reintroduction streams are currently known.

**Potential augmentation streams:** Existing populations are not believed to warrant augmentation.

**Biology:** *Elimia hydei* is generally restricted to shoal habitats, where it is found on rocky substrates in channel and sometimes in softer sediments along stream margins. The species has also been found along channel margins in reservoirs. The snail is dioecious and females lay eggs from late March through June. They attach eggs to firm clean substrates or other snail shells, generally in moderate current.

**Culture difficulty:** Unknown, although egg masses have been brought into culture and hatched in small numbers. Rearing of newly hatched juveniles was successful. However, no attempts have been to initiate female oviposition in captivity.

### **Recommended priority actions:**

1. Periodically monitor status of known Locust Fork populations
2. Determine status and range of Black Warrior river populations
3. Determine taxonomic and systematic status of Mobile Delta populations
4. Study life history and perfect culture methods in case augmentation or reintroduction become necessary
5. Address water quality concerns in the Mulberry Fork so it might support future reintroduction efforts

**Recovery potential:** High, if suitable habitat can be located for reintroduction in the middle and lower Black Warrior River system, additional populations could be established.

## 25. *Elimia showalteri* - Compact Elimia

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – None; AFS – T; **State:** AL – P2; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Cahaba River Basin above the Fall Line (Jefferson, Shelby, and Bibb, Cos., AL).

**Population status:** Endemic to the Cahaba River Basin. *Elimia showalteri* populations appear healthy where they occur.

**Potential reintroduction streams:** Pending additional survey efforts, *Elimia showalteri* could possibly be reintroduced into the lower Little Cahaba River, Bibb Co., AL.

**Potential augmentation streams:** No augmentation is recommended at this time.

**Biology:** *Elimia showalteri* is generally restricted to shoal habitats, where it is usually found on rocky substrates. Specifics about its life history are unknown.

**Culture difficulty:** *Elimia showalteri* has not previously been cultured. Some populations appear robust enough to support limited translocation of adults should R/A efforts be deemed necessary. Brood stock collection for culture trials should not be difficult.

### **Recommended priority actions:**

- Determine systematic and taxonomic relationships with other Cahaba *Elimia* spp.
- Quantitatively study population dynamics
- Study life history and perfect culture methods
- Periodically monitor status of known populations
- Determine distribution of *E. showalteri* in larger Cahaba tributaries

**Recovery potential:** High, the habitat is currently available to possibly expand the range of *E. showalteri* in the Cahaba River Basin.

## 26. *Elimia varians* - Puzzle *Elimia*

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – None; AFS – T; **State:** AL – P2; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** *Elimia varians* is currently restricted to the Cahaba River, from the Fall Line to near Boothton in Bibb and Shelby Cos., AL.

**Population status:** *Elimia varians* has disappeared at the extremes of its historical range in the Cahaba River, but remains locally common at many sites.

**Potential reintroduction streams:** None recommended at this time. However, pending a more complete survey effort, the species could possibly be reintroduced into the lower Little Cahaba River, Bibb Co., AL.

**Potential augmentation streams:** None recommended at this time.

**Biology:** *Elimia varians* is a species of shoal habitat, where it is usually found on rocky substrates. Specifics about its life history are unknown.

**Culture difficulty:** Unknown. However, some populations appear robust enough to support limited translocation of adults should R/A efforts be deemed necessary. Collection of brood stock for culture trials should not be difficult.

### **Recommended priority actions:**

1. Determine systematic and taxonomic relationships with other Cahaba basin *Elimia* spp.
2. Quantitatively study population dynamics
3. Study life history and perfect culture methods
4. Periodically monitor status of known Cahaba basin populations
5. Determine distribution in large Cahaba River Basin tributaries

**Recovery potential:** High, the habitat is currently available to possibly expand the range of *E. varians* in the Cahaba River basin.

## **27. Elimia variata - Squat Elimia**

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – None; AFS – T; State: AL – P2; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Cahaba River Basin above the Fall Line (Shelby and Bibb Cos., AL), Little Cahaba River (Bibb Co., AL), Buck (Shelby Co., AL), Shades (Bibb Co., AL), and Sixmile creeks (Bibb Co., AL).

**Population status:** Endemic to the middle Cahaba River and tributaries, *Elimia variata* is locally common.

**Potential reintroduction streams:** None recommended at this time, pending a more complete survey effort.

**Potential augmentation streams:** None are recommended at this time.

**Biology:** *Elimia variata* requires shoal habitats and it is usually found on rocky substrates. Specifics about its life history are unknown.

**Culture difficulty:** Unknown. However, some populations appear robust enough to support limited translocation of adults should R/A efforts be deemed necessary. Collection of brood stock for culture should not be difficult.

### **Recommended priority actions:**

1. Determine systematic and taxonomic relationships with other Cahaba basin *Elimia* spp.
2. Quantitatively sample and study population dynamics
3. Study life history and perfect culture methods
4. Periodically monitor status of known populations
5. Determine specific distribution in larger Cahaba tributaries

**Recovery potential:** High, habitat is currently available to possibly expand the range of *E. variata* in the Cahaba River Basin.

## 28. *Leptoxis ampla* - Round Rocksnail

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – None; AFS – T; State: AL – P2; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Cahaba River from near the Piney Creek confluence to the Fall Line (Bibb Co., AL), downstream reaches of lower Little Cahaba River (Bibb Co., AL), Shades (Bibb and Shelby Cos., AL) and Six-mile creeks (Bibb Co., AL).

**Population status:** *Leptoxis ampla* populations can be locally abundant. The better populations generally occur from Bibb CR 24 Bridge downriver to the Fall Line in Centerville, AL.

**Potential reintroduction streams:** *Leptoxis ampla* is a Cahaba River basin endemic. If water quality conditions improve the species range might be extended upriver. Some larger tributaries such as the upper Little Cahaba River (Jefferson Co., AL) and Schultz Creek (Bibb Co., AL) may support the species.

**Potential augmentation streams:** As most populations are generally robust augmentation is not recommended at this time.

**Biology:** *Leptoxis ampla* is a species of shoal habitat, where it is usually found on rocky substrates. The snail is dioecious and the females lay eggs in a concentric clutch between March and May. Clutch sizes are substantially smaller (generally 5–10 eggs) than some other MRB congeners (*L. foremani*, *L. picta*).

**Culture difficulty:** Moderate, *Leptoxis ampla* was successfully cultured in experimental trials in 2005 and 2009. It was not particularly difficult to hatch and rear juveniles. However, some populations appear robust enough to support limited translocations should R/A efforts be deemed necessary. Currently the collection of brood stock is not difficult.

### **Recommended priority actions:**

1. Determine systematic and taxonomic relationships with other *Leptoxis* spp.
2. Determine if the *L. mimica* form of *L. ampla* that occurs in the lower Little Cahaba River deserves elevation to species status
3. Quantitatively study population dynamics
4. Determine life history and perfect culture methods
5. Determine distribution in larger tributaries of the Cahaba River basin above the Fall Line
6. Periodically monitor status of known populations

**Recovery potential:** High, habitat is currently available to expand the range of *L. ampla* in the Cahaba River basin. Other tributary populations would need to be established to move the species towards delisting.

## 29. *Leptoxis picta* - Spotted Rocksnail

**Prioritization:** Tier 3; **Global status:** G2; **Conservation status:** Federal – None; AFS – T; **State:** AL – P2; GA – NA; MS – NA; TN – NA

**Streams with extant occurrences:** Alabama River, tail waters below Claiborne (Clarke and Monroe Cos., possibly Baldwin Co., AL), Millers Ferry (Wilcox Co., AL) and Robert F. Henry (Autauga and Dallas Cos., AL, possibly Lowndes Co., AL) dams.

**Population status:** Historical occurrences in the lower Coosa River, (Coosa and Elmore Cos., AL) and the lower Cahaba River (Bibb, Perry, and Dallas Cos., AL) and throughout the Alabama River. Although *L. picta* is locally abundant in a short reach of the Alabama River below Claiborne and R.F. Henry dams; it is rare below Millers Ferry Dam. Existing populations would not likely support translocation attempts.

**Potential reintroduction streams:** Lower Cahaba River in (Perry and Dallas Cos., AL) and the lower Coosa River, Jordan Dam tail waters (Elmore County, AL) pending flow modifications.

**Potential augmentation streams:** Millers Ferry Dam tail waters (Wilcox Co., AL).

**Biology:** *Leptoxis picta* is known only from flowing habitat in large rivers. Snails are dioecious and females lay concentric egg clutches from February to June in captivity. Clutch size appears to range from 7–20 eggs per clutch. Egg-laying appears to be cued by thermal changes.

**Culture difficulty:** Low, although it is difficult to produce large numbers of individuals in a single year. Small numbers of *L. picta* have been successfully cultured at AABC. Collection of brood stock is currently not difficult.

### **Recommended priority actions:**

1. Determine systematic and taxonomic relationships with other *Leptoxis* spp.
2. Assess need for augmentation in Alabama River tail waters
3. Assess habitat suitability in lower Cahaba and Coosa rivers to support reintroduction attempt
4. Attempt reintroductions at selected localities
5. Periodically monitor status of known populations

**Recovery potential:** Moderate, *Leptoxis picta* is currently restricted to riverine reaches of the Alabama River. The species is a large river animal and tributaries are likely too small to support populations of this species long term. To successfully establish a reproducing population in a large river will likely require a large sustained culture effort.



### 30. *Tulotoma magnifica* - Tulotoma

**Prioritization:** Tier 3; Global status: G2; Conservation status: Federal – E; AFS – T; State: AL – P1; GA – NA; MS – NA; TN - NA

**Streams with extant occurrences:** Coosa River below Jordan Dam (Elmore, Co., AL) and Logan Martin Dam tail waters (Shelby and Talladega Cos, AL), Kelly Creek (St. Clair Co., AL), Hatchet Creek (Coosa Co., AL), Weogufka Creek (Coosa Co., AL) Weoka Creek (Elmore Co., AL), Choccolocco Creek (Talladega Co., AL), Yellowleaf Creek (Shelby Co., AL), Alabama River below Claiborne (Clarke and Monroe Cos., AL), Millers Ferry (Wilcox Co., AL) and Jones Bluff dams (Dallas, Autauga and Lowndes Cos., AL).

**Population status:** Improving, monitoring and survey efforts have discovered new populations of this species and determined former populations to be stable or increasing. The USFWS has proposed down-listing to Threatened status.

**Potential reintroduction steams:** *Tulotoma magnifica* did not historically occur upstream of the middle Coosa River Basin so reintroduction into the Weiss Reservoir bypass (Cherokee Co., AL) does not appear to be an option.

**Potential augmentation streams:** Pending a habitat investigation, lower Choccolocco Creek, Talladega Co., AL may be a suitable for augmentation. Several sites in the Alabama River (Autauga, Dallas, and Wilcox Cos., AL), may support augmentation efforts.

**Biology:** Females are ovoviviparous and release fully formed young (2-4 mm shell width). The snails are found in colonies under large rocks in moderate to swift currents. Snails are likely filter feeders and may feed more actively at night. The snail's longevity is 3-5 years.

**Culture difficulty:** Unknown, no attempt has been made to culture *Tulotoma magnifica* but culture may be difficult. However, culture efforts may not be necessary because of population sizes robust enough to attempt translocations.

**Recommended priority actions:**

1. Complete status review and determine range of Alabama River populations
2. Periodically monitor status of known Coosa River Basin populations
3. Continue monitoring extant populations for drought resilience
4. Assess lower Choccolocco Creek habitat for suitability for reintroduction attempt

**Recovery potential:** High. The large source population below Jordan Dam should make recovery though translocation a viable alternative for this species if additional suitable reintroduction sites can be found.

**Appendix IV.** A summary list of priority drainages for reintroduction options in the MRB for species identified in Appendix III. The following is an initial priority list should not be considered a comprehensive of MRB reintroduction options.

Stream	Reintroduction Priorities
<b>Coosa River Basin:</b>	
Conasauga River, Polk Co., TN	<p><b>Mussels:</b> <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b> <i>Elimia striatula</i></p>
Armuchee Creek, Chattooga, Floyd & Walker Cos., GA	<p><b>Mussels:</b> <i>Hamiota altilis</i></p>
Little River, Cherokee Co., AL	<p><b>Mussels:</b> <i>Elliptio arca</i> <i>Elliptio arctata</i> <i>Medionidus acutissimus</i> <i>Medionidus parvulus</i></p>
Terrapin Creek, Cherokee, Calhoun, & Cleburne Cos., AL	<p><b>Mussels:</b> <i>Medionidus acutissimus</i> <i>Medionidus parvulus</i> <i>Pleurobema hanleyianum</i> <i>Ptychobranthus foremanianus</i> <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b> <i>Lioplax cyclostomaformis</i></p>
Coosa River, Weiss Bypass, Cherokee Co., AL	<p><b>Mussels:</b> <i>Elliptio arca</i> <i>Elliptio arctata</i> <i>Epioblasma penita</i> <i>Ligumia recta</i> <i>Medionidus acutissimus</i> <i>Medionidus parvulus</i> <i>Pleurobema georgianum</i> <i>Ptychobranthus foremanianus</i> <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b> <i>Leptoxis foremani</i> <i>Lioplax cyclostomaformis</i></p>
Big Canoe Creek, St. Clair Co., AL	<p><b>Mussels:</b> <i>Elliptio arca</i> <i>Hamiota altilis</i> <i>Ligumia recta</i> <i>Pleurobema hanleyianum</i> <i>Toxolasma corvunculus</i></p>

<b>Stream</b>	<b>Reintroduction Priorities</b>
Big Canoe Creek, St. Clair Co., AL (continued)	<p><b>Snails:</b>  <i>Elimia crenatella</i>  <i>Leptoxis taeniata</i>  <i>Lioplax cyclostomaformis</i></p>
Kelly Creek, St. Clair & Shelby Cos., AL	<p><b>Mussels:</b>  <i>Lasmigona etowaensis</i>  <i>Pleurobema athearni</i></p> <p><b>Snails:</b>  <i>Elimia crenatella</i>  <i>Leptoxis taeniata</i>  <i>Pleurocera foremani</i></p>
Shoal Creek, Cleburne Co., AL	<p><b>Mussels:</b>  <i>Medionidus parvulus</i>  <i>Pleurobema athearni</i></p>
Choccolocco Creek, Talladega, Calhoun, & Cleburne Cos., AL	<p><b>Mussels:</b>  <i>Amblema elliottii</i>  <i>Elliptio arca</i>  <i>Elliptio arctata</i>  <i>Hamiota altilis</i>  <i>Lasmigona etowaensis</i>  <i>Ligumia recta</i>  <i>Medionidus acutissimus</i>  <i>Medionidus parvulus</i>  <i>Pleurobema athearni</i>  <i>Pleurobema georgianum</i>  <i>Pleurobema hanleyianum</i>  <i>Ptychobranhus foremanianus</i>  <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b>  <i>Elimia crenatella</i>  <i>Leptoxis foremani</i>  <i>Lioplax cyclostomaformis</i>  <i>Pleurocera foremani</i></p>
Cheaha Creek, Talladega & Clay Co., AL	<p><b>Mussels:</b>  <i>Pleurobema georgianum</i></p>
Tallaseehatchee Creek, Talladega Co., AL	<p><b>Mussels:</b>  <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b>  <i>Elimia crenatella</i></p>
Yellowleaf Creek, Shelby Co., AL	<p><b>Mussels:</b>  <i>Lasmigona etowaensis</i>  <i>Strophitus connasaugaensis</i>  <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b>  <i>Leptoxis taeniata</i></p>

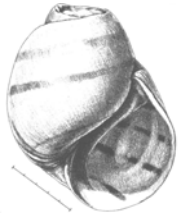
<b>Stream</b>	<b>Reintroduction Priorities</b>
Yellow Leaf Creek, Chilton Co., AL	<p><b>Mussels:</b> <i>Pleurobema georgianum</i></p>
Weogufka Creek, Coosa Co., AL	<p><b>Mussels:</b> <i>Elliptio arca</i> <i>Pleurobema georgianum</i> <i>Pleurobema hanleyianum</i> <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b> <i>Leptoxis taeniata</i></p>
Hatchet Creek, Coosa Co., AL	<p><b>Mussels:</b> <i>Elliptio arca</i> <i>Ligumia recta</i> <i>Medionidus parvulus</i> <i>Pleurobema hanleyianum</i> <i>Ptychobranchnus foremanianus</i> <i>Strophitus connasaugaensis</i> <i>Toxolasma corvunculus</i></p> <p><b>Snails:</b> <i>Elimia crenatella</i> <i>Leptoxis foremani</i> <i>Leptoxis taeniata</i> <i>Leptoxis taeniata</i> <i>Lioplax cyclostomaformis</i></p>
Coosa River, Jordon Dam Tailwater, Elmore Co., AL	<p><b>Mussels:</b> <i>Elliptio arca</i> <i>Elliptio arctata</i> <i>Hamiota altilis</i> <i>Pleurobema decisum</i> <i>Pleurobema taitianum</i> <i>Potamilus inflatus</i></p> <p><b>Snails:</b> <i>Elimia lachryma</i> <i>Elimia vanuxemiana</i> <i>Leptoxis picta</i> <i>Leptoxis taeniata</i> <i>Lioplax cyclostomaformis</i></p>
<b>Cahaba River Basin:</b>	
Cahaba River, Shelby, Bibb, Perry, Dallas Cos., AL	<p><b>Mussels:</b> <i>Elliptio arca</i> <i>Epioblasma penita</i> <i>Obovaria jacksoniana</i> <i>Obovaria unicolor</i> <i>Pleurobema rubellum</i> <i>Pleurobema taitianum</i> <i>Potamilus inflatus</i></p>

Stream	Reintroduction Priorities
	<b>Snails:</b> <i>Leptoxis picta</i>
upper Little Cahaba, Jefferson Co., AL	<b>Mussels:</b> <i>Pleurobema rubellum</i>  <b>Snails:</b> <i>Leptoxis ampla</i>
lower Shades Creek, Bibb & Shelby Co., AL	<b>Snails:</b> <i>Clappia cahabensis</i> <i>Elimia ampla</i> <i>Leptoxis ampla</i>
lower Little Cahaba, Bibb Co., AL	<b>Mussels:</b> <i>Amblema elliottii</i> <i>Elliptio arca</i> <i>Elliptio arctata</i> <i>Medionidus acutissimus</i> <i>Pleurobema perovatam</i> <i>Pleurobema rubellum</i>  <b>Snails:</b> <i>Clappia cahabensis</i> <i>Elimia ampla</i> <i>Elimia showalteri</i> <i>Elimia varians</i> <i>Leptoxis ampla</i> <i>Lepyrium showalteri</i> <i>Lioplax cyclostomaformis</i>
Sixmile Creek, Bibb Co., AL	<b>Mussels:</b> <i>Elliptio arca</i> <i>Elliptio arctata</i>  <b>Snails:</b> <i>Clappia cahabensis</i>
Schultz Creek, Bibb Co., AL	<b>Snails:</b> <i>Clappia cahabensis</i> <i>Leptoxis ampla</i>
Oakmulgee Creek, Perry & Dallas Co., AL	<b>Mussels:</b> <i>Elliptio arctata</i> <i>Obovaria unicolor</i>
<b>Black Warrior River Basin:</b>	
Mulberry Fork, Cullman, Blount, Walker Cos., AL	<b>Mussels:</b> <i>Hamiota perovalis</i> <i>Pleurobema rubellum</i> <i>Ptychobranthus greenii</i> <i>Toxolasma corvunculus</i>

<b>Stream</b>	<b>Reintroduction Priorities</b>
Mulberry Fork, Cullman, Blount, Walker Cos., AL (continued)	<b>Snails:</b> <i>Elimia hydei</i> <i>Leptoxis plicata</i> <i>Lioplax cyclostomaformis</i>
Clear Creek, Cullman Co., AL	<b>Mussels:</b> <i>Ptychobranthus greenii</i>
Locust Fork, Blount & Jefferson Co., AL	<b>Mussels:</b> <i>Hamiota perovalis</i> <i>Pleurobema rubellum</i>  <b>Snails:</b> <i>Lioplax cyclostomaformis</i>
Blackburn Fork / Little Warrior, Blount Co., AL	<b>Mussels:</b> <i>Lasmigona etowaensis</i>  <b>Snails:</b> <i>Leptoxis plicata</i>
Sipsey Fork, Winston Co., AL	<b>Mussels:</b> <i>Toxolasma corvunculus</i>
Black Warrior River, Tuscaloosa, Hale, & Greene Cos., AL	<b>Snails:</b> <i>Leptoxis plicata</i>
Big Prairie Creek, Hale Co., AL	<b>Snails:</b> <i>Lioplax cyclostomaformis</i>
<b>Alabama River Basin:</b>	
Alabama River, Autauga, Dallas, Wilcox, Monroe Cos., AL	<b>Mussels:</b> <i>Ligumia recta</i> <i>Obovaria jacksoniana</i> <i>Obovaria unicolor</i> <i>Pleurobema taitianum</i>
Big Flat Creek, Monroe Co., AL	<b>Mussels:</b> <i>Margaritifera marrianae</i> <i>Obovaria unicolor</i>
Limestone Creek, Monroe Co., AL	<b>Mussels:</b> <i>Margaritifera marrianae</i>
Tensaw River, Baldwin Co., AL	<b>Mussels:</b> <i>Ligumia recta</i>
<b>Tombigbee River Basin:</b>	
Bull Mountain Creek, Itawamba Co., MS	<b>Mussels:</b> <i>Epioblasma penita</i>

<b>Stream</b>	<b>Reintroduction Priorities</b>
Buttahatchee River, Lowndes & Monroe Cos., MS	<b>Mussels:</b> <i>Ptychobranchnus greenii</i>
Coal Fire Creek, Pickens Co., AL	<b>Mussels:</b> <i>Ptychobranchnus greenii</i>
Sucarnoochee River, Sumter Co., AL	<b>Mussels:</b> <i>Hamiota perovalis</i>

**Appendix V.** An example of a site plan completed for Mobile Basin reintroduction activities. A similar site plan should be completed and approved by the FWS and state agencies prior to stocking any federally listed species into public waters of the MRB.



**Reintroduction Proposal for the Painted Rocksnail, *Leptoxis taeniata*, in tail waters of Jordan Dam, Coosa River, Elmore County, Alabama, and Hatchet Creek, Coosa County, Alabama: March 2006**

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**Background:** The Painted Rocksnail, *Leptoxis taeniata* (Conrad 1834) historically occupied the largest range of any Rocksnail in the Mobile Basin (Goodrich, 1922). The Painted Rocksnail was historically found in the middle and lower Coosa River and tributaries and in the Alabama River downriver to Monroe County, Alabama. In the mainstem Coosa River, *L. taeniata* was distributed from Wetumpka in Elmore County, upriver to Clarence Shoals in St. Clair County (Goodrich, 1922). However, it has been eliminated from most of its range and is extant in only three Coosa River tributaries, Choccolocco Creek, Talladega County, Alabama, Buxahatchee Creek, Shelby County, Alabama, and Ohatchee Creek, Calhoun County, Alabama. The species was not recorded from the upper Coosa basin, and reports from the Cahaba River drainage were misidentified Round Rocksnails (*Leptoxis ampla*). Few historical records of the species in tributaries exist, but the Painted Rocksnail was often sympatrically distributed with *Tulotoma magnifica*. Rocksnails (*Leptoxis* spp.) in the Mobile River Basin are highly imperiled as 10 of the 15 species once found in the basin are already considered extinct. Of the 5 remaining species, 3 are federally listed (*L. ampla*, *L. plicata*, *L. taeniata*) and the others are candidates (*L. foremani*, *L. picta*).

The Painted Rocksnail was listed as threatened by the US Fish and Wildlife Service (FWS) under the Endangered Species Act (ESA) in 1998. The Painted Rocksnail was included in a recent FWS recovery plan for six Mobile Basin gastropods (FWS, 2005). Additionally, the Alabama Department of Conservation and Natural Resources (ADCNR) has listed the species as a Priority 2 (P2), species of high conservation concern, in recent state wildlife planning efforts (Mirarchi, 2005). In both the FWS and ADCNR plans, removal of the species from the endangered species list was given as the recovery objective. Delisting of the Painted Rocksnail at the federal level will be considered when the following parameters are met:

- 1) There are at least three stable, viable populations (stable or increasing) for a period of 10 years (2 to 5 generations).
- 2) There are no apparent or immediate threats to the existing populations.

Should any of the 3 remaining populations be lost, delisting could be postponed, and would likely warrant elevating the species status to endangered. Additionally, at least two of the existing populations do not currently meet the definition of a "persistent population". The FWS recovery plan defines a population as "all snails occurring within a contiguous river or stream reach extending a minimum of 30 km (18 mi.)." The extent of the species distributions are very limited in Buxahatchee and Ohatchee creeks, much smaller than 30 km stream distance. Only the Choccolocco Creek population seems to be secure, but its distribution may also be < 30 km in length. Although geographically limited, the Choccolocco Creek population is extremely robust in specific sections. In fact, densities appear to exceed 250 m<sup>2</sup> at several



locations. These populations are locally so robust they would easily support the harvest of 5,000 – 10,000 individuals for translocation efforts.

This proposal seeks to establish 2 new populations of the Painted Rocksnail, in a tributary of the Coosa River (Hatchet Creek) and in the mainstem Coosa River, by translocating a minimum of 5,000 adults from Choccolocco Creek to each location. If successful, this could establish 2 additional populations of the Painted Rocksnail, representing a major step forward in recovery.

**Reintroduction Strategy:** The reintroduction will be carried out by translocating at least 5,000 adult Painted Rocksnails from Choccolocco Creek near the CR 005 Bridge in Talladega County, into Hatchet Creek and the Coosa River. Proposed localities for the reintroductions will be as follows:

- 1) Hatchet Creek, Coosa County, Alabama, just downstream of the U.S. Hwy 280 Bridge.
- 2) Coosa River, Jordan Dam tail waters, Elmore County, Alabama, Gray's Island Shoal.

Habitat conditions at these sites appear excellent for Painted Rocksnails. Other species of Pleuroceridae (*Elimia* spp. and/or *Pleurocera parasinata*) occur at the sites in good numbers. These species were historical and currently coexist with Painted Rocksnails.

Snails will be translocated to the same sites for at least 5 years, following regular monitoring each fall at each reintroduction site. The current reintroduction strategy may be modified, after an assessment of the original attempt is completed in the fall of 2006.

The reintroduction should take place in March or April of 2006, as this will insure adult female *L. taeniata* will likely oviposit at the reintroduction localities almost immediately. Successful *L. taeniata* recruitment at either reintroduction sites will be apparent during the initial fall 2006 monitoring.

**Justification:** Painted Rocksnails were historical found in the Coosa River at Wetumpka (numerous museum records). Although no specific museum records have been located from Hatchet Creek, there are almost no historical records from the Hatchet Creek prior to 1970. Hatchet Creek is within the historical range of the species (middle and lower Coosa River and tributaries), and the proposed reintroduction site is similar in habitat to sites where the species currently survives. In addition the occurrence in Hatchet Creek of *Tulotoma magnifica* and several federally listed mussels that were sympatric with Painted Rocksnail are evidence that the species occurred there, but was never recorded. Both proposed localities, Hatchet Creek and the Coosa River below Jordan Dam are already designated as Critical Habitat by the FWS for 8 and 9 species of federally protected mussels respectively. Completion of an additional Critical Habitat designation for federally listed Mobile River Basin snails is currently pending.

This project also seeks to use the Painted Rocksnail reintroduction into Jordan Dam tail waters as a test case for determining threshold densities required for introduced snails to become established. Previous releases of the Interrupted Rocksnail (*Leptoxis foremani*) into Jordan Dam tail waters have yet to establish a reproducing population. Numbers of released Interrupted Rocksnails were necessarily small due to logistical restraints in the previous culture facility and limited brood stock availability. However, the new Alabama Aquatic Biodiversity Center (AABC) will have the potential to propagate much larger numbers of Interrupted Rocksnails within 2 years. If a reproducing population of Painted Rocksnails can be initiated by releasing larger numbers of adult snails at this site, this will suggest a range of adult production required to establish a reproducing population of the Interrupted Rocksnail at the same locality. Previous culture efforts with both species have shown that fecundity may be more limited for *L. taeniata*.

**Site preparation:** Snail densities at each reintroduction site will be estimated prior to any transplantation through Surber sampling (n = 30). Calculation of initial snail densities will assist future monitoring efforts.

**Scheduled release date:** The release will be conducted as soon as the reintroduction proposal has been approved by project partners. The reintroduction will hopefully occur by mid-April 2006.

**Future monitoring:** Following the initial translocation visual (qualitative) monitoring will occur annually with quantitative monitoring every 2 years post-release (planned for the fall, during low-water levels). Initial monitoring of reintroduction sites will begin in the autumn of 2006. Annual augmentations (using snails transplanted from Choccolocco Creek, possibly mixed with individuals from Buxahatchee and/or Ohatchee creeks) will be carried out at the same localities for at least the next 5 years (5,000 individuals per site per year). However, if no survivorship can be established at the reintroduction sites after 3 years, translocation efforts may be stopped at one or both sites. Recent reintroduction efforts with another North American pleurocerid snail (spiny river snail - *Io fluviialis*) through translocation, took 1000's of individuals and 10 years to complete successful reintroductions.

**Disease risk:** Although unknown, it is believed disease risk to any indigenous pleurocerids is minimal. Most likely, any "disease" that occurs in Choccolocco Creek is also indigenous to Hatchet Creek and lower reaches of Coosa River. Although these snails are known to harbor the cercaria stage of a parasitic trematode, direct disease transmission between individual pleurocerids has never been documented.

**Possible reintroduction locality and recovery problems:** Painted Rocksnails will be transplanted to Hatchet Creek, Coosa County, Alabama, downstream of the U.S. Hwy 280 Bridge, and Coosa River, Jordan Dam tail waters, Elmore County, Alabama, Gray's Island Shoal. Water quality and habitat conditions at these sites appear to be very favorable. Causal factors that resulted in the disappearance of Painted Rocksnails from Hatchet Creek are unknown. However, human perturbations in upper reaches of Choccolocco Creek, which is home to the best remaining population of Painted Rocksnails, are believed to be far more severe than those in Hatchet Creek. Extirpation of this species from tail waters of Jordan Dam appears to be the result of diversion of most of the river's discharge through Bouldin Dam and resultant poor water quality in the channel downstream of Jordan Dam. However, initiation of minimum flows from Jordan Dam during the mid 1990's resulted in immense habitat improvements to the tail waters. Snails and mussels which survived the years of poor flow have rebounded drastically. Problems specific to the mainstem Coosa River site include direct predation by Freshwater Drum, which is believed to be considerable. The predation levels at this location may be the critical factor limiting the establishment of a *L. foremani* population at this locality. This initial predation problem is further complicated by the size of the habitat (very large) and peaking discharge below the dam. However, if a threshold of adults can be reached, the reintroduction of a new population of *L. taeniata* in the Jordan Dam tail waters appears to be a viable recovery option.

**Alternative analysis:** Without the successful establishment of at least 3 additional populations, the Painted Rocksnail cannot be moved toward recovery and eventually delisted (FWS 2005).

Although the Coosa River population is geographically the closest to either Hatchet or the Coosa River below Jordan Dam, this population is exceedingly small. A previous survey attempt located only 7 individuals in a 1 hour dive. In fact, these numbers are too low to initiate a large captive breeding effort. Although the Buxahatchee Creek population is large enough to provide brood stock for culture efforts, it does not contain sufficient numbers to support a large translocation attempt. Although, Buxahatchee Creek is closer to the intended reintroduction sites, it would be more time intensive and expensive to culture the snails than translocate them.

The very large population of Painted Rocksnails existing in Choccolocco Creek will easily support translocation efforts, without endangering the host population (far less than 5% of the total population would be used). Additionally, translocation of a large number of individuals is preferred when establishing new populations because of increased genetic variability of the natural brood stock. *Leptoxis taeniata* is one of a few mollusks in the MRB that can be recovered through translocation attempts.

Simply augmenting existing populations in the Choccolocco Creek basin will not increase the elements of occurrence for this species, and thus cannot move the species towards de-listing.

Dams create physical barriers to natural emigration in the Coosa River basin. Therefore additional populations cannot be established naturally. A do nothing alternative will not establish new populations that promote recovery and eventual delisting of the Painted Rocksnail.

**Appendix VI.** The Mobile River Basin mollusk recovery activity reporting form. This form should be completed by the individual/organization conducting any species recovery activities in the basin. A completed form should be filed with the appropriate state agency and FWS field office, after the completion of any recovery activity. Some states (i.e. Alabama) may require additional stock reporting forms, presented in Appendix V. An electronic version of this reporting form is available from the FWS and state agencies.

**Mobile River Basin Mollusk R/A Reporting Form**

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*Note: Click on bracketed text to enter requested data. Italicized brackets are optional.*

**I. Responsible Entity**

- A. [Organization/Agency]
- B. [Project Point of Contact]  
     [Address]  
     [Phone Number(s)]  
     [Email Address]  
     "[Permit Number(s) - State and Federal]"
- C. "[Date of Report]"

**II. Type of recovery activity (check all that apply)**

Reintroduction "[{ }]"            Augmentation "[{ }]"            Translocation "[{ }]"

**III. Taxa group (check all that apply)**

Mussels "[{ }]"            Snails "[{ }]"

**IV. Type of release (check one)**

- Adult wild mollusk "[{ }]"
- Cultured sub-adult mollusk "[{ }]"
- Cultured adult mollusk "[{ }]"

**V. Collection information regarding donor brood stock**

- A. **Species:** "[Species, Common Name]"
- B. **Number collected:** [Number collected]
  - i. **Size range:** [Report min-max lengths (mm)]
  - ii. **Sex:** [Sex (enter N/A if unknown)]
- C. **Donor population condition:**
  - i. **Population estimate:** [Estimated population size]
  - ii. **Estimation method:** [e.g., visual estimate, transect sampling, census]
  - iii. **Population viability:**  
     "[Enter good, fair, poor - provide explanation if fair or poor]"
- D. **Collection date:** [Collection date]
- E. **Drainage:** [Drainage]
- F. **Latitude:** [Latitude]            **Longitude:** [Longitude]
- G. **County, State:** [County, State]

- H. **Specific locality:** [Specific locality]
- I. **Additional information:** [General comments]

**VI. Disposition of Mollusks Introduced**

- A. **Type of action:** "[Augmentation, Reintroduction, Translocation]"
- B. **Method:** "[Relocation, Laboratory transformed juveniles, or glochidia infested fish]"
- C. **If laboratory transformed juveniles, complete the following:**
  - i. **Name of facility:** [Name of facility]
  - ii. **Organization/Agency:** [Sponsoring entity]
  - iii. **Point of contact:** [POC name]
  - iv. **Address:** [POC address]
  - v. **Phone number:** [POC phone number(s)]
  - vi. **Email:** [POC email address]
  - vii. **Type(s) of holding structures:** [Holding structure(s)]
  - viii. **Monitoring schedule:** [Monitoring schedule]
  - ix. **Additional information:** [General comments]

**D. Released species data:**

- i. **Species:** "[Species, Common Name]"
- ii. **Number released:** [Number released]
  - a. **Size range:** [Report min-max lengths (mm)]
  - b. **Sex:** [Sex (enter N/A if unknown)]
  - c. **Tag type:** [Tag type]
- iii. **Release date:** [Release date]
- iv. **Drainage:** [Drainage]
- v. **Latitude:** [Latitude]      **Longitude:** [Longitude]
- vi. **County, State:** [County, State]
- vii. **Specific locality:** [Specific locality]

**E. Origin of released individuals:**

"[wild caught adult, laboratory-transformed juveniles, or glochidia infested fish]"

- i. **If glochidia-infested fish:**
  - a. **Fish species released:** [Fish species]
  - b. **Number of fish released:** [Number of fish released]
  - c. **Number of female mollusks used for glochidia production:**  
[Number of female mollusks used for glochidia production]
- ii. **If laboratory transformed juveniles:**
  - a. **Age of juveniles released:** [Age of juveniles]
  - b. **Number of female mollusks used for glochidia production:**  
[Number of female mollusks used for glochidia production]
- iii. **Release of [enter number of adults] adults and/or [enter number of juveniles] juveniles from wild, non-cultured populations.**
- iv. **Additional information:** [General comments]

**IV. Miscellaneous Reporting Information**

- A. Will data from this translocation be presented in a thesis, report, or scientific publication? [Yes/No]**
- B. If yes, provide citation and state how the publication can be accessed:  
[Citation and means of access]**

**Appendix VII.** Genetics guidelines to be considered when developing a long term hatchery based propagation program for freshwater mussels. The following table is adapted from Jones et al. (2006).

	<b>Summary</b>	<b>Justification</b>
Guideline 1:	Threats to population persistence should be identified and, when feasible, corrected prior to implementing captive propagation for a species.	Increases availability of suitable habitat for population restoration
Guideline 2:	Each mussel species targeted for recovery using propagation technology should have a recovery plan that defines: (1) necessity of genetic characterization of remaining populations, (2) number of populations to be augmented or reintroduced to effectively recover the species, (3) appropriate locations for release of juvenile mussels, (4) number of juveniles to be released per year at a site, (5) number of gravid females to be collected per year for brood stock, and (6) field and laboratory protocols to minimize genetic risks incurred by recovery activities.	Promotes implementation of hatchery activities using approved plans designed to protect genetic resources of populations
Guideline 3:	Collection of gravid female mussels for an augmentation ideally should come from the natal river, or from the closest genetically similar viable population, and that for restoring species into historical river habitat from the closest adjacent river system.	Maintains within-and among-population genetic variation
Guideline 4:	Establish an appropriate number of gravid females to be collected each year for propagation from a small population, as well as protocols to monitor survival and recruitment of artificially propagated juveniles.	Minimizes over-collection of brood stock from small populations
Guideline 5:	Maintain the largest possible genetically effective population size ( $N_e$ ) of propagated juvenile mussels by collecting an appropriate number of adult females each year to use as brood stock, and when feasible, rotate brood stock periodically.	Maintains within-population genetic variation
Guideline 6:	To avoid declines in population fitness due to outbreeding depression, populations that qualify as evolutionarily significant units (ESUs), subspecies, or closely related species should not be mixed.	Maintains among-population genetic variation
Guideline 7:	Reduce domestication selection during propagation and culture of juvenile mussels by mimicking natural life history processes, such as fish hosts, diet, temperature regimes, and	Increases progeny fitness and survival when released to the wild

<b>Summary</b>	<b>Justification</b>
<p>habitat of a targeted species as closely as possible in the hatchery.</p>	
<p>Guideline 8: Protocols are needed to prevent mixing of species or other management units through inadvertent exchanges of juveniles on laboratory equipment.</p>	<p>Maintains among population genetic variation</p>
<p>Guideline 9: Release an appropriate number of juvenile mussels from an appropriate number of parents at release sites to maximize effective population size (<math>N_e</math>), and at an early life stage to maximize survival in the wild, and to minimize the effects of domestication selection.</p>	<p>Maintains within population genetic variation and reduces domestication selection</p>
<p>Guideline 10: Monitoring, evaluation, and database management should be regarded as an integral part of any augmentation or restoration program, followed as appropriate with modification of program goals and operations procedures to promote program effectiveness.</p>	<p>Promotes program effectiveness and adaptive management</p>



**Appendix VIII.** A summary of various state agency requirements conducting mollusk survey and recovery activities within the MRB.

### **Alabama**

The Alabama Department of Conservation and Natural Resources (ADCNR) requires an approved stocking permit be completed and approved prior to any stocking activity in state waters. An electronic application for a stocking permit can be obtained from the Alabama Division of Wildlife and Freshwater Fisheries, Fisheries Section office, 64 North Union Street, Suite 551, Montgomery, AL 36130-1456 (334-242-3471). A copy of the permit application and reporting form are provided below. A signed letter of authorization from the Chief of Fisheries will be sent to the recovery partner if the stocking is allowed. Restoration of federally threatened and endangered species in state waters is authorized under the current Section 6 agreement between ADCNR and the USFWS (ADCNR 1990). Conservation partners should also contact the Alabama Aquatic Biodiversity Center (AABC, Route 3, Box 86, Marion, AL 36756; 334/683-5000) for informal consultation prior to the submission of any stocking permit for non-game species to the ADCNR Fisheries Chief.

In addition to a valid state scientific collection permit, ADCNR requires special permission to work with any state listed species. Application for state scientific collection permit and the special provision to work with state listed mussels can be obtained by contacting the Director, ADCNR, 64 North Union Street, Suite 567, Montgomery, AL 36746; Phone (334-242-3465). Conservation partners should also contact the AABC, Route 3, Box 86, Marion, AL 36756 (334-683-5000), for informal consultation prior to the initiation of any recovery activity with a state listed species. Be certain to reference the Tennessee or Mobile River Basin plans for the state list of mollusks occurring in each basin. An additional plan and species list for other gulf coastal drainages (i.e., Choctawhatchee, Conecuh) will be forthcoming, and state listed mollusk species occur in those basins that are not covered in either the Tennessee or Mobile River basin plans. The Alabama state listed mollusks found in the Mobile River Basin are:

**MUSSELS:** *Anodontooides radiatus*, Rayed Creekshell; *Elliptio arca*, Alabama Spike; *Elliptio arctata*, Delicate Spike; *Lasmigona etowaensis*, Southern Toesplitter; *Ligumia recta*, Black Sandshell; *Margaritifera marrianae*, Alabama Pearlshell; *Obovaria unicolor*, Alabama Hickorynut; *Strophitus connasaugensis*, Alabama Creekmussel; *Toxolasma corvunculus*, Southern Purple Lilliput; *Villosa umbrans*, Coosa Creekshell.

**SNAILS:** *Antrorbis breweri*, Manitou Cavesnail; *Clappia cahabensis*, Cahaba Pebblesnail; *Elimia ampla*, Ample Elimia; *Elimia annettae*, Lilyshoals Elimia; *Elimia bellacrenata*, Princess Elimia; *Elimia cochliaris*, Cockle Elimia; *Elimia hydei*, Gladiator Elimia; *Elimia lachryma*, Teardrop Elimia; *Elimia melanoïdes*, Black Mudalia; *Elimia vanuxemiana*, Cobble Elimia; *Elimia varians*, Puzzle Elimia; *Elimia variata*, Squat Elimia; *Leptoxis foremani*, Interrupted Rocksnail; *Leptoxis picta*, Spotted Rocksnail; *Pleurocera foremani*, Rough Hornsnail; *Pseudotryonia grahamae*, Salt Spring Hydrobe; *Rhodacme elatior*, Domed Ancyloid; *Stobia nana*, Sculpin Snail.

**Alabama Division of Wildlife and Freshwater Fisheries  
Fisheries Section**



**Application for Public Water Stocking Permit**



<b>PERMITTEE INFORMATION</b>			
Applicant's Name		Phone Number	Fax Number
Address		City, State, and Zip Code	
Organization			
<b>SOURCE OF FISH</b>			
Hatchery Name		Phone Number	Fax Number
Address		City, State, and Zip Code	
Name of Hatchery Owner/Manager			
<b>FISHES, MUSSELS, SNAILS OR CRAYFISHES TO BE STOCKED</b>			
Species	Stock/Strain	Size (inches)	Number
Origin of Parental Stock			
<b>WATERBODY TO BE STOCKED</b>			
Name of Waterbody		Date of Stocking	
Specific Stocking Site(s)			
County	GPS Coordinates (approximate)		
Purpose of Stocking			
List precautions taken to insure no aquatic nuisance species will be introduced with this stocking			
Explain how you will evaluate the effectiveness of this public water stocking			

**DO NOT WRITE IN THE BOX BELOW**

Application	APPROVED <input type="checkbox"/>	DENIED <input type="checkbox"/>	(see attached denial letter)
Permit Number	Issue Date	Expiration Date	

**Alabama Division of Wildlife and Freshwater Fisheries  
Fisheries Section**



**Alabama Public Water Stocking Report**



**REPORT ON THE STOCKING OF FISHES, MUSSELS, SNAILS, OR CRAYFISHES INTO  
ALABAMA PUBLIC WATERS**

*Submit report within 7 days of stocking.*

**Permit Information**

Permit Holder	Phone Number
Organization	Permit Number

**Waterbody Stocked**

Name of Water Body	County	Date of Stocking
Specific Stocking Site(s)	GPS Coordinates (LAT)	(LON)

**Fishes, Mussels, Snails, or Crayfishes Stocked**

Species	Stock/Strain	Size (inches)	Wet Weight (lbs)	Number
Total Hauling Time	Time of Stocking	Driver's Name and Phone Number		

Submit Report to:  
Alabama Division of Wildlife and Freshwater Fisheries  
Fisheries Section  
64 N. Union Street, Suite 551  
Montgomery, AL 36130  
Fax (334)242-2061

## Georgia

The Georgia Department of Natural Resources (GA-DNR) requires prior approval before release of any animal into state waters can take place. Any applicant wishing to complete species restoration work in Georgia must first have a valid GA-DNR scientific collection permit. If an individual has a valid general permit, they apply and receive an approved Animal Liberation Permit issued by the Nongame Conservation Section in conjunction with the Special Permits Unit (2065 U.S. Highway 278 SE, Social Circle, GA 30025-4714, 770-918-6411). The state malacologist should also be contacted for informal consultation (same address) prior to initiating a formal letter requesting the liberation permit. The Animal Liberation Permit Application is merely a letter requesting release activities within state waters. The letter should include: species of mussel (common and scientific name); release location, including stream, county, locality name and coordinates; brood stock source, including stream, county, locality name, and coordinates; number of animals to be released, age of released animals; any markings; and any other pertinent locality information. In the event that animals will be liberated in waters located within the boundaries of Georgia State Park property, the liberator must have scientific collecting permit issued by the GA-DNR – State Parks and Historical Sites Division and written permission to liberate animals within the park's waters. Applications for State Park Scientific Collecting Permits may be sent to the above address where they will be reviewed. Furthermore, the State of Georgia Animal Liberation Permit does not alleviate the responsibility to acquire any necessary permits required to release animals within the boundaries of U.S. Forest Service property. In the event that liberations shall be done on private lands, the liberator must include with their application, proof of permission from all applicable landowners where liberations will take place. Proof of permission can be in the form of a signed letter stating that the liberator has informed the landowner of the liberation process, explained any potential legal implications of the release, and the landowner permits this activity on his/her property and valid contact information limited to no less than the name, address, and phone number of the property owner. Upon receiving the appropriate permits, the Animal Liberation Permit as well as all letters of landowner permission must be in the possession of the person(s) conducting the release at all times. GA-DNR does have a state list of threatened and endangered species other than those listed by the USFWS.

**Mussels:** *Elliptio arca*, Alabama Spike; *Elliptio arctata*, Delicate Spike; *Pleurobema hanleyianum*, Georgia Pigtoe; *Strophitus connasaugensis*, Alabama Creekmussel; *Strophitus subvexus*, Southern Creekmussel. **Snails:** *Leptoxis foremani*, Interrupted Rocksnail.



*Scientific Research & Collection Permit Application*

Name of person requesting permit: \_\_\_\_\_

Title: \_\_\_\_\_

Institution: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_ Telephone: ( ) \_\_\_\_\_

Please note: Permits are valid until 12/31 of the current calendar year.

List the species you wish to collect, quantities and methods of capture to be used (e.g., live traps, nets, etc.)

List area (s) and park (s) in which you wish to collect.

Describe briefly what you plan to do, including problem and methods.

What will be the disposition of your specimens? (All specimens must remain part of the public domain and thus be housed in a museum, college, university, school, park or other such institution.)

Justification: Describe briefly the reason for your research or collection.

Note: If additional space is needed, please attach additional sheets.

I certify that the above information is correct and true to the best of my knowledge.

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Researcher's Signature)

**Please submit completed permits to:**  
**Nikki Castleberry**  
**State Parks Biologist**  
**Georgia Department of Natural Resources**  
**Nongame Conservation Section**  
**2065 US Hwy. 278 SE**  
**Social Circle, GA 30025-4743**  
**770-761- 3042**  
**FAX 706-557-3033**  
[nikki\\_castleberry@dnr.state.ga.us](mailto:nikki_castleberry@dnr.state.ga.us)



**To be completed by Parks & Historic Site Division**

**I recommend that this application be:**

**Approved**

**Not Approved**

\_\_\_\_\_  
**(Date)**

\_\_\_\_\_  
**(Permit Coordinator)**

**Date of Issue:** \_\_\_\_\_

**Date of Expiration:** \_\_\_\_\_

**Comments or Restrictions:**

## Mississippi

The Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) requires that a permit be issued before aquatic species can be released into the public waters of the state (Section 49-7-80, Mississippi Code of 1972), including those propagated for recovery efforts. The permit may be obtained from the MDWFP Fisheries Division, 1505 Eastover Drive, Jackson, MS 39211-6374 (601-432-2205). Recovery of federally listed species in Mississippi is authorized under a Section 6 agreement, in effect since 1985, between MDWFP and the FWS. A Mississippi administrative permit (Section 49-1-41) is required to collect or to possess any freshwater mussel in the state of Mississippi and may be issued for scientific or propagation purposes. Applications are available from the Mississippi Museum of Natural Science, 2148 Riverside Drive, Jackson, MS 39202-1353 (601-354-7303). Permits from the USFWS are also required for federally listed species. Mississippi maintains a state list of endangered species (Sections 49-5-101 through 49-5-117) in addition to those listed by the USFWS. The Mississippi state listed mollusks found in the Mobile River Basin are: *Elliptio arctata*, Delicate Spike; *Quadrula metanevra*, Monkeyface.



## **Tennessee**

The Tennessee Wildlife Resources Agency (TWRA) under TCA 70-8-106 is granted authority to establish programs deemed necessary for management of non-game, threatened, and endangered wildlife. TWRA requires a scientific collection permit (TCA 70-2-213) and approval from the state Non-Game and Endangered Species Coordinator prior to the release of any non-game species into state waters TCA 70-2-212. A letter of request must be sent to state Non-Game and Endangered Species Coordinator (TWRA, Ellington Agriculture Center, Box 40747, Nashville, TN 37204, 615-781-6500). The letter should include: species of mollusk (common and scientific name); release location, including stream, county, locality name and coordinates; brood stock source, including stream, county, locality name, and coordinates; age of released mollusks; any markings; and any other pertinent locality information. The state malacologist should also be contacted for informal consultation (same address) prior to initiating a formal letter of request.

**TENNESSEE WILDLIFE RESOURCES COMMISSION  
PROCLAMATION 00-15  
ENDANGERED OR THREATENED SPECIES**

Pursuant to the authority granted by Tennessee Code Annotated, Sections 70-8-105 and 70-8-107, the Tennessee Wildlife Resources Commission does hereby declare the following species to be endangered or threatened subject to the regulations as herein provided.

**SECTION I. ENDANGERED OR THREATENED SPECIES**

**MOLLUSKS**

**MUSSELS - Endangered**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Federal</b>
Cumberland Elktoe	<i>Alasmidonta atropurpurea</i>	E
Appalachian Elktoe	<i>Alasmidonta raveneliana</i>	E
Birdwing Pearly Mussel	<i>Lemiox rimosus</i>	E
Fanshell Mussel	<i>Cyprogonia stegaria (=irrorata)</i>	E
Dromedary Pearly Mussel	<i>Dromus dromas</i>	E
Cumberlandian Combshell	<i>Epioblasma brevidens</i>	E
Oyster Mussel	<i>Epioblasma capsaeformis</i>	E
Yellow-Blossom Pearly Mussel	<i>Epioblasma florentina florentina</i>	E
Upland Combshell	<i>E. metastrata</i>	E
Southern Acornshell	<i>E. othcaloogensis</i>	E
Green-Blossom Pearly Mussel	<i>E. torulosa gubernaculum</i>	E
Tuberculed-Blossom Pearly Mussel	<i>E. torulosa torulosa</i>	E
Turgid-Blossom Pearly Mussel	<i>E. turgidula</i>	E
Tan Riffleshell	<i>E. florentina wallkeri</i>	E
Purple Cat's Paw Pearlymussel	<i>E. obliquata obliquata</i>	E
Fine-Rayed Pigtoe	<i>Fusconaia cuneolus</i>	E
Shiny Pigtoe	<i>F. cor</i>	E
Cracking Pearly Mussel	<i>Hemistena lata</i>	E
Pink Mucket Pearly Mussel	<i>Lampsilis abrupta</i>	E
Alabama Lampmussel	<i>L. virescens</i>	E
Coosa Moccasinshell	<i>Medionidus parvulus</i>	E
Ring Pink Mussel	<i>Obovaria retusa</i>	E
Little Birdwing Pearly Mussel	<i>Pegias fabula</i>	E
White Wartyback Pearly Mussel	<i>Plethobasus cicatricosus</i>	E
Orangefooted Pearly Mussel	<i>P. cooperianus</i>	E
Clubshell	<i>Pleurobema clava</i>	E
Southern Clubshell	<i>P. decisum</i>	E
Southern Pigtoe	<i>P. georgianum</i>	E
Cumberland Pigtoe	<i>P. gibberum</i>	E
Ovate Clubshell	<i>P. perovatum</i>	E
Rough Pigtoe Pearly Mussel	<i>P. plenum</i>	E
Triangular Kidneyshell	<i>Ptychobranhus greenii</i>	E
Rough Rabbitsfoot	<i>Quadrula cylindrica strigillata</i>	E
Cumberland Monkeyface Pearly Mussel	<i>Quadrula intermedia</i>	E

<b>Common Name</b>	<b>Scientific Name</b>	<b>Federal</b>
Winged Mapleleaf Mussel	<i>Q. fragosa</i>	E
Appalachian Monkeyface Pearly Mussel	<i>Q. sparsa</i>	E
Pale Lilliput	<i>Toxolasma cylindrella</i>	E
Cumberland Bean	<i>Villosa (=Micromya) trabalis</i>	E
Purple Bean	<i>Villosa perpurpurea</i>	E

**MUSSELS – Threatened**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Federal</b>
Fine-lined Pocketbook	<i>Hamiota altilis</i>	T
Alabama Moccasinshell	<i>Medionidus acutissimus</i>	T

**SNAILS – Endangered**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Federal</b>
Painted snake coiled forest snail	<i>Anguispira picta</i>	T
Anthony's Riversnail	<i>Athearnia anthonyi</i>	E
Royal Snail	<i>Marstonia ogmorhapse</i>	E

\*Federal Status: E = Federally Endangered, T = Federally Threatened, MC = Management Concern, an unofficial indication that this species has been brought to federal attention for review for possible future federal listing