

U.S. Fish and Wildlife Service

Recovery Plan for

SIX MOBILE RIVER BASIN AQUATIC SNAILS

CYLINDRICAL LIOPLAX
FLAT PEBBLESNAIL
PLICATE ROCKSNAIL
PAINTED ROCKSNAIL
ROUND ROCKSNAIL
LACY ELIMIA



U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia



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Approved:



for Regional Director, U.S. Fish and Wildlife Service

Date:

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By approving this document, the Regional Director certifies that the information used in its development represents the best scientific and commercial data available at the time it was written. Copies of all documents reviewed in development of the plan are available in the administrative record, located at the Jackson, Mississippi, Field Office.

Literature citations should read as follows:

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5430 Grosvenor Lane, Suite 110
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EXECUTIVE SUMMARY

CURRENT STATUS: The cylindrical lioplax (E), flat pebblesnail (E), plicate rocksnail (E), painted rocksnail (T), round rocksnail (T), and lacy elimia (T) are aquatic snails that are endemic to the Mobile River Basin (Basin). All six species have disappeared from more than 90 percent of their historic ranges as a result of habitat modifications (impoundment, channelization, mining, dredging) and water quality degradation (point and nonpoint sources).

HABITAT REQUIREMENTS AND LIMITING FACTORS: All six aquatic snails inhabit shoals, rapids and riffles of large streams and rivers above the Fall Line in Alabama. All require stable hard substrates, such as boulders and cobbles, and clean unpolluted water. Limiting factors include activities which affect stream and river flow, or water and substrate quality.

RECOVERY OBJECTIVES: Specific recovery objectives for the six snail species are as follows:

- cylindrical lioplax -reclassify from endangered to threatened, and delist the species.
- flat pebblesnail -reclassify from endangered to threatened, and delist the species.
- plicate rocksnail -reclassify from endangered to threatened, and delist the species.
- painted rocksnail -delist.
- round rocksnail -delist.
- lacy elimia -delist.

RECOVERY CRITERIA: Reclassification of the cylindrical lioplax, flat pebblesnail, and plicate rocksnail will require confirmation of stability or increase in their existing populations for 10 or more years, establishment of captive populations, and identification or establishment of at least two additional populations for each species. Delisting for all six species will require the confirmation of at least three stable or increasing populations for each species for 10 or more years. Before either reclassification or delisting may be considered, threats to the species will be removed, and plans should be developed and implemented to protect and monitor water and habitat quality in the watersheds where they occur.

ACTIONS NEEDED:

- (1) Protect habitat integrity and water quality.
- (2) Develop mitigation strategies that give high priority to avoidance and restoration.
- (3) Promote increased levels of voluntary stewardship to reduce nonpoint pollution from private and public lands.
- (4) Encourage and support community based watershed stewardship planning and action.
- (5) Develop and implement public education programs and materials defining ecosystem management and stewardship responsibilities.
- (6) Conduct basic research on endemic species and apply the results of this research to management.
- (7) Develop and implement technology for maintaining and propagating endemic species in captivity.

- (8) Reintroduce imperiled aquatic species into restored habitats, as appropriate.
- (9) Monitor listed species populations.
- (10) Coordinate ecosystem management actions and species recovery efforts.

TOTAL ESTIMATED COST OF RECOVERY TASK IMPLEMENTATION: Cost of full and appropriate implementation of Federal and State regulatory authorities will be absorbed under existing programs. Implementation of recovery tasks for which cost estimates can be made over an initial 3-year period of recovery effort total \$375,000.

DATE OF RECOVERY: Estimated date of reclassification of the cylindrical lioplax, flat pebblesnail, and plicate rocksnail, and delisting the round rocksnail, painted rocksnail, and lacy elimia is 2015.

Year	Action										Total
	1	2	3	4	5	6	7	8	9	10	
2005	*	*	*	*	25	+	50	25	25		125
2006	*	*	*	*	25	+	50	25	25		125
2007	*	*	*	*	25	+	50	25	25		125
2008	*	*	*	*	25	+	50	25	25		125
2009	*	*	*	*	25	+	50	25	25		125
Total					125		250	125	125		625

(Dollar amounts listed above in thousands of dollars)

* Costs may be absorbed under existing State and Federal programs.

+ Costs absorbed under Action 7.

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Cover Photo: Cahaba River National Wildlife Refuge. Emily Hartfield, Louisiana State University

PART I: BACKGROUND

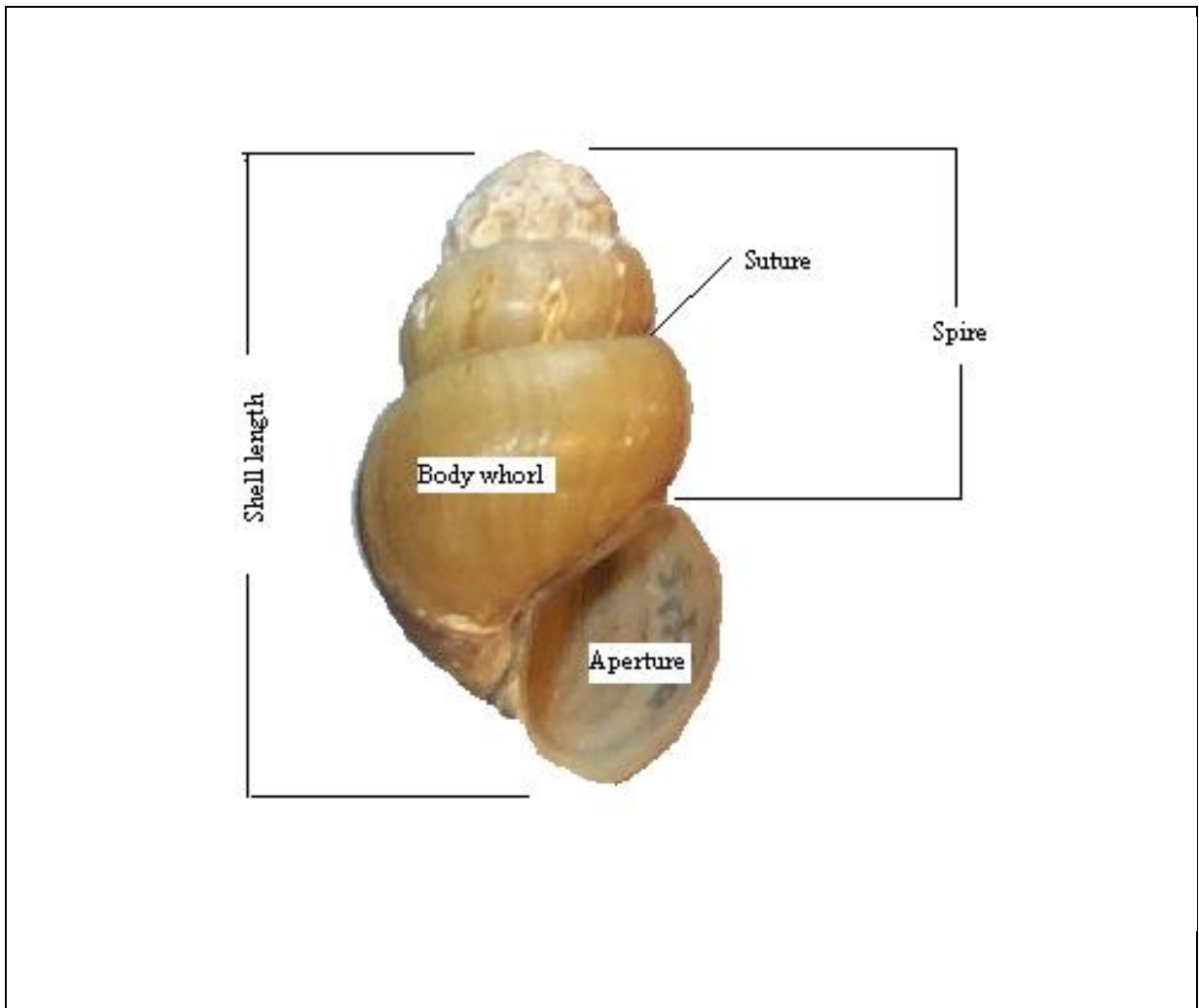
The Mobile River Basin (Basin) historically supported the most diverse aquatic snail fauna in the world (Bogan *et al.* 1995), including six genera and over 100 species that were endemic to the Basin. This fauna was severely affected by the construction of dams throughout the Basin and the inundation of extensive shoal habitats by impounded waters (Goodrich 1944, Athearn 1970, Heard 1970, Stein 1976, Palmer 1986, Garner 1990). As many as 38 aquatic snail species endemic to the Basin are currently considered extinct (Bogan *et al.* 1995). Following extensive surveys in the Basin during the early and mid 1990's, the Service listed the cylindrical lioplax, flat pebblesnail, and plicate rocksnail, as endangered, and the painted rocksnail, round rocksnail, and lacy elimia as threatened (U.S. Fish and Wildlife Service, 1998).

A total of 39 aquatic species endemic to the Mobile River Basin are now protected under the Endangered Species Act of 1973, as amended. These include 2 turtles, 11 fish, 17 mussels, 7 snails, and 2 plants. In 2000, the Service published the Mobile River Basin Aquatic Ecosystem Recovery Plan (Ecosystem Recovery Plan) to address the immediate recovery objectives of 22 of these species, and to complement recovery plans previously developed for an additional 17 aquatic species listed as threatened or endangered in the Basin (U.S. Fish and Wildlife Service, 2002). Summary accounts of the cylindrical lioplax, flat pebblesnail, plicate rocksnail, painted rocksnail, round rocksnail, and lacy elimia were included in the Ecosystem Recovery Plan, however, it was published without identifying specific recovery objectives and criteria for these six species.

This *Recovery Plan for Six Mobile River Basin Aquatic Snails* summarizes the information available on these species, and presents objectives and criteria for their recovery. The recovery strategy and tasks herein follow those outlined in the Ecosystem Recovery Plan, which should also be referred to for summaries of historical and current information on the Basin's biota, their aquatic habitats, and modern human impacts on the ecosystem. The Ecosystem Recovery Plan also provides a basic foundation for discussions and negotiations that must occur at both ecosystem and watershed levels if listed aquatic species are to be protected and recovered. Descriptions, ranges, life histories, and other information concerning each of the other 33 listed species inhabiting the Basin can be found in appendices attached to the Ecosystem Recovery Plan.

THE SPECIES ACCOUNTS

Aquatic snail species are described by size, shape, and other morphological features of their shells. Shell features used in the text are illustrated below.



Cylindrical Lioplax (*Lioplax cyclostomaformis* (Lea, 1841))



Paul Johnson, Tennessee Aquarium Research Institute

Status of the Species

Endangered, 63FR57619, October 28, 1998.

Species Description and Taxonomy

The cylindrical lioplax is a gill-breathing snail in the family Viviparidae. The shell is elongate, reaching about 28 millimeters (mm) (1.1 inches (in)) in length. Shell color is light to dark olivaceous-green externally, and bluish inside of the aperture (shell opening). The cylindrical lioplax is distinguished from other viviparid (eggs hatch internally and the young are born as juveniles) snails in the Basin by the number of whorls, and differences in size, sculpture, microsculpture, and spire angle. No other species of lioplax snails are known to occur in the Mobile Basin (see Clench and Turner, 1955 for a more detailed description).

Population Trends and Distribution

Collection records for the cylindrical lioplax exist from the Alabama River (Dallas County, Alabama), Black Warrior River (Jefferson County, Alabama) and tributaries (Prairie Creek, Marengo County, Alabama; Valley Creek, Jefferson County, Alabama); Coosa River (Shelby, Elmore counties, Alabama) and tributaries (Oothcalooga Creek, Bartow County, Georgia; Coahuila Creek, Whitfield County, Georgia; Annuchee Creek, Floyd County, Georgia; Little

Wills Creek, Etowah County, Alabama; Choccolocco Creek, Talladega County, Alabama; Yellowleaf Creek, Shelby County, Alabama); and the Cahaba River (Bibb, Shelby counties, Alabama) and its tributary, Little Cahaba River (Jefferson County, Alabama) (Clench and Turner, 1955). A single collection of this species has also been reported from the Tensas River, Madison Parish, Louisiana (Clench, 1962); however, there are no previous or subsequent records outside of the Alabama-Coosa system, and searches of the Tensas River in Louisiana by Service biologists (1995) and others (Vidrine, 1996) have found no evidence of the species or its typical habitat.

The cylindrical lioplax is currently known only from approximately 24 kilometers (km) (15 miles (mi)) of the Cahaba River above the Fall Line in Shelby and Bibb counties, Alabama (Bogan and Pierson, 1993b). Survey efforts by Davis (1974) failed to locate this snail in the Coosa or Alabama rivers, and more recent survey efforts have also failed to relocate the species at historic localities in the Alabama, Black Warrior, Little Cahaba, and Coosa rivers and their tributaries (Bogan and Pierson, 1993a, 1993b; M. Pierson, *in litt.*, 1993, 1994; Service Field Records, 1991, 1992, 1993).

Life History/Ecology

Little is known of the biology or life history of the cylindrical lioplax. It is believed to brood its young and filter-feed, as do other members of the Viviparidae. Life spans have been reported from 3 to 11 years in various species of Viviparidae (Heller, 1990). Habitat for the cylindrical lioplax is unusual for the genus, as well as for other genera of viviparid snails. It lives in isolated mud deposits found under large rocks in the rapid flowing sections of stream and river shoals. Other lioplax species are usually found along the margins of rivers in exposed muddy substrates.

Flat Pebblesnail (*Lepyrium showalteri* (Lea, 1861))



Paul Freeman, The Nature Conservancy

Status of the Species

Endangered, 63FR57619, October 28, 1998.

Species Description and Taxonomy

The flat pebblesnail is a small snail in the family Hydrobiidae; however, the species has a large and distinct shell, relative to other hydrobiid species. This snail's shell is also distinguished by its depressed spire and expanded, flattened body whorl. The shells are ovate in outline, flattened, and grow to 3.5 to 4.4 mm (0.1 to 0.2 in) high and 4 to 5 mm (0.2 in) wide. The umbilical area is imperforate (no opening), and there are 2 to 3 whorls which rapidly expand. The anatomy of this species has been described in detail by Thompson (1984).

Population Trends and Distribution

The flat pebblesnail was historically known from the mainstem Coosa River in Shelby and Talladega counties; the Cahaba River in Bibb and Dallas counties; and Little Cahaba River in Bibb County, Alabama (Thompson, 1984). The flat pebblesnail has not been found in the Coosa River portion of its range since the construction of Lay and Logan Martin Dams, and recent survey efforts have failed to locate any surviving populations outside of the Cahaba River drainage (Bogan and Pierson, 1993a, 1993b; McGregor *et al.* 1996; Service Field Records, Jackson, Mississippi, 1989-1996; Bogan *in litt.*, 1995; M. Pierson Field Records, Calera, Alabama, *in litt.*, 1993-1994; J. Garner, pers. comm., 1996; J. Johnson, *in litt.*, 1996).

The flat pebblesnail is currently known from one site on the Little Cahaba River, Bibb County, and from a single shoal series on the Cahaba River above the Fall Line, Shelby County, Alabama (Bogan and Pierson, 1993b).

Life History/Ecology

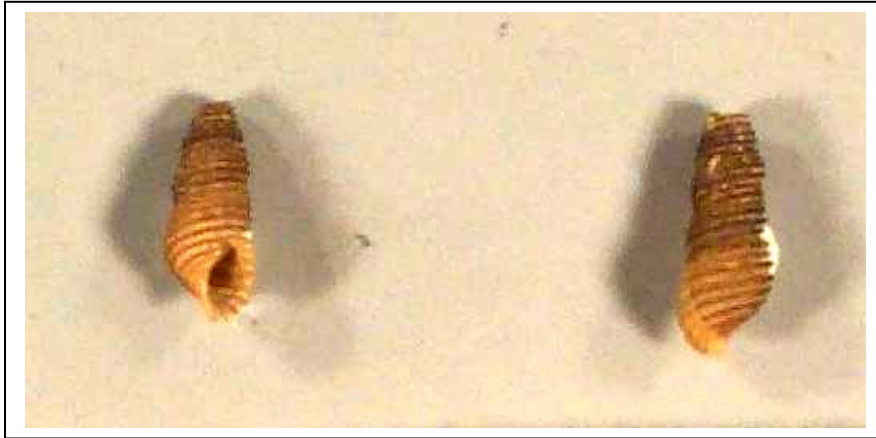
Eggs are laid in capsules on hard surfaces (Thompson, 1984). Life span appears to be 1 year (P. Johnson, pers. comm., 2005). Little else is known of the natural history of this species. The flat pebblesnail is found attached to clean, smooth stones in rapid currents of river shoals.

Flat pebblesnails and eggs.



Randall Haddock, Cahaba River Society

Lacy Elimia (*Elimia crenatella* (Lea, 1860))



Paul Johnson, Tennessee Aquarium Research Institute

Status of the Species

Threatened, 63FR57619, October 28, 1998.

Species Description and Taxonomy

The lacy elimia is a small species in the family Pleuroceridae. Growing to about 1.1 centimeters (cm) (0.4 in) in length, the shell is conic in shape, strongly striate, and often folded in the upper whorls. Shell color is dark brown to black, often purple in the aperture, and without banding. The aperture is small and ovate. The lacy elimia is easily distinguished from other elimia species by a combination of characters (i.e., size, ornamentation, color).

In a recent genetic sequence study of the 16S rRNA gene, the lacy elimia was found to be very similar to the compact elimia (*Elimia showalteri*) (Lydeard *et al.*, 1997). Despite their apparent close genetic relationship, the authors made no suggestion that the two species represented a single species. Upon review of Lydeard *et al.* (1997), Dillon (College of Charleston, Charleston, South Carolina, *in litt.*, 1997) suggested that additional genetic studies were needed to demonstrate the genetic uniqueness of the lacy elimia. However, the Lydeard *et al.* (1997) genetic study addressed only one small genetic character of the genome (entire genetic make-up of an individual) of these species, and other characters strongly support the taxonomic status of the lacy elimia. The two species are allopatric (do not overlap in distribution--the compact elimia occurs in the Cahaba River, whereas the lacy elimia is found in the Coosa River drainage), and are strikingly different in size, appearance, and behavior. The compact elimia has a large, robust, smooth shell boldly colored brown and/or green, whereas the lacy elimia has a small, delicate, darkly colored, and ornamented shell. The lacy elimia is one of the few elimia snails in the Basin that does not exhibit clinal variation (Goodrich, 1936). In addition, compact elimia are found grazing individually throughout shoal habitats, whereas the lacy elimia is usually found in

tight clusters or colonies on larger rocks within a shoal (P. Hartfield, pers. obsv.). Allopatry, morphology, and behavior are strong characters supporting species status of the lacy elimia.

Population Trends and Distribution

The lacy elimia was historically abundant in the Coosa River main stem from St. Clair to Chilton County, Alabama, and was also known in several Coosa River tributaries--Big Will's Creek, DeKalb County; Kelley's Creek, St. Clair County; and Choccolocco and Tallaseehatchee Creeks, Talladega County, Alabama (Goodrich, 1936). Currently, the lacy elimia is only known to survive in three Coosa River tributaries--Cheaha, Emauhee, and Weewoka Creeks, Talladega County, Alabama (Bogan and Pierson, 1993a).

The species is locally abundant in the lower reaches of Cheaha Creek. This stream originates within the Talladega National Forest; however, no specimens of the lacy elimia have been collected on Forest Service lands. The species has also been found at single sites in Emauhee and Weewoka creeks, where specimens are rare, and difficult to locate.

Life History/Ecology

Little is known specific to the lacy elimia, however, elimia snails are gill-breathing snails that typically inhabit highly oxygenated waters on rock shoals and gravel bars. Most species graze on periphyton (attached algae) growing on benthic (bottom) substrates. Individual snails are either male or female. Eggs are laid in early spring and hatch in about 2 weeks. Snails apparently become sexually mature in their first year, but, in some cases, females may not lay eggs until their second year. Some elimia species may live as long as 5 years (Dillon, 1988).

Painted Rocksnail (*Leptoxis taeniata* (Conrad, 1834))



Paul Johnson, Tennessee Aquarium Research Institute

Status of the Species

Threatened, 63FR57619, October 28, 1998.

Species Description and Taxonomy

The painted rocksnail is a small to medium pleurocerid snail measuring about 19 mm (0.8 in) in length, and subglobose to oval in shape. The aperture is broadly ovate, and rounded anteriorly. Coloration varies from yellowish to olive-brown, and usually with four dark bands. Some shells may not have bands and some have the bands broken into squares or oblongs (see Goodrich, 1922 for a detailed description). All of the rocksnails that historically inhabited the Mobile Basin had broadly rounded apertures, oval shaped shells, and variable coloration. Although the various species were distinguished by relative sizes, coloration patterns, and ornamentation, identification could be confusing. The painted rocksnail is the only known survivor of the 15 rocksnail species that historically occurred in the Coosa River drainage.

Population Trends and Distribution

The painted rocksnail had the largest range of any rocksnail in the Mobile River Basin (Goodrich, 1922). It was historically known from the Coosa River and tributaries from the northeastern corner of St. Clair County, Alabama, downstream into the mainstem of the Alabama River to Claiborne, Monroe County, Alabama, and the Cahaba River below the Fall Line in Perry and Dallas counties, Alabama (Goodrich, 1922, Burch, 1989). Surveys by Service biologists and others (Bogan and Pierson, 1993a, 1993b; M. Pierson, *in litt.*, 1993) in the Cahaba River, unimpounded portions of the Alabama River, and a number of free-flowing Coosa River tributaries have located only three localized Coosa River drainage populations.

The painted rocksnail is currently known from the lower reaches of three Coosa River tributaries--Choccolocco Creek, Talladega County; Buxahatchee Creek, Shelby County (Bogan and Pierson, 1993a); and Ohatchee Creek, Calhoun County, Alabama (Pierson *in litt.*, 1993).

Life History/Ecology

Painted rocksnails are gill breathing snails found attached to cobble, gravel, or other hard substrates in the strong currents of riffles (a shallow area in a streambed that causes ripples in the water) and shoals. Adult rocksnails move very little, and females probably glue their eggs to stones in the same habitat (Goodrich, 1922). Longevity in the painted rocksnail is unknown; however, Heller (1990) reported a short life span (less than 2 years) in a Tennessee River rocksnail.

Round Rocksnail (*Leptoxis ampla* (Anthony, 1855))



Paul Johnson, Tennessee Aquarium Research Institute

Status of the Species

Threatened, 63FR57619, October 28, 1998.

Species Description and Taxonomy

The round rocksnail is a pleurocerid snail that grows to about 20 mm (0.8 in) in length. The shell is subglobose, with an ovately rounded aperture. The body whorl is shouldered at the suture, and may be ornamented with folds or plicae. Color may be yellow, dark brown, or olive green, usually with four entire or broken bands (Goodrich 1922). Lydeard *et al.* (1997) found slight differences in DNA sequencing between the painted rocksnail and the round rocksnail, and considered them to be sister species. Following analysis by allozyme electrophoresis on these same species, Dillon (*in litt.*, 1997) speculated that the two species represented isolated populations belonging to a single species. The two species are geographically separated, with the painted rocksnail inhabiting Coosa River tributaries, while the round rocksnail is the only surviving rocksnail species in the Cahaba River drainage. Both species are currently recognized by the malacological community (e.g., Burch, 1989; Turgeon *et al.*, 1998).

Population Trends and Distribution

The round rocksnail was historically found in the Cahaba River and the Little Cahaba River, Bibb County, Alabama; and the Coosa River, Elmore County, and tributaries—Big Canoe and Kelly's creeks, St. Clair County; Ohatchee Creek, Calhoun County; Yellowleaf Creek, Shelby County; and Waxahatchee Creek, Shelby/Chilton counties, Alabama (Goodrich, 1922).

The round rocksnail is currently known from a shoal series in the Cahaba River, Bibb and Shelby counties, Alabama, and from the lower reach of the Little Cahaba River, and the lower reaches of Shade and Six-mile creeks in Bibb County, Alabama (Bogan and Pierson, 1993b).

Life History/Ecology

Rocksnailes are gill breathing snails found attached to cobble, gravel, or other hard substrates in the strong currents of riffles and shoals. Adult rocksnails move very little, and females probably glue their eggs to stones in the same habitat (Goodrich, 1922). Longevity in the round rocksnail is unknown; however, Heller (1990) reported a short life span (less than 2 years) in a Tennessee River rocksnail.

Plicate Rocksnail (*Leptoxis plicata* (Conrad, 1834))



Paul Johnson, Tennessee Aquarium Research Institute

Status of the Species

Endangered, 63FR57619, October 28, 1998.

Species Description and Taxonomy

The plicate rocksnail is a pleurocerid snail that grows to about 20 mm (0.8 in) in length. Shells are subglobose with broadly rounded apertures. The body whorl may be ornamented with strong folds or plicae. Shell color is usually brown, occasionally green, and often with four equidistant color bands. The columella (central column or axis) is smooth, rounded, and typically pigmented in the upper half. The aperture is usually bluish-white, occasionally pink or white. The operculum (plate that closes the shell when the snail is retracted) is dark red, and moderately thick (Goodrich, 1922). Although morphologically similar to the Basin's other three surviving rocksnail species, the plicate rocksnail is genetically distinct (Lydeard *et al.*, 1997, Dillon *in litt.*, 1997).

Population Trends and Distribution

The plicate rocksnail historically occurred in the Black Warrior River, the Little Warrior River, and the Tombigbee River (Goodrich, 1922).

Recent status surveys have located plicate rocksnail populations only in an approximately 88 km (55 mi) reach of the Locust Fork of the Black Warrior River, Jefferson and Blount counties, Alabama (Service Field Records, Jackson, Mississippi, 1991, 1992; Malcolm Pierson, Calera, Alabama, Field Notes, 1993). The latest survey information indicates that the snail has recently disappeared from the upstream two-thirds portion of that habitat and now appears to be restricted to an approximately 32 km (20 mi) reach in Jefferson County (Garner *in litt.*, 1998, Johnson 2002).

Life History/Ecology

Plicate rocksnails inhabit shallow gravel and cobble shoals in flowing waters. Although longevity has not been well documented, specimens have survived 2 years in captivity (P. Johnson, Tennessee Aquarium Research Institute, pers. comm., 2002).

REASONS FOR LISTING/CURRENT THREATS

The cylindrical lioplax, flat pebblesnail, lacy elimia, round rocksnail, painted rocksnail, and plicate rocksnail have all disappeared from more than 90 percent of their historic ranges. All of these snails are strongly associated with river or stream habitats characterized by flowing currents, and hard, clean bottoms (e.g., bedrock, boulder, gravel) (Goodrich, 1922, 1936; Clench and Turner, 1955). The curtailment of habitat and range for these six species in the Mobile Basin's larger rivers (Coosa, Alabama, Tombigbee, and Black Warrior) is primarily due to extensive construction of dams and the inundation of the snail's shoal habitats by impounded waters. Thirty dams have changed this system from a continuum of free-flowing riverine habitats into a series of impoundments connected by short, free-flowing reaches. On the Alabama River, there are 3 dams (built between 1968-1971); the Black Warrior has 5 (1915-1959); the Coosa 10 (1914-1966), and the Tombigbee 12 (1954-1979). Dams impound more than 1,770 km (1,100 mi) of river channel habitats in the Basin.

These six snail species have disappeared from all portions of their historic habitats that have been impounded by dams. As noted earlier, they are all associated with fast currents over clean, hard bottom materials. Dams change such areas by eliminating or reducing currents, and allowing sediments to accumulate on inundated channel habitats. Impounded waters also experience changes in water chemistry which could affect survival or reproduction of riverine snails. For example, many reservoirs in the Basin currently experience eutrophic (enrichment of a water body with nutrients) conditions and chronically low dissolved oxygen levels (Alabama Department of Environmental Management [ADEM], 1994, 1996). Such physical and chemical changes can affect feeding, respiration, and reproduction of these riffle and shoal snail species.

In addition to directly altering snail habitats, dams and their impounded waters also formed barriers to the movement of snails that continued to live below dams or in unimpounded tributaries. It is suspected that many such isolated colonies gradually disappear as a result of local water and habitat quality changes. Unable to emigrate (move out of the area), the isolated snail populations are vulnerable to local discharges as well as any detrimental land surface runoff within their watersheds. Although many watershed impacts have been temporary, eventually improving or even disappearing with the advent of new technology, management practices, or laws, dams and their impounded waters prevent natural recolonization by snail populations surviving elsewhere.

Prior to the passage of the Clean Water Act and the adoption of State water quality criteria, water pollution may have been a significant factor in the disappearance of snail populations from unimpounded tributaries of the Basin's impounded mainstem rivers. For example, Hurd (1974) noted the extirpation of freshwater mussel communities from several Coosa River tributaries, including the Conasauga River below Dalton, Georgia, the Chatooga River, and Tallaseehatchee Creek, apparently as a result of textile and carpet mill waste discharges. He also attributed the disappearance of the mussel fauna from the Etowah River, Talladega and Swamp creeks, and from many of the lower tributaries of the Coosa River, to organic pollution and siltation.

Short-term and long-term impacts of point and nonpoint source water and habitat

degradation continue to be a primary concern for the survival of all these snails, compounded by their isolation and localization. Point source discharges and land surface runoff (nonpoint pollution) can cause eutrophication, decreased dissolved oxygen concentration, increased acidity and conductivity, and other changes in water chemistry that are likely to seriously impact aquatic snails. Point sources of water quality degradation include municipal and industrial effluents.

Nonpoint source pollution from land surface runoff can originate from virtually all land use activities, and may include sediments, fertilizers, herbicides, pesticides, animal wastes, septic tank and gray water leakage, and oils and greases (ADEM, 1996). During recent surveys for these snails, sediment deposition and/or dense algal mats (a sign of nutrient pollution of streams) were noted at many historic collection localities where snails had disappeared (Bogan and Pierson, 1993a, 1993b; Hartfield, 1991; Service Field Observations, 1992-1994, Jackson Field Office, MS).

Excessive sediments are believed to impact riverine snails requiring clean, hard shoal stream and river bottoms, by making the habitat unsuitable for feeding or reproduction. Similar impacts resulting from sediments have been noted for many other components of aquatic communities. For example, sediments have been shown to abrade and/or suffocate periphyton (organisms attached to underwater surfaces, upon which snails may feed); affect respiration, growth, reproductive success, and behavior of aquatic insects and mussels; and affect fish growth, survival, and reproduction (Waters, 1995).

Sediment is the most abundant pollutant produced in the Basin (ADEM, 1989). Potential sediment sources within a watershed include virtually all activities that disturb the land surface, and all localities currently occupied by these snails are affected to varying degrees by sedimentation. The amount and impact of sedimentation on snail habitats may be locally correlated with the land use practice, and the degree of implementation of agriculture, forestry, and construction Best Management Practices.

Land surface runoff contributes the majority of nutrients to streams in the Mobile River Basin (Atkins *et al.*, 2004). Excessive nutrient input (from fertilizers, sewage waste, animal manure, etc.) can result in periodic low dissolved oxygen levels that are detrimental to aquatic species (Hynes, 1970). Nutrients also promote heavy algal growth that may cover and eliminate clean rock or gravel habitats of shoal dwelling snails. Nutrient and sediment pollution may have synergistic effects (a condition in which the toxic effect of two or more pollutants is much greater than the sum of the effects of the pollutants when operating individually) on freshwater snails and their habitats, as has been suggested for aquatic insects (Waters, 1995).

The cylindrical lioplax, flat pebblesnail, and the round rocksnail currently survive in localized reaches of the Cahaba River drainage. Water quality studies in the upper Cahaba River drainage by the Geological Survey of Alabama (Shepard *et al.*, 1996) found that discharges from 34 waste water treatment plants (WWTPs) in the upper drainage have contributed to water quality impairment. This was reflected by low levels of dissolved oxygen downstream of Birmingham; ammonia and chlorination by-products in excess of recommended water quality criteria; and eutrophication (demonstrated by dense algal mats and nightly sags in dissolved oxygen levels)

due to excessive levels of phosphorus and nitrogen. The study noted that these problems are chronic and have been a factor in a loss of mollusk and fish diversity throughout the drainage. Their results indicate that the upper Cahaba River drainage is primarily impacted by nonpoint runoff and WWTPs through physical habitat destruction by sedimentation, and chronic stress from exposure to toxics and low dissolved oxygen. The middle Cahaba River is primarily impacted by eutrophication and associated effects.

The lacy elimia is now restricted to three small stream channels in Talladega County, Alabama--Cheaha, Emauhee, and Weewoka creeks (Coosa River drainage). The painted rocksnail currently survives in localized reaches of three other Coosa River tributaries, Choccolocco, Buxahatchee, and Ohatchee Creeks. The plicate rocksnail inhabits a single short reach of the Locust Fork River in Jefferson County, Alabama (Black Warrior River drainage). All of these streams are variously impacted by sediments and nutrients from a variety of upstream rural, suburban, and/or urban sources. Because of their small sizes and limited flows, their water and habitat quality can be rapidly affected by local and off site pollution sources.

Aquatic snails are consumed by various vertebrate predators, including fishes, mammals, and possibly birds. Predation by naturally occurring predators is a normal aspect of the population dynamics of a species and is not considered a threat to these species. However, the potential now exists for black carp (*Mylopharyngodon piceus*), a nonselective snail eating fish recently introduced into waters of the United States, to eventually enter the Mobile River Basin. Exotic black carp escaped to the Osage River in Missouri when hatchery ponds were flooded during a 1994 spring flood of the river (LMRCC newsletter, 1994). Although black carp have been banned for use in aquaculture in the State of Alabama, they are cultured and sold within the State of Mississippi (D. Reike, Mississippi Department of Wildlife, Fisheries, and Parks, pers. comm., 1997). The extent of stocking black carp for snail control in aquaculture ponds within the Basin is currently unknown.

CONSERVATION MEASURES

The U.S. Fish and Wildlife Service, Alabama Department of Conservation and Natural Resources, Tennessee Aquarium Research Institute (TNARI), Cahaba River Society, The Nature Conservancy, Alabama Natural Heritage Program, and others, have conducted or assisted in surveys and/or monitoring of imperiled aquatic snails in the Mobile River Basin over the last three decades. These partners also assisted in developing propagation, augmentation, and reintroduction plans for imperiled Mobile River Basin mollusks (U.S. Fish and Wildlife Service, 2004). In recent years, TNARI has worked with the Service and these other partners to design and construct mollusk holding and propagation facilities, and to develop and test holding and propagation protocols. TNARI has established captive populations of plicate rocksnails, flat pebblesnails, and painted rocksnails. Hatchery produced offspring of plicate rocksnails were released into the Locust Fork in 2003; hatchery produced flat pebblesnails were released into the Cahaba River in 2004; and releases of hatchery produced painted rocksnails are planned for 2005.

PART II: RECOVERY

The U.S. Fish and Wildlife Service's goal in developing and implementing recovery plans is to improve the status of listed species to the point that protection under the Endangered Species Act is no longer required. However, imperilment and extinction in the Mobile River Basin are Basin-wide phenomena affecting all trophic levels, and are directly associated with human population density, habitat modifications to meet human needs, and/or past and current land use activities (U.S. Fish and Wildlife Service, 2000). Demands for housing, transportation, recreation, water, electricity, forest and agricultural products, waste disposal, aggregates, etc., will continue to impact the aquatic ecosystem and the Basin's imperiled species. Therefore, it is highly unlikely that recovery can be achieved, or the *status quo* of the Basin's imperiled aquatic species can be maintained, without a high degree of protection and management of the species and their habitats.

Recovery Strategy

The primary strategy of the Ecosystem Recovery Plan is to encourage stewardship and management responsibilities shared by all inhabitants of the Basin in maintaining aquatic ecosystem functions and values (U.S. Fish and Wildlife Service, 2000). Surviving populations of these snails and their habitats can be protected through appropriate application of existing laws and regulations. Conditions can be improved by encouraging higher levels of public stewardship and support in ecosystem and watershed planning. Management options and flexibility can be increased by conducting basic research on the life histories of these snail species and their habitat needs, and applying that knowledge to local and watershed activities.

Recovery Objectives

The immediate recovery objective for the cylindrical lioplax, flat pebblesnail, and plicate rocksnail is to reduce threats to a point where they may be reclassified from endangered to threatened species. Each of these three species are currently known from limited river reaches. They are isolated from areas of historic range by dams and impounded waters. Establishing additional populations within their historic range will decrease the species' vulnerability to natural or human-induced random events (i.e., droughts, floods, toxic spills, etc.). The recovery objective for all six snail species is to restore the species to viable self-sustaining levels so that they no longer require protection of the Act.

Population Criteria for Recovery

Population targets are often used as a measurement of recovery for threatened and endangered species. Unfortunately, the natural population demographics of these six snail species are unknown. At best, historical accounts note whether the species were rare, common, or abundant at a specific location and particular point in time, as based on a collector's experience. Aquatic snail species in the Mobile River Basin may be extremely abundant at locations where conditions may favor a particular species. In other locations, the same species may persist in very low

numbers. Since the relationship of abundance to long-term persistence for these six species is currently unknown, specific population targets would be purely speculative.

The numerical increase of a localized snail population over time is an obvious measurement of recovery. However, in some locations the carrying capacity of the habitat may only allow small to moderate numbers of a particular species. In other cases (e.g., cylindrical lioplax), the cryptic nature of a species (e.g., under rocks in shoals) makes it difficult or destructive to measure population numbers. In both cases, the persistence of a species over several generations may be used to demonstrate successful reproduction, recruitment, and therefore, successful management.

Life spans in the wild for pebblesnails, rocksnails, and elimia snails are probably 1 to 4 years. Life spans of viviparid snails may be longer (3 to 11 years), however, based on size, thickness, and condition of living and dead cylindrical lioplax shells collected in the Cahaba River, it is unlikely that life span of this species exceeds 5 years (P. Hartfield, pers. obsv.). Therefore, a 10 year period should span 2 to 5 generations of these six species.

Criteria for reclassification to threatened status (Cylindrical Lioplax, Flat Pebblesnail, Plicate Rocksnail)

The cylindrical lioplax, flat pebblesnail, and plicate rocksnail, will be considered for reclassification to threatened status when the following criteria are met:

1. The existing population has been shown to be stable or increasing over a period of 10 years (2 to 5 generations). This may be measured by numbers/area, catch per unit/effort, or other methods developed through population monitoring, and must be demonstrated through annual monitoring.
2. There are no apparent or immediate threats to the listed population (see Listing/Recovery Criteria, below).
3. A captive population has been established at an appropriate facility, and the species has been successfully propagated.
4. A minimum of two additional populations have been established (or discovered) within historic range.

Recovery tasks specifically addressing these benchmarks include 6.1, 6.3, 6.4, 7, 8.1, 8.2, and 8.3.

Criteria for delisting species:

The lacy elimia, round rocksnail, painted rocksnail, cylindrical lioplax, flat pebblesnail, and plicate rocksnail will be considered for delisting when:

1. A minimum of 3 natural or re-established populations have been shown to be persistent (i.e., stable or increasing) for a period of 10 years (2 to 5 generations).
2. There are no apparent or immediate threats to the populations (see Listing/Recovery Factor Criteria, below).

A population is defined as all snails occurring within a contiguous river or stream reach extending a minimum of 30 km (18 mi). Snails in a recovered population should be easily found in appropriate habitat throughout the occupied reach.

Listing/Recovery Factor Criteria

The following criteria (Factors A through E) apply equally to downlisting or delisting objectives identified above. These criteria are linked to specific recovery tasks and will serve to measure progress in removing threats to the species.

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

To provide assurance of population stability when any of the six species increase to the levels specified under the population criteria, threats to their habitat must be reduced as specified under this factor. Populations of the six species have declined in response to a wide variety of impacts upon streams and their watersheds (see Endangered Status for Three Aquatic Snails and Threatened Status for Three Aquatic Snails in the Mobile River Basin [63 FR 57610] and Mobile River Basin Aquatic Ecosystem Recovery Plan: Aquatic Ecosystem Impacts and Their Effects on Biota, and Current and Future Threats to the Basin's Imperiled Species [U.S. Fish and Wildlife Service, 2000]). Therefore, reducing threats to their habitat must be accomplished through a broad application of measures that focus on protecting stable natural stream channels and riparian zones, and protecting or improving water quality and quantity. Effective watershed conservation will not only reduce habitat threats to the listed snails, but it will also benefit more common aquatic species.

The following criteria shall serve to indicate a reduction in habitat threats:

- 1) Streams supporting populations of the six snails are not subject to impoundment. Habitat loss and fragmentation due to impoundment was the major cause of decline of these six snails. There should be no pending permits, applications, or known future projects considering impoundment of recovery habitats. Recovery Task 1 will contribute to habitat protection.
- 2) Stream channels at all sites occupied by the snails are stable (not actively aggrading or degrading or undergoing excessive bank erosion) and adjacent riparian zones are adequately vegetated. Recovery Tasks 1, 2, 3, and 4 will contribute towards achieving this criterion.

3) Water quality and quantity are fully supporting a minimum designated use of fishing or fish and wildlife habitat (as reported by the states under Section 305(b) of the Clean Water Act) in all stream reaches where the snails occur. Water pollution is believed to have been a significant factor in the disappearance of snail populations from unimpounded portions of their historic habitat. Degraded water quality, particularly due to sedimentation and eutrophication, currently prevents these species from expanding into portions of historical habitat. Recovery Tasks 1, 2, 3, and 4 will contribute towards achieving this criterion.

Factor B. Overutilization for commercial, recreational, scientific, or educational purposes.

Overutilization has not been implicated in the decline of these species. The potential of overutilization, however, should be assessed prior to reclassification.

Factor C: Disease or predation.

Drainages supporting the snails should be free of the introduced black carp.

Factor D: The inadequacy of existing regulatory mechanisms.

A lack of adequate research and data regarding sensitivities of these snails to certain pollutants may prevent agencies from exercising their existing regulatory authorities. Establishing and monitoring multiple populations of each species and their habitats will provide a measure of protection from unknown pollutants. Recovery Tasks 6.1 and 6.3 will provide a mechanism to identify and address any existing problems.

Factor E: Other natural or manmade factors affecting its continued existence.

Vulnerability to natural or manmade random catastrophic events will be reduced by increasing the number of populations of each species and by extending the range of individual populations, as outlined under the Criteria, above. Recovery Tasks 7 and 8 will contribute to reducing this threat. Genetic diversity and strategies for addressing potential problems will be addressed by Recovery Task 6.2

Recovery Narrative

The following recovery tasks are taken from the Mobile River Basin Aquatic Ecosystem Recovery Plan (U.S. Fish and Wildlife Service, 2000). They were developed to support the recovery of all endangered and threatened aquatic species in the Basin.

1. **Protect habitat integrity and quality of river and stream segments that currently support or could support imperiled aquatic species.** Stemming the decline and loss of instream aquatic habitats throughout the Basin is essential for maintenance and management of the species and communities these habitats support. River and stream reaches known to be occupied by endangered or threatened aquatic species are generally protected by provisions of the Endangered Species Act from projects and actions that would adversely affect instream habitats. However, many high quality stream and river reaches currently without known listed populations may contain other unlisted imperiled species, or may be suitable for eventual restocking with listed aquatic species. Providing a higher degree of consideration for such areas will maintain options essential for the successful management of isolated populations within a fragmented ecosystem. Regulatory agencies, municipalities, businesses and industries, and private land owners should thoroughly consider and apply creative alternatives to habitat modification, waste disposal, and other impacts to the aquatic ecosystem. The key to successful recovery planning that minimizes impacts to both listed species and stakeholders is vigilant monitoring and management of remaining instream habitats through informed participation by all stakeholders.
 - 1.1 **Identify for protection free flowing stream and river reaches that support high native aquatic biodiversity.** Identification brings recognition of special protection needs. River and stream reaches in the Basin that support historically occurring, reproducing endemic species and communities are valuable but diminishing resources and should be recognized by regulatory agencies and given appropriate consideration to mitigate (i.e., avoid, minimize, or compensate for) adverse impacts.
 - 1.2 **Minimize aquatic habitat impacts resulting from activities or permits conducted or issued by regulatory authorities.** Major habitat modifications that have had the most serious impacts on the aquatic biota of the Basin have been either constructed or authorized by Federal and/or State regulatory agencies. Future modifications for flood control, navigation, water supply, mining, etc. must be fully considered for need and alternatives. Practical alternatives such as floodplain easement purchases, relocation of floodplain structures or activities, protection of headwater wetlands, etc., should be used where and when appropriate. All construction activities permitted or conducted by Federal, State, County, or other local regulatory authority should effectively implement Best Management Practices for stormwater runoff and sediment control.

- 1.3 **Encourage development and implementation of appropriate guidelines for mining sand and gravel from alluvial channels and floodplains.** Mining for sand and gravel within river and stream channels should be tightly regulated. Such activities, including the mining of point bars can change the geometry of the channel and result in channel adjustment, upstream channel degradation and bank erosion, and downstream sediment deposition and turbidity. In a study conducted for the U.S. Army Corps of Engineers, Mobile District, Simons *et al.* (1982) made recommendations to avoid channel degradation from gravel dredging operations within the Tennessee-Tombigbee Waterway. These included developing quantitative safe yield analyses prior to mining, before and after extraction hydrographic surveys of the channel, and maintenance of extraction amount records. Floodplain sand and gravel mines can be environmentally sound and economical sources of aggregates; however, improperly designed or sited mines can also initiate channel adjustment problems. Appropriate State agencies in the Basin should develop and implement guidelines to ensure that floodplain mines are properly designed and located, adequate buffer strips between mines and stream channels are maintained, waste treatment and discharges are monitored, and mine sites are rehabilitated upon closure. Geomorphic studies should be conducted on free flowing streams with current or past sand and gravel mining operations. Appropriate actions should be taken to protect stream channel integrity where geomorphic problems are identified.
- 1.4 **Work with States under the Triennial Review Process to ensure water quality standards and water use classifications that provide for ecosystem stabilization.** In many streams and rivers, even where instream physical habitats remain adequate, water quality degradation has caused the extirpation of entire faunal assemblages (e.g., pleurocerid snails and freshwater mussels in the Mulberry Fork, Black Warrior River drainage), or significantly reduced species diversity (e.g., mussels in the Cahaba and Coosa River drainages). Although measures taken to improve water quality over the past two decades have generally been effective, in some stream segments they have been overwhelmed by local increases in urban and agricultural runoff, and/or industrial and municipal discharges. Protection of water quality into the next century will require strict adherence to current standards and regulations. In some cases, changes of the standards and criteria may be necessary. Water quality standards and classifications of each State in the Basin are reviewed and revised at 3-year intervals. State water quality classifications, waste load allocation models, permit review processes, and other important water quality actions should be revised where appropriate studies have identified and quantified inadequacies.
- 1.5 **Promote and support a watershed management approach to water quality.** A watershed management approach synchronizes water quality monitoring, inspections, and permitting within a defined watershed (see Appendix F (2) in Ecosystem Recovery Plan). It has the potential of integrating imperiled species habitat concerns with all other water quality issues, including economic and

human health, within the defined watershed. Such an approach allows a greater degree of public education about, and involvement with, local water quality issues and decisions. It may also be useful in providing community incentive to reduce nonpoint source impacts to water quality

- 1.51 **Develop coordinated plans to address sanitary wastewater treatment plant effluents within severely impacted watersheds.** Sanitary wastewater treatment plant effluents are a major contributor to stream eutrophication, particularly in urban areas. Many wastewater treatment plants need to be upgraded as necessary to protect aquatic resources. Alternative methods of handling urban and suburban wastes, such as constructed wetlands or land application, need to be investigated and adopted where possible.
- 1.52 **Encourage alternative disinfection measures for the treatment of sewage wastes in sensitive watersheds.** Residual chlorine and certain other wastewater components resulting from disinfectant procedures are toxic to aquatic organisms. There may be adverse long-term impacts from these diluted discharges on the survival and reproduction of the Basin's endemic aquatic fauna. The nature and extent of such impacts are currently unknown. However, many listed and imperiled aquatic species have disappeared from receiving stream reaches. Alternative disinfectant techniques, such as treatment with ultraviolet radiation, ozone, etc., are available and should be considered for use in sensitive watersheds, i.e., those with listed species and/or endemic communities.
- 1.53 **Encourage compliance with current water quality discharge limitations and regulations.** Current State and Federal enforcement programs should ensure consistent compliance with National Pollution Discharge Elimination System (NPDES) permit conditions and discharge limitations. Regulated industrial, sewage treatment plant, surface mine permitted discharges, and stormwater runoff should be monitored with sufficient frequency to ensure compliance with water quality standards. Unpermitted discharges should be identified and brought into compliance. Increased public involvement and attention to watershed conditions may provide opportunities for community based monitoring.
- 1.54 **Encourage effective silt and sediment runoff control from all construction activities.** Uncontrolled sediments from temporary construction activities contribute to river and stream degradation. Excess sediments may smother stream bottom habitats and/or result in erosion and other channel changes. Construction contractors should be encouraged to use and maintain effective sediment control techniques and dispose of excess sediments such that these materials will not eventually reach surface waters.

1.55 **Encourage consideration of standards for water withdrawal from tributary streams in States drained by the Basin.** Water withdrawal from streams for irrigation and other uses severely affects some streams in the Basin during low flow periods. Surface water demands for domestic, industrial, and irrigation purposes will likely continue to increase. Identifying and adopting sustainable minimum flow standards applicable to water withdrawals will protect aquatic resources and communities, encourage consideration of alternative technology, and reduce future conflicts.

2. **Consider options for free-flowing river and stream mitigation strategies that give high priority to avoidance and restoration.** As noted above, avoidance of impact is the most important and immediate management need for maintaining existing imperiled populations and their habitats. However, long-term management requires the ability to accommodate changes in human use of the Basin's resources. Restoration of stream and river reaches, and rehabilitation of their aquatic communities will increase management options to accommodate future changes within the Basin. Compensating for aquatic habitat impacts can be an important component of aquatic habitat management.

2.1 **Identify appropriate mitigation measures for free flowing streams and rivers.** When destruction or alteration of stream or river habitat is unavoidable, there should be an effort to restore or rehabilitate a comparable amount of instream aquatic habitat elsewhere in the Basin. Unfortunately, there is little guidance or consensus for the amount and degree of measures that could satisfy mitigation goals for free flowing riverine habitat. Federal, State, and local environmental and regulatory agencies and nongovernmental interests must work toward consensus on this problem, considering issues such as amount, quality, and location of river or stream segments under consideration for mitigation measures, and other alternatives, such as the need and possibility of establishing mitigation banks for permit applicants.

2.11 **Investigate the potential of partnerships and assistance to relieve land use problems within watersheds as a form of mitigation.** Concentrated land uses within watersheds can overwhelm the benefits of individual landowner Best Management Practices (BMPs). Animal wastes from concentrated husbandry of poultry, fish, and livestock is a major determinant of water quality in some watersheds. Urbanization of watersheds also causes complex runoff/water quality problems. Such problem areas may offer creative mitigation opportunities. Examples include developing equipment, facilities, or other components to establish centralized waste treatment for areas of high concentration of poultry farms and other animal feedlots; and providing assistance to communities for stormwater catchment and treatment.

3. **Promote voluntary stewardship as a practical and economical means of reducing nonpoint pollution from private land use.** BMPs can be effective and practical actions identified to prevent or reduce nonpoint pollution from specific land use activities (ADEM, 1989). For example, agricultural BMPs are designed to reduce sediments, animal wastes, fertilizers, and pesticides in stormwater runoff (e.g., Alabama Soil and Water Conservation Committee (ASWCC), 1995). Mining BMPs address sediments and water quality parameters such as acidity and metal concentrations (e.g., ADEM, 1989). Silviculture BMPs include actions to minimize sediments, nutrients, organics, chemicals, and stream canopy removal (e.g., Alabama Forestry Commission, 1993). BMPs are also available for urban, construction, and homeowner activities that address stormwater runoff quality and quantity (ASWCC, 1992, MSDEQ, 1994). BMPs are developed by State and industry planning partnerships with public participation, and can be effective when they are properly implemented and adequately maintained. BMPs, however, are not always fully implemented or maintained. Industry groups and organizations, and State resource agencies should continue to promote and improve BMPs when necessary as a nonregulatory approach to aquatic ecosystem management.

3.1 **Work with State and private partners to promote land and water stewardship awareness.** Local offices of State and Federal agencies and private organizations can become a primary source of encouragement and information for imperiled species and aquatic ecosystem management. For example, local offices (e.g, Soil and Water Conservation Districts, Natural Resources Conservation Service, State Forestry Commissions, private industry groups, environmental groups, etc.) can identify watersheds with listed species within their areas; inform local landowners of listed species' presence, needs, and special management concerns; recommend appropriate BMPs; and mediate landowner concerns or conflicts with appropriate State and/or Federal agencies. In some watersheds, standard BMPs may need to be adjusted according to stream size, soil conditions, and land use intensity. Private industry groups can work with local landowners to customize BMPs where needed to address watershed problems and practices.

3.2 **Encourage the development and implementation of adequate Streamside Management Zones (SMZs) along all streams and rivers in the Basin.** Properly designed SMZs, which act as filter strips, can buffer the impacts of land use activities on water and stream bottom habitat quality. SMZs protect public and private property from erosion, reduce downstream sedimentation, and enhance fish and wildlife values for both game and nongame species. SMZs can also reduce nutrient levels in tributary streams in the Basin, which will help control eutrophication in Basin reservoirs (see Part I, Section C in Ecosystem Recovery Plan). Some farmlands adjacent to streams and rivers may qualify for SMZ set aside under the U.S. Department of Agriculture's Conservation Reserve Program and other initiatives. SMZs are widely recognized as cost effective habitat management practices. For example, the American Forest and Paper Association's Sustainable Forestry Initiative requires its members to meet or exceed existing SMZ state standards. SMZs may be custom designed to protect

stream habitat while achieving individual landowners management objectives. For example, the Natural Resources Conservation Service recommends SMZs from 22 to 91 meters (75 to 300 feet), with varying restrictions, depending on soil, slope, topography, and land use. Other government agencies and private groups make similar recommendations. SMZs are also effective in controlling urban and suburban stormwater runoff.

4. **Encourage and support community based watershed stewardship planning and action.** Protection, restoration, and management planning for imperiled aquatic habitats is best accomplished by partners and stakeholders within a watershed. Such grassroots community planning educates participants about aquatic species, their habitat needs, and sensitivities; acknowledges local activities, problems and their effects on water; and leads to consensus based local solutions. Stewardship partnerships are essential in watersheds supporting listed or other imperiled aquatic species, and should be encouraged within any of the Basin's watersheds. Resource and regulatory agencies should offer support, materials, and technical and facilitation assistance when requested.
 - 4.1 **Reduce private land use/endangered species conflicts.** Landowners and other watershed residents may feel threatened by the presence of listed aquatic species, and be reluctant to participate in watershed stewardship planning or action. In such cases, Watershed Habitat Conservation Plans, Safe Harbor Agreements, or other innovative avenues to assure and guarantee private land uses within watersheds should be developed.
5. **Develop and implement programs to educate the public on the need and benefits of ecosystem management, and to involve them in watershed stewardship.** Only an informed and proactive public can bring about ecosystem stabilization and rehabilitation. Successful ecosystem management will require public involvement, monitoring, and commitment of resources. Educational materials and programs should describe the concept and need for ecosystem management, its long-term economic and environmental advantages, and public and individual stewardship responsibilities.
6. **Conduct basic research on endemic aquatic species and apply the results toward management and protection of aquatic communities.** The biology and ecology of endemic aquatic species in the Basin are poorly known. Information on distribution, habitat requirements, life stage sensitivity to contaminants, and the identification of mussel host fish is essential to the recovery of endemic species and management and protection of their communities and habitats. All partners should be aware of research efforts and results, so that information can be immediately applied.
 - 6.1 **Survey and monitor the status of listed and other endemic aquatic species.** Extant populations of listed and other endemic species should be located and their status monitored.
 - 6.2 **Conduct detailed physical and molecular genetic analyses of endemic species.**

Most of the Basin's endemic aquatic species have not been fully described anatomically. This information, in conjunction with genetic biochemical comparisons of populations and related species, may provide information important to population management and recovery.

- 6.3 **Determine contaminant sensitivity for each life stage.** It is known that juvenile and adult life stages of aquatic fauna may differ in sensitivity to contaminants. The technology and methodology should be developed to determine sub-lethal and lethal levels of pesticides, herbicides, and common contaminants and discharges to listed species and other endemic organisms in the Basin.
- 6.4 **Conduct life history research on endemic species to include reproduction, food habits, age and growth, mortality factors. etc..** Life history information may provide insight into past declines, current status of endemic species, weak links in the life cycle, and management guidance for their recovery.
 - 6.41 **Determine nutritional requirements of endemic species life stages.** It is possible that juvenile forms of many taxa feed on different items than adults. Such requirements may be limiting factors in the survival of these species. Nutritional requirements must be known for successful captive propagation of endemic species (see Task 7).
7. **Develop and implement technology for maintaining and propagating endemic species in captivity.** Populations of endemic species in the Basin are isolated by large expanses of impounded, or otherwise severely altered, habitat. Maintenance of genetic flow between extant populations, and reintroduction of species to restored habitats, will require human intervention. Populations of many species are currently too low to justify translocation of wild stock between drainages. Captive propagation will be required to produce reintroduction stock if ecosystem restoration is eventually successful (see Task 8). Large numbers of juveniles and adults will also be needed for research to determine sensitivity of species to common contaminants (Task 6.3).
8. **Reintroduce aquatic species into restored habitats, as appropriate.** For many listed species, this step will be possible only when, and if, successful captive propagation technology is developed. Reintroduction will be closely coordinated with appropriate State agencies and affected private landowners. No reintroduction or translocation of species should be made without the concurrence of the appropriate State wildlife resource agencies and the knowledge and consensus of local watershed residents.
 - 8.1 **Identify sites for translocation/reintroduction.** Potential sites for reintroduction consist of streams within the historic range of endemic species that meet the substrate, flow, water quality, and other environmental requirements of the species. Such sites need to be identified and monitored.

- 8.11 **Survey and prioritize potential sites.** Water quality, substrate composition, aquatic community composition, and watershed land uses should be characterized. Priority should be given to watersheds with appropriate habitat, diverse faunal assemblages, minimal land use impacts, and active management programs.
 - 8.2 **Translocate target endemic species to priority sites.** Translocations should be conducted in a rigorous, scientific manner, and should be well-documented.
 - 8.3 **Monitor translocated populations.** Stream and river reaches with translocated populations should be monitored and surveyed annually for a minimum of 10 years following translocation.
9. **Monitor listed species population levels and distribution and periodically review ecosystem management strategy.** Listed species will be monitored by Tasks 6.1 and 8.3. Changes in distribution (losses and gains) should be used to focus recovery efforts and priorities. Ecosystem management strategy should be periodically reviewed and revised, if appropriate, based on this information.
10. **Coordinate ecosystem management actions.** The above recovery tasks approach ecosystem stabilization and management on three tiers: Federal and State regulatory authority and responsibility; private activities, public education and involvement; and research. Implementation of these tasks will involve multiple partners including State and Federal agencies, municipal and county governments, environmental and recreational organizations, civic groups, educational and research institutions, business and industry groups, landowners, and interested individuals. Successful implementation requires development of partnerships, coordination of on-going activities, determination and prioritization of needed actions, and monitoring recovery progress within each of the Basin's major drainages.

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PART III: IMPLEMENTATION SCHEDULE

Recovery plans are intended to assist the U.S. Fish and Wildlife Service and potential Federal, State, and private partners in planning and implementing actions to recover and/or protect endangered and threatened species. The following Implementation Schedule outlines recovery actions and their estimated costs for the first 3 years of this recovery program. It is a guide for planning and meeting the objectives discussed in Part II of this plan. The Schedule indicates task priorities, task numbers, task descriptions, duration of tasks, potential partners and responsible agencies, and lastly, estimated costs.

Recovery tasks are assigned numerical priorities to highlight the relative contribution they may make to species recovery. Priorities in column 1 of the Implementation Schedule are assigned as follows:

- 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
- 3 - All other actions necessary to provide for full recovery of the species.

While the Endangered Species Act assigns a strong leadership role for the U.S. Fish and Wildlife Service in recovery of listed species, it also recognizes the importance of other Federal agencies, States, and private citizens in the recovery process. The Responsible Agency column of the Implementation Schedule identifies partners who can make significant contributions to specific recovery tasks. **The identification of agencies within the Schedule does not constitute any additional legal responsibilities beyond existing authorities, i.e., Endangered Species Act, Federal Land Policy and Management Act, Clean Water Act, etc.. Recovery plans do not obligate other parties to undertake specific tasks and may not represent the views nor the official positions or approval of any individuals or agencies involved in developing the plan, other than the U.S. Fish and Wildlife Service.**

The Cost Estimates provided in the Implementation Schedule identify foreseeable expenditures that could be made to implement the specific recovery tasks during a three year period. **Actual expenditures by identified agencies/partners will be contingent upon appropriations and other budgetary constraints.**

Key to acronyms used in Implementation Schedule:

USFWS	-U.S. Fish and Wildlife Service
ES	-Ecological Services Division
USDA	-U.S. Department of Agriculture, includes Forest Service and Natural Resources Conservation Service
COE	-Corps of Engineers
EPA	-Environmental Protection Agency
ALOWR	-Alabama Office of Water Resources
ADEM	-Alabama Department of Environmental Management
ADCNR	-Alabama Department of Conservation and Natural Resources

Other State and Federal agencies which may participate in implementation:

- Alabama Department of Conservation and Natural Resources
- Alabama Forestry Commission
- Alabama Department of Industrial Relations
- Alabama Surface Mining Commission
- Office of Surface Mining
- Tennessee Valley Authority
- U.S. Geological Survey

Other partners and stakeholders may include concerned businesses and industries, research institutions, County and City governments, private landowners, conservation organizations, etc..

Implementation Schedule

PRIORITY #	(1) TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY			COST ESTIMATES					COMMENTS/ NOTES
				USFWS		OTHER	FY 1	FY 2	FY 3	FY4	FY5	
				REGION	DIVISION							
1	1.0	Protect habitat integrity and quality	continuous	4	ES	All partners and stakeholders						Cost may be absorbed under existing programs
2	1.1	Identify stream and river reaches	continuous	4	ES	Appropriate State and Federal agencies						Cost may be absorbed under existing programs
2	1.2	Minimize aquatic habitat impacts	continuous	4	ES	Federal, State Agencies, County and local governments						Cost may be absorbed under existing programs
2	1.3	Encourage development and implementation of mining guidelines	5 years	4	ES	COE, EPA, State Governments						Cost may be absorbed under existing programs
2	1.4	Work with States to ensure water quality	continuous	4	ES	EPA, ADEM						Cost may be absorbed under existing programs
2	1.5	Promote and support a watershed management approach to water quality	continuous	4	ES	EPA, ADEM						Cost may be absorbed under existing programs
2	1.51	Develop coordinated plans to address WTP effluents within watersheds	5 years	4	ES	EPA, ADEM, other State and local partners						Cost may be absorbed under existing programs
2	1.52	Encourage alternative STP disinfection measures	5 years	4	ES	EPA, ADEM						Cost may be absorbed under existing programs
2	1.53	Encourage compliance with current water quality discharge limitations	continuous	4	ES	EPA, ADEM						Cost may be absorbed under existing programs
1	1.54	Encourage effective silt and sediment runoff control	continuous	4	ES	EPA, USDA, ADEM						Cost may be absorbed under existing programs
2	1.55	Encourage standards for water withdrawal from tributary streams	5 years	4	ES	EPA, COE, ADEM						Cost may be absorbed under existing programs

(1) For a complete task description, refer to the narrative outline.

(2) Reflects cost only for the implementation of the recovery task.

Implementation Schedule

PRIORITY #	(1) TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY			COST ESTIMATES					COMMENTS/ NOTES
				USFWS		OTHER	FY 1	FY 2	FY 3	FY4	FY5	
				REGION	DIVISION							
2	2.0	Consider options for river and stream mitigation	Continuous	4	ES	COE, EPA, USDA State Agencies						Cost may be absorbed under existing programs
2	2.1	Identify appropriate mitigation measures	3 years	4	ES	COE, EPA, USDA, State Agencies						Costs determined by measures recommended
2	2.11	Investigate partnerships and landowner assistance	3 years	4	ES	COE, EPA, USDA, State Agencies						Costs determined by measures recommended
2	3.0	Promote voluntary private land stewardship to reduce nonpoint pollution	Continuous	4	ES	All involved agencies and partners						Cost may be absorbed under existing programs
3	3.1	Promote land and water stewardship awareness	Continuous	4	ES	All involved agencies and partners						Cost may be absorbed under existing programs
2	3.2	Encourage development and implementation of adequate Streamside Management Zones	5 years	4	ES	All involved agencies and partners						Some costs may be absorbed under existing programs
2	4.0	Encourage and support community based watershed planning and action	Continuous	4	ES	All involved agencies and partners						Cost may be absorbed under existing programs
3	4.1	Reduce land use/endangered species conflicts	Indefinite	4	ES	All involved agencies and partners						Cost may be absorbed under existing programs
1	5.0	Educate and involve the public in watershed stewardship	Continuous	4	ES	All involved agencies and partners	25	25	25	25	25	

Implementation Schedule

PRIORITY #	(1) TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY			COST ESTIMATES					COMMENTS/ NOTES
				USFWS		OTHER	FY 1	FY 2	FY 3	FY 4	FY 5	
				REGION	DIVISION							
1	6.1	Survey and monitor imperiled aquatic species	Indefinite	4	ES	Appropriate State and Federal agencies						
1	6.2	Conduct anatomical and biochemical analysis of endemic species	10 years	4	ES	Appropriate agencies and partners						As need arises
1	6.3	Determine contaminant sensitivity	10 years	4	ES	Appropriate agencies and partners						Cost may be absorbed under existing programs
1	6.4	Conduct life history research	10 years	4	ES	Appropriate agencies and partners						As needs are identified
1	7.0	Develop and implement technology for artificial propagation and captive maintenance	10 years	4	ES	ADCNR and partners	50	50	50	50	50	
1	8.0	Reintroduce species into restored habitats, as appropriate	Indefinite	4	ES	ADCNR and partners	25	25	25	25	25	
3	9.0	Monitor progress and review management strategy	Continuous	4	ES	All partners and stakeholders	25	25	25	25	25	
3	10.0	Coordinate ecosystem management actions	Continuous	4	ES							Costs may be absorbed under existing programs

PART IV: SUMMARY OF COMMENTS RECEIVED

Cahaba River Society:

Comment: “We support the Recovery Plan in terms of the background information, the reasons for listing of species, and the proposed conservation measures outlined in the recovery document. We offer the following comments with the hope they may facilitate the goals of this Draft Recovery Plan.”

A. Is it feasible to...(use a) critical number of stable populations as a factor supporting a decision for delisting?

Service Response: The Recovery Plan requires a minimum of 3 persistent populations be located or established prior to consideration for delisting. A persistent population is one that is shown to be stable or increasing for a period of 10 years.

B. We suggest that for the sake of population and genetic diversity reasons, it would be better to increase that number (3) to six or nine.

Service Response: We agree that additional populations reduce the potential of stochastic threats to the species. However, due to the limited natural range of these species, the degree of habitat loss and isolation, and other factors, opportunities for re-establishing multiple populations are limited. Those opportunities are further limited by current conditions such as land uses and associated water quality problems. We have defined a “population” as those snails “...occurring within a contiguous river or stream reach extending a minimum of 30 km (18 mi).” Other criteria require that there should be no apparent or immediate threats to those populations. We believe that persistent snail populations over 90 km (54 mi) of habitat with no apparent threats may constitute recovery. This minimum standard is not intended to discourage establishing additional populations throughout the range of these species.

C. We strongly support the development of a facility dedicated to propagation of these imperiled mollusk species.

Service Response: Recovery Tasks 7 and 8 encourage the development of propagation technology and facilities. We are currently working with the State of Alabama and the Tennessee Aquarium Research Institute to implement these tasks.

Alabama Audubon Council, Alabama Environmental Council and Alabama Ornithological Society:

Comment: “We strongly support the Recovery Plan for the six Mobile Basin aquatic snails covered in your notice of December 15, 2004 and believe that the background information, threats to the species and proposed conservation measures for recovery are appropriate. We... submit these further comments for your consideration:”

A. The *Mobile River Basin Aquatic Ecosystem Recovery Plan* (Ecosystem Plan) lists all six species as endangered, but this plan lists three of them as threatened.

Service Response: Table 1 of the Ecosystem Plan correctly identifies the lacy elimia, painted rocksnail and round rocksnail as threatened species, and the cylindrical lioplax, flat pebblesnail, and

plicate rocksnail as endangered. Appendix A of the Ecosystem Plan, however, incorrectly reports the first three as endangered. This *Recovery Plan for Six Mobile River Basin Aquatic Snails* correctly labels the lacy elimia, painted rocksnail and round rocksnail as threatened species.

B. Reintroduction of each of these snails into habitat should be considered a primary recovery task

Service Response: Part III: Implementation Schedule, above, identifies reintroduction of species into restored habitats (Recovery Task 8) as a Priority 1 action.

C. No impoundments or channelization projects should be approved for the snails existing ranges or the ranges where they are reintroduced.

Service Response: See “Criteria for delisting species,” and “Listing/Recovery Factor Criteria,” above. Recovery criteria require that there are no apparent or immediate threats to the populations prior to consideration for delisting.

D. Stream setbacks and bank protection are required to protect these species.

Service Response: These actions are encouraged under Recovery Tasks 1-5.

E. Water quality regulations under the Clean Water Act must be enforced.

Service Response: We concur, see Recovery Task 1.5.

F. We urge that the number of populations required for delisting be increased to at least six.

Service Response: See “Service Response” to Cahaba River Society Issue B, above. We believe that the criteria defined under Part II, above, may constitute recovery for these species.

PART V: NOTIFICATION LIST

The following agencies, organizations, and individuals were solicited to review and comment on this recovery plan. This does not imply that they provided comments or endorsed the contents of the plan.

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