Interrupted Rocksnail
(*Leptoxis foremani*)

5-Year Review:
Summary and Evaluation

Photograph Credit: Thomas Tarpley, Alabama Department of Conservation and Natural Resources

U.S. Fish and Wildlife Service
South Atlantic-Gulf Region
Alabama Ecological Services Field Office
Daphne, Alabama

5-YEAR REVIEW

Interrupted Rocksnail (*Leptoxis foremani*)

I. GENERAL INFORMATION

A. Methods used to complete the review: This review was completed by the lead recovery biologist for the species in the U.S. Fish and Wildlife Service (Service)'s Alabama Ecological Services (ES) Field Office, Tuscaloosa Sub-office, Tuscaloosa, Alabama. The primary sources of information used in this analysis were the final rule listing this species under the Endangered Species Act (Act) (75 FR 67512), the recovery plan, peer-reviewed reports and journal publications, unpublished survey data and reports, and personal communications with recognized experts. All literature and documents used for this review are on file at the Alabama ES Field Office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the interrupted rocksnail. Comments and suggestions regarding this review were received from peer reviewers from outside the Service, evaluated, and incorporated as appropriate (see Appendix A). In addition, this review was announced to the public on August 30, 2016 (81 FR 59650) with a 60-day comment period. No comments were received from the public.

B. Reviewers

Lead Region: South Atlantic-Gulf : Aaron Valenta (404 679-4114)

Lead Field Office: Alabama ES Field Office, Tuscaloosa Sub-office, Tuscaloosa, AL: Jennifer Grunewald (205) 247-3726

C. Background

1. **Federal Register (FR) Notice citation announcing initiation of this review:** 81 FR 59650; August 30, 2016

2. **Species status:** Stable. Though the species' range has gotten larger since it was listed, it is still confined to a short linear reach of the Oostanaula River. Collections in 2014 state that the species was not uncommon within the site and both adults and juveniles were documented (P. Johnson pers. comm. 2019).

3. **Recovery achieved:** 1 (1 = 0-25% species' recovery objectives achieved)

4. **Listing history:**
   Original Listing
   FR notice: 75 FR 67512
   Date listed: November 2, 2010

Entity listed: Species
Classification: Endangered

5. Associated rulemakings: None

6. Review History:

Each year, the Service reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we did a recovery data call that including showing status recommendations, such as "Stable", "Improving", or "Declining" for species. We continue to show that species status recommendation in our 5-year reviews. The most recent evaluation for this snail was completed in 2019.

Recovery Plan: 2014 (with 2019 amendment)

Five-year Review: This document represents the first 5-year review done for this snail.

7. Species' Recovery Priority Number at start of 5-year review (48 FR 43098): 2.
Degree of Threat: High
Recovery Potential: High
Taxonomy: Species

8. Recovery Plan
Name of Plan: Recovery Plan for Georgia Pigtoe Mussel (*Pleurobema hanleyianum*), Interrupted Rocksnail (*Leptoxis foremani*), and Rough Hornsnail (*Pleurocera foremani*). Atlanta, Georgia.
Date Issued: November 6, 2014

An amendment to this final recovery plan was issued on September 25, 2019.

II. REVIEW ANALYSIS

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

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

B. Recovery Criteria

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

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? Yes

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

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

Delisting of the interrupted rocksnail will be considered when:

1. The existing population in the Oostanaula River in Georgia maintains a stable or increasing trend, evidenced by natural recruitment and multiple age classes;

A collection effort in 2014 indicated recruitment is occurring at this location; 70 of the 132 individuals captured were juveniles. Trend data have not been collected, so at this time, this criterion has not been met.

2. A minimum of five (5) new populations in the Coosa River drainage exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes;

This criterion has not been met. Only one geographically distinct population exists of the interrupted rocksnail in the Oostanaula River. No new populations have been documented, reported, or successfully introduced since the time of listing.

3. A long-term agreement with hydropower operators is established that provides assurances that the flows in the Coosa and Oostanaula Rivers will be operated such that water quality and flow regimes provide suitable habitat for the new populations within Federal Energy Regulatory Commission boundaries in the Coosa River drainage area.

This criterion has not been met. A comprehensive, long-term agreement has not been developed with hydropower operators in the Coosa and Oostanaula Rivers. Also, no new populations of interrupted rocksnails have been established that would be protected under such agreement.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. New information on the species' biology and life history:

The interrupted rocksnail lives attached to bedrock, boulders, cobbles, and gravel in medium to large rivers and tends to move slowly, except in response to rising or falling water level (Figure 1). They lay their adhesive eggs within the same habitat (Johnson 2004). New life history studies have been conducted on the species. In a hatchery setting, mean clutch size was significantly higher for 4 and 5+ year-old snails compared to 1 and 2 year old snails. This indicates fecundity increases with size and/or age and adults naturally reproduce for multiple years (Whelan et al. 2015). Eggs were approximately 0.3 mm in diameter and were surrounded by mucus, which reduces egg mortality. Eggs were laid in a spiral pattern at, or slightly below or above the water line (Whelan et al. 2015). Water temperature strongly influenced timing of initiation of oviposition (laying of eggs) for multiple *Leptoxis* species. Specifically, interrupted rocksnail began laying at 12 and ended at 22 degrees Celsius (˚C) (Whelan et al. 2015). Field observations in the Oostanaula River indicate eggs are laid on the undersides or vertical sides of clean, hard substrates.

Figure 1 Interrupted rocksnails attached to cobble-sized substrate (left). Rocksnails laying adhesive eggs in a spiral pattern (below).

Photos courtesy of Paul Johnson, Alabama Department of Conservation and Natural Resources

Shell morphology of interrupted rocksnails has been further described. In a hatchery setting juvenile specimens lacked shallow ribs (costae) and prominent striae that are found in adults (Figure 2, Row C) and shell morphology phenotypic plasticity (change in response to a unique environment) does not appear to influence distinct shell characters or color (Whelan et al. 2015).

Figure 2. Growth series of clutch-laying *Leptoxis* species. A. *L. ampla*. B. *L. coosaensis*. C. *L. foremani*. D. *L. picta*. Scale bar = 5 mm. Symbol ~ indicates captive-propagated individuals. (Whelan et al. 2015)

Interrupted rocksnails are found in shoal habitats with sand-boulder substrate, at water depths less than 50 centimeters (cm) (20 inches (in)), and in water currents less than 40 cm/second (sec) (16 in/sec) (Johnson 2004). We know little of the biology of pleurocerid snails; however, they are considered generalist scrapers and feed by ingesting periphyton (algae attached to hard surfaces) and biofilm detritus scraped off of the substrate by the snail's radula (a horny band with minute teeth used to pull food into the mouth) (Morales and Ward 2000). Interrupted rocksnails have been observed grazing on silt-free gravel, cobble, and boulders (Johnson 2004).

Results from a successful reintroduction of a closely related species, *Leptoxis picta*, in the Cahaba River, demonstrated release of a large number of individuals is required for several years before recruitment is achieved. This is likely due to low fecundity, natural mortality and significant predation rates (P. Johnson pers. comm. 2018).

b. Abundance/population trends, demographic features or trends:

In October 2003, a reintroduction effort took place in the Coosa River downstream of Jordan Dam. At this point, none of the released animals have ever been found. It is suspected that the released animals were consumed by the large number of freshwater drum that occupy this area.

In October 2012, a reintroduction effort (2,034 individuals) took place in the Weiss Bypass, Cherokee County, Alabama (Johnson 2012). The Weiss Bypass is a 21-mile (mi) (34 kilometer (km)) bypass channel on the Coosa River created by the diversion of flows to the Weiss Dam powerhouse. The snails were progeny of Oostanaula River brood stock taken propagated and cultured at the Alabama Aquatic Biodiversity Center (AABC).

A follow-up monitoring event in the summer of 2013, searched the relocation area in the Weiss Bypass and released interrupted rocksnails were found, but no additional snails, indicating no successful recruitment. No additional reintroductions have taken place in the Weiss Bypass due to sediment movement, unstable flows, and temperature fluctuations. Additional habitat monitoring is required before another attempt to establish *L. foremani* at this location (P. Johnson pers. comm. 2018).

Field collections conducted in November of 2014, in the Oostanaula River in Georgia found interrupted rocksnails were in good numbers based on qualitative observations (52 adults and 70 juveniles) (P. Johnson pers. comm. 2019). A select number of individuals from this survey were taken to AABC for propagation and their progeny are currently being held at AABC.

c. Genetics, genetic variation, or trends in genetic variation:

Johnson et al. (2013) recognized 162 pleurocerid species, making it the second most diverse group of North American gastropods. Molecular studies conducted on this family have shown that the current classification needs substantial revision. The Johnson et al. (2013) publication is currently used for classification of pleurocerids until a comprehensive taxonomy is completed. Unpublished phylogenetic work has found that interrupted rocksnail, *L. foremani*, is a valid species (P. Johnson pers. comm. 2019). Additional information on pleurocerid species is forthcoming.

d. Taxonomic classification or changes in nomenclature:

No changes to the taxonomic classification or changes in nomenclature have occurred (ITIS 2019).

e. Spatial distribution, trends in spatial distribution, or historic range:

A location of interrupted rocksnail was found in 2010 near Jones Bend in the Oostanaula River, Floyd County, Georgia (Dinkins and Hughes 2011). This collection extended the current range which now totals approximately 10.2 river mi (16.4 river km). Subsequent sampling in 2012, 2014, and 2016, in this stretch of river has confirmed the snail's presence (P. Johnson pers comm. 2019; G. Dinkins pers. comm. 2019, A. Popp pers. comm. 2019). No new information has been discovered regarding historic range.

f. Habitat:

Whelan et al. (2015) recognized the importance of egg laying patterns and timing and their associated habitat conditions. The clutch laying pattern that interrupted rocksnail displays is associated with large rivers. The 2015 study reported that temperature is important for egg laying timing, particularly initiation. Alterations to flow and climate change may lead to egg laying temporal changes (Whelan et al. 2015).

2. Five-Factor Analysis

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

The interrupted rocksnail has been eliminated from almost 99 percent of an historical range of 800-river km (497 river miles) suffering extreme habitat curtailment (Service 2014) (Figures 3 and 4). This snail continues to exist in a short reach (10.2 river mi (16.4 river km)) of the Oostanaula River in Georgia (Dinkins and Hughes 2011; P. Johnson pers. comm. 2019; Whelan et al. 2015). Since the species was listed, the habitat (defined as bedrock, boulders, cobbles, and gravel in slowly moving water, USFWS 2014) and water quality for the interrupted rocksnail has not improved in the Coosa River due to existing hydropower dams. More than 60 percent of the Coosa River and its 19 largest tributaries are inundated or affected by flow regulation (Marcinek et al. 2005). These impoundments have left fragmented and isolated habitats that may be more susceptible to runoff or dam discharges. Test reintroductions of the interrupted rocksnail, in Alabama, have not proven successful to date, possibly due to low fecundity, predation by freshwater drum (*Aplodinotus grunniens*), and the overall lack of suitable habitat. Additional reintroductions are planned in the Weiss Bypass but due to continually moving sediments in the Weiss Bypass no reintroductions will be taking place until bypass

substrates become more stable. Unlike the successful *L. picta* reintroduction effort in the lower Cahaba River, riverine habitat of sufficient size and water quality is extremely limited in the Coosa River basin. The majority of *L. foremani* historic records were collected from the Oostanaula, lower Etowah and particularly the Coosa River or in the mouths of large tributaries in Alabama (Figure 4).

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

The interrupted rocksnail is not known to have any commercial value and overutilization has not been a concern for the species. Therefore, based on the best available data, overutilization is not believed to be a threat at this time. Individuals have been taken for propagation purposes, in consultation with the U.S. Fish and Wildlife Service, and have not impacted populations due to the nature of pleurocerid snails occurring in large numbers where quality habitat exists.

c. Disease or predation:

Diseases of aquatic snails are for the most part unknown. Within the range of the interrupted rocksnail, the freshwater drum (*Aplodinotus grunniens*), a very successful molluscivore, is reported to be a contributing factor to the poor reintroduction success of other rocksnails (P. Johnson pers. comm. 2018). Molluscivore turtles, such as map turtles, likely predate on interrupted rocksnail as well (J. Garner pers. comm. 2020). No other predators are currently reported or known for the interrupted rocksnail, though additional fish, like redear sunfish (*Lepomis microlophus*) are known to predate on snails, and as such, may also forage on the interrupted rocksnail.

d. Inadequacy of existing regulatory mechanisms:

The interrupted rocksnail is afforded some protections through Section 7 and Section 9 of the Endangered Species Act (ESA), and is also protected by the State of Alabama under their Invertebrate Species Regulation (Alabama Administrative Code 220-2-.98). The Invertebrate Species Regulation (220-2-.98) states that it shall be unlawful to take, capture, kill, or attempt to take, capture, or kill; possess, sell, trade for anything of monetary value, or offer to sell or trade anything of monetary value without a scientific collection permit or written permit from the Commissioner, Department of Conservation and Natural Resources, which shall specifically state what the permittee may do with the species. In Georgia the snail is protected under the Rules and Regulations of the State of Georgia, Subject 391-4-10 and the following acts are prohibited: 1. Any activities which are intended to harass, capture, kill, or otherwise directly cause death of any protected animal species are prohibited, except as specifically authorized by law or by regulation as adopted by the

Board of Natural Resources; 2. The sale or purchase of any protected animal species or parts thereof is prohibited and the possession of any such species or parts thereof is prohibited unless the possession is authorized by a scientific collecting, wildlife exhibition, or other permit or license issued by the Department; 3.The destruction of the habitat of any protected animal species on public lands is prohibited; 4. The authorization to take certain nongame animal species set forth in O.C.G.A. Section 27-1-28 shall not apply to any protected species whether on public or private land.

While the interrupted rocksnail may have species protections afforded it by both state and federal governments, the majority of the people are unaware of its presence and protected status within the Oostanaula drainage.

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

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

Section 303(d) of the CWA requires each state to list its polluted water bodies and to set priorities for their clean up with a watershed restoration action plan called a "Total Maximum Daily Load" (TMDL) for each impaired water body. Under CWA's Section 303d, water quality impairment from PCB's has been identified in tributaries leading to the Oostanaula River (Dozier, Armuchee, and Woodward creeks) and portions of the Oostanaula River in Floyd/Gordon counites (GEPD 2006). Fecal coliform has also been identified as an impairment to waterways (Big Dry and Camp creeks) flowing into the Oostanaula River and TMDL's have been developed for these streams (GEPD 2018). Initial toxicity data gathered for *Leptoxis ampla* (Gibson et al., 2016; Gibson et al., 2018) indicated extreme sensitivity to the surfactant, metals and salts tested. The lack of background toxicity testing data for most prosbranch freshwater gastropods is problematic for managing species recovery for *L. foremani* and other listed Pleuroceridae and Viviparidae gastropods.

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

While a single project (e.g., Section 404) will usually not jeopardize the continued existence of interrupted rocksnails, the collective encroachment on the snail's finite and linear habitat may have a larger impact and is usually not assessed on a permit-by-permit case.

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

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

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

Natural factors such as drought can potentially threaten the continued existence of the interrupted rocksnail. Natural droughts can have negative impacts on water quality (e.g. dissolved oxygen) and waste dissemination of point source discharges. The Coosa Basin experienced a drought in 2016, but we are unsure if there were affects to the interrupted rocksnail. Snails can also be left stranded in stagnate stream segments or other forms of dewatered habitat as the direct result of drought.

An increase in the number of days with heavy precipitation over the next 25 to 35 years is expected to increase across the Mobile River Basin (https://science2017.globalchange.gov/chapter/7/). As mentioned in the Poff et al. (2002) report on Aquatic Ecosystems and Global Climate Change, impacts of climate change on aquatic systems can potentially include:

- Increases in water temperatures that may alter fundamental ecological processes, thermal suitability of aquatic habitats for resident species, and their geographic distribution.
- Changes and shifts in seasonal patterns of precipitation and runoff, which can alter the hydrology of stream systems, affecting species composition and ecosystem productivity. Aquatic organisms are sensitive to changes in frequency, duration, and timing of extreme precipitation events such as floods or droughts, potentially resulting in interference of reproduction. Further, increased water temperatures and

seasonally reduced streamflow can alter many ecosystem processes, including increases in nuisance algal blooms.

- Cumulative or synergistic impacts that can occur when considering how climate change may be an additional stressor to sensitive freshwater systems, which are already adversely affected by a variety of other human impacts, such as altered flow regimes and deterioration of water quality.
- Adapting to climate change may be limited for some aquatic species depending on their life history characteristics and resource needs. Reducing the likelihood of significant impacts would largely depend on human activities that reduce other sources of ecosystem stress to ultimately enhance adaptive capacity, which could include, but not be limited to: maintaining riparian forests, reducing nutrient loading, restoring damaged ecosystems, minimizing groundwater and stream withdrawal, and strategically locating any new reservoirs to minimize adverse effects.
- Changes in presence or combinations of native and nonnative, invasive species could result in specific ecological responses to changing climate conditions that cannot be easily predicted at this time. These types of changes (e.g., increased temperatures that are more favorable to a nonnative, invasive species compared to a native species) can result in novel interactions or situations that may necessitate adaptive management strategies.

Since the interrupted rocksnail occurs in one river at one location, genetic exchange and diversity are undoubtedly low. This makes the species more vulnerable to disease and changing climate conditions.

Human-induced random events such as toxic spills within the drainage could also jeopardize the interrupted rocksnail if pollutants are spilled within the drainage. A kill associated with a spill in the Oostanaula could potentially jeopardize the species.

D. Synthesis

The existence of the interrupted rocksnail continues to be threatened due to stressors occurring in its limited range and continued impacts to its habitat. Altered flows, fragmented habitat, and non-point discharges are expected to continue. Habitat destruction or modification is a substantial threat to this species. Though the species' range was extended slightly since it was listed, it is still limited to a very shortreach of the Oostanaula River. Because the interrupted rocksnail is geographically isolated and occurs in a single, linear reach of the river, catastrophic events such as spills or natural events (e.g. drought) could greatly reduce the geographic or genetic viability of the snail. Although the species has been successfully propagated and can be raised in

captivity, reintroductions have not been successful (no recruitment documented). Understanding the species' habitat needs and interactions with other species is important prior to additional reintroduction attempts. Based on efforts of similar species, a much larger effort than previously attempted will be a major factor in successful reintroductions.

Analyzing the preceding information in this review, the interrupted rocksnail continues to meet the definition of an endangered species under the Act and requires a new recovery priority number (from 2 to 5 due to low recovery potential). This is based on unsuitable habitat, and continued threats to the species.

III. RESULTS

Recommended Classification:

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist
_X_ No change needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Additional monitoring of known locations and habitat conditions.

- Additional surveys for new populations and potential habitats for reintroduction should be evaluated.

- Continue working with Alabama Power Company and partners to monitor and improve physical and chemical habitats in the Weiss Bypass, downstream of Jordan, and at other potential reintroduction sites.

- Conduct research to document life history and habitat needs, including environmentally relevant toxicological information on similar species, as specific toxicity threats aren't well understood for the Pleuroceridae.

- A review of the entire Pleuroceridae family should be conducted to better define current species boundaries and understand the evolution of life history strategies.

- Pursue opportunities including land acquisition, conservation easements, and other conservation opportunities adjacent to large water habitats preferred by the species.

- Perform large and sustained reintroduction efforts (approximately 10,000 individuals per year for a minimum of 3 years) to increase chances of

establishing a recruiting population.

- Create and implement an outreach program aimed at educating farmers, developers, and other landowners in the species' range about good land use practices and water conservation.

- Develop a contingency plan for spill response(s) or natural disaster within occupied snail habitat.

- Develop new and continue using existing partnerships like the Alabama Rivers and Streams Network to utilize conservation initiatives with landowners along the riparian habitats and within the upper Coosa River Basin.

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Figure 3. Historic range of the interrupted rocksnail. Map created by the U.S. Fish and Wildlife Service, Alabama ES Field Office, Daphne, Alabama.

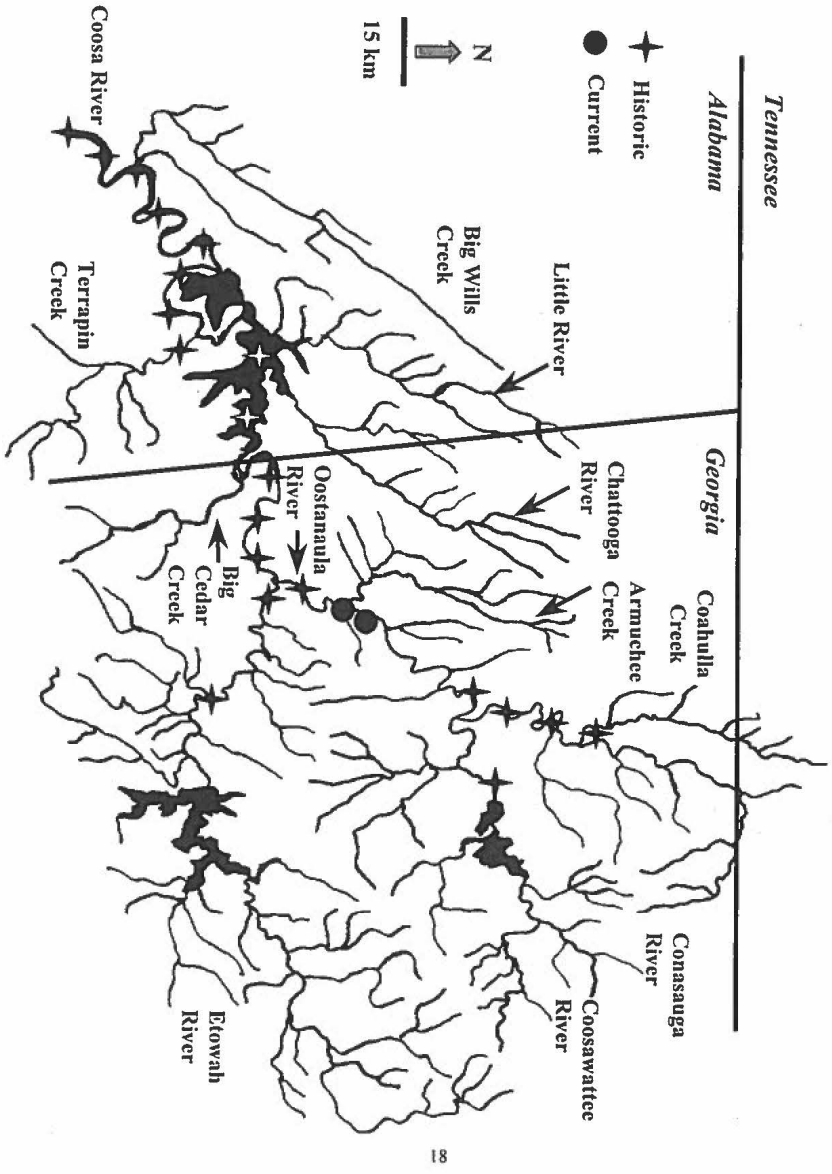

Figure 1. The historic and contemporary distributions of *Leptoxis downiei*, the in the upper Coosa River system.

Figure 4. Historic range of the interrupted rocksnail. Map cited in Johnson and Evans 2001.

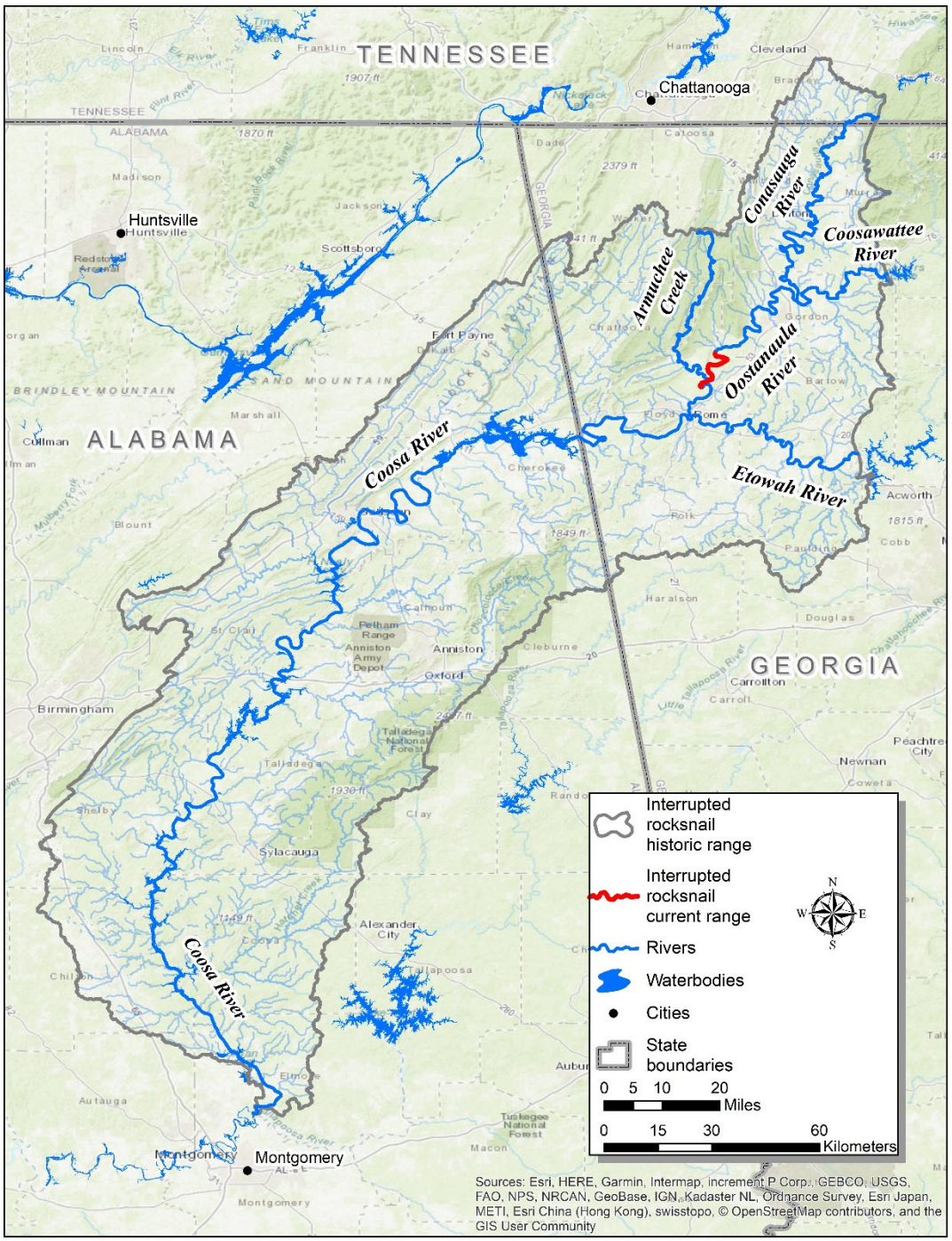

Figure 5. Topography within and surrounding the interrupted rocksnail watersheds. Map created by the U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama. Data sources are in bottom right corner.

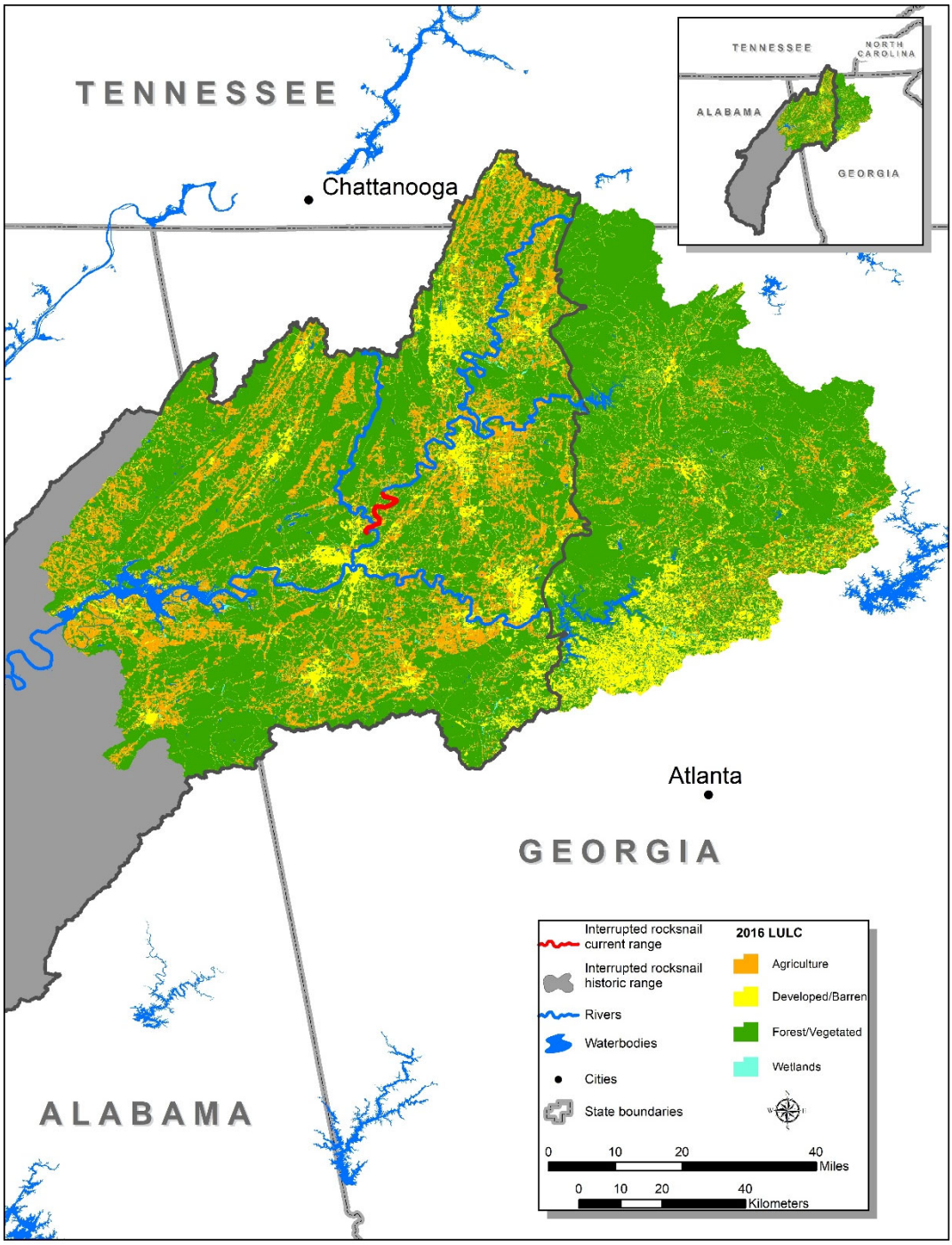

Figure 6. 2015 Land Use Land Cover (LULC) data within and surrounding the known interrupted rocksnail watersheds (Homer et al. 2007 and 2015). Map created by the U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama.

	2001		2006		2011		2016	
	Acres	**Percentage**	**Acres**	**Percentage**	**Acres**	**Percentage**	**Acres**	**Percentage**
Agriculture	558921.36	15.57	543146.22	15.13	534517.60	14.89	588976.08	16.40
Developed/Barren	422146.43	11.76	460813.86	12.83	476928.00	13.28	467956.09	13.03
Forest/vegetated	2525142.75	70.33	2501654.22	69.67	2493377.83	69.44	2450332.11	68.24
Wetlands	24897.16	0.69	24768.91	0.69	25306.53	0.70	22118.48	0.62

Table 1. Analysis of land use land cover changes between 2001 and 2016 for the five watersheds including and surrounding the current range of the interrupted rocksnail within the Oostanaula River (Figure 6). The five HUC8 watersheds used in the LULC Analysis were: Upper Coosa, Conasauga, Coosawattee, Oostanaula, and Etowah. Geospatial analysis of land use land cover performed by US Fish and Wildlife Service, Alabama Field Office, Daphne, AL. Data was derived from 2001, 2006, 2011, 2016 National Land Cover Database (NLCD) which was created by the Multi-Resolution Land Characteristics Consortium, a partnership of federal agencies led by the U.S. Geological Survey and uses 2001, 2006, and 2011 Landsat satellite data (Homer et al. 2007 and 2015) .
***Land Use Land Cover groups have been consolidated from original data to form these four similar land type classifications.**

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of the Interrupted Rocksnail (*Leptoxis foremani)*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

__X__ No change is needed

Review Conducted By: Jennifer Grunewald and Erin Padgett, Alabama ES Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve: WILLIAM PEARSON Digitally signed by WILLIAM PEARSON Date: 2020.03.24 14:34:13 -05'00' Date: _____

APPENDIX A: Summary of peer review for the 5-year review of the Interrupted Rocksnail (*Leptoxis foremani*)

A. Peer Review Method: Peer review requests were sent by Aaron Valenta, U.S. Fish and Wildlife Service Chief, Division of Restoration and Recovery via email with instruction to direct comments to Kelly Bibb. Requests included a Conflict of Interest form.

B. Peer Review Charge: Kelly Bibb, U.S. Fish and Wildlife Service, Southeast Regional Recovery Coordinator

C. Summary of Peer Review Comments/Report:

Paul Johnson Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources: Dr. Johnson provided resources on toxicity testing of federally threatened and petitioned mollusk species. He also made typographical and grammatical edits and minor changes to future actions. He suggested including historical range information to out maps based on museum records.

Anakela Popp, Coosa Aquatic Diversity Biologist, Georgia Department of Natural Resources: Ms. Popp made grammatical and typographical edits and provided clarifications to future actions.

Arthur E. Bogan Ph.D. FLS Research Curator of Mollusks, North Carolina State Museum of Natural Sciences: Dr. Bogan had no further information to add.

Jeff Garner, Mussel Management Supervisor, Alabama Division of Wildlife and Freshwater Fisheries: Mr. Garner added that molluscivore turtles may predate on snails. He provided a correction to the caption on Figure 2, and provided typographical edits.

D. **Response to Peer Review:** Comments were accepted and incorporated into the final 5-year review.