Slender Campeloma
Campeloma decampi

5-Year Review:
Summary and Evaluation

Photo Credit: Jeff Garner, Alabama Department of Conservation and Natural Resources

Photo Credit: USFWS

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

5-YEAR REVIEW

Slender Campeloma / *Campeloma decampi* (Binney)

I. GENERAL INFORMATION

1. Methods used to complete the review:

We announced initiation of this review in the *Federal Register* on May 7, 2018 (83 FR 20092) with a 60-day comment period. The primary sources of information used in this analysis were the 2000 final listing rule (65 FR 10033), the 2012 five-year review, peer-reviewed reports, unpublished survey data and reports, and personal communication with recognized experts. This review was completed by the lead recovery biologists for the species in the U.S. Fish and Wildlife Service (Service), Alabama Ecological Services Field Office (AFO), Daphne, Alabama. No public comments were received. 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 slender campeloma. The Appendix provides a brief summary of the peer-review approach.

2. Reviewers

Lead Region:

Atlanta, GA—Kelly Bibb (404) 679-7132

Lead Field Office:

AFO, Daphne, AL:
Evan Collins (251) 441 - 5837
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3. Background

1. Federal Register Notice citation announcing initiation of this review: 83 FR 20092; May 7, 2018.

2. Species status: Stable. The species continues to be found in the habitat it occupied at the time of listing. It has also been found in sites not known to be occupied at the time of listing. Demographics and taxonomy of these populations documented since the time of listing remains unknown. Furthermore, rapid urban growth and infrastructure development expose the species to new stressors in addition to historical stressors.

3. Recovery achieved: 1 (1 = 0-25% species' recovery objectives achieved) A slight improvement has been observed due to the presence of additional populations not known at the time of listing. However, these

populations are known from a single animal (Williams Spring), to occur over a small extent of habitat (Cypress Creek), or be clouded with taxonomic uncertainty (Beaverdam Creek).

4. Listing history
Original Listing
FR notice: 65 FR 10033
Date listed: February 25, 2000
Entity listed: Species
Classification: Endangered

5. Associated rulemakings: None.

6. Review History:

Five-year Review: August 17, 2012— In the 2012 review no change was recommended to the listing status of the slender campeloma. Primary threats include habitat destruction and modification due to development or effects of agriculture in the area of the associated creeks.

7. Species' Recovery Priority Number at start of review (48 FR 43098): 5
This number indicates:
Degree of Threat: High
Recovery Potential: Low
Taxonomy: Species

8. Recovery Plan or outline
We are in the process of drafting a recovery plan and anticipate announcing it later this year.

II. REVIEW ANALYSIS

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

The Act defines species as including any subspecies of fish, wildlife, or plant, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPSs to only vertebrate species of fish and wildlife. Because the species under review is an invertebrate, the DPS policy is not applicable and will not be addressed further in this review.

2. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** No.

3. Updated Information and Current Species Status

1. Biology and Habitat

a) Biology and Life History:

Relatively little is known about life history and ecology of the slender campeloma. The slender campeloma belongs to the family Viviparidae and as with other members of this family, they give birth to live young instead of laying eggs (USFWS 2000), and their life span does not appear to extend beyond 3 years of age (Haggerty, et al. 2014). The shell is medium to large typically measuring between 5 to 35 mm (0.2 to 1.4 inches) in length (ARC 1997, USFWS 2000). The slender campeloma is identified in the field by its larger size for this type of snail, ovately conic shell, and tapered pointed spire (Burch 1989, Garner 2004b) and is distinguished from the sympatric *C. decisum* by the presence of fine sculpture in the form of faint striations and a relatively higher spire on the shell of the slender campeloma (USFWS 2000). The slender campeloma is typically found burrowing in soft sediments (sand or mud) or detritus (ARC 1997). While the food habits of the slender campeloma are not known, it is thought that they most likely feed on detritus (USFWS 2000).

b) Abundance/population trends:

The slender campeloma is known to occur in tributaries to the Tennessee River in northern Alabama. Populations of the slender campeloma have been confirmed in four streams in northern Alabama (Figure 1). These streams include Cypress Creek (Lauderdale County) (J. Garner personal communication 2019), Round Island Creek (Limestone County) (Haggerty and Garner 2007, 2008), Piney Creek (Limestone County) (Haggerty and Garner 2007, 2008), and Limestone Creek (Limestone County) (Haggerty and Garner 2007, 2008). Beaverdam Creek has historically been included as part of the species range (AST 2014-2017; Garner and Johnson 2017) but recent studies have questioned whether populations of snails that superficially resemble the slender campeloma in Beaverdam Creek) are truly slender campeloma and perhaps an undescribed species (see **Taxonomic classification or changes in nomenclature**, below). The slender campeloma has also been observed Williams Spring (on Redstone Arsenal, Madison County) (P. Johnson, Stuart McGregor, *in litt*). However, more field surveys are needed to evaluate the status of this population.

Haggerty and Garner (2007, 2008) assessed populations of the slender campeloma in Limestone, Piney, and Round Island creeks. They found live and/or fresh dead slender campeloma snails at 14 of 30 sampling locations within the three surveyed streams. In Limestone Creek, the slender campeloma was found at all sites that were surveyed downstream of river mile 14.5 (six sites). Upstream of river mile 14.5, the snail was not found at the seven surveyed sites (Haggerty and Garner 2007, 2008). The slender campeloma was observed at two of ten sites surveyed in Piney Creek and was noted as having the lowest catch per unit effort of the three surveyed streams. The species was not observed upstream of river mile 19.3 in Piney Creek (Haggerty and Garner 2007, 2008).

In the Round Island Creek watershed, the snails were found at four of the seven surveyed locations, up to river mile 7.8. Haggerty and Garner (2007, 2008) found more snails per search effort in Round Island Creek than in either Limestone or Piney creeks. This was presumably due to the presence of more suitable habitat. A density distribution survey of Round Island Creek in 2010 found the slender campeloma at 19 of the 32 survey locations (Haggerty, et al. 2014). The overall mean density for the entire site was 49.2/m^2 with the highest density recorded at 284/m^2 (Haggerty, et al. 2014).

The slender campeloma was reported to occur in the Beaverdam Creek watershed in 2009 (USFWS 2012). Since then, Selby with AST Environmental (2014-2017) has discovered numerous snail populations throughout the mid to northern portions of Beaverdam Creek. The AST surveys not only extended the range of slender campeloma to the northern most reaches of Beaverdam Creek, but have also provided a consistent record for the snail since 2014. It has been noted that the slender campeloma found in Beaverdam Creek differs slightly in shell morphology from other slender campeloma (Garner and Johnson 2017) and it is unclear whether this population is genetically distinct from slender campeloma found elsewhere (see **Taxonomic classification or changes in nomenclature**, below).

In 2009, 2011, 2012, 2014, and 2019, a population of slender campeloma was recorded in Cypress Creek, Lauderdale County, Alabama, at the crossing of Rasch Road (County Road 16) (Garner personal communication 2020). Juveniles were noted during each survey conducted. Additional surveys were conducted in Cypress Creek and in Big, Middle, and Little Cypress Creeks but these surveys produced no observations of the snail. During the summer of 2019, Garner observed slender campeloma at six sites (including the original) in Cypress Creek over a 1.86 mi (3 km) reach.

Juveniles were observed at most sites during the 2019 survey. It was noted during 2019 that habitat at the originally discovered locality had been altered; presumably by floods of spring 2019 (the detritus/leaf pack where all previous snails had been found was mostly gone). Such habitat was not common over the 9 mi (14.5) km of stream assessed, so flood damage to habitat appears to have been widespread in the stream. Sub-adults were found at most sites where slender campleoma were observed so the habitat damage does not appear to have been catastrophic. .

As of the previous 5-year review, the Flint River, Madison County, Alabama, was reported to contain a population of slender campeloma and, as such, was included in the slender campeloma distribution range. Further research has shown that although genetically similar to *C. decampi*, this population shares more conchological characteristics with *C. decisum* (Garner and Johnson 2017). Since this population's identity is undetermined, the Flint River is not included in the current habitat distribution (Garner and Johnson 2017). Further research needs to be conducted in order to determine the identity and status of this population.

Additionally, the slender campeloma was observed and reported by the Geological Survey of Alabama (GSA) from Williams Spring during survey efforts targeting the Tuscumbia darter (*Etheostoma tucumbia*) on the Redstone Arsenal property in Madison County, Alabama in 2014 (Stuart McGregor personal communication 2020). Additional surveys and research are necessary to assess the population of the slender campeloma in this area.

Figure 2 summarizes the current known distribution for the slender campeloma.

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

A recent systematic review of snails in the genus *Campeloma* found in the Tennessee River basin has indicated that cryptic biodiversity may be present within the slender campeloma species as it is currently recognized, meaning the currently recognized species may actually represent multiple species that are superficially similar in appearance (Campbell undated). Additional, genetic research specific to the slender campeloma is needed.

d) Taxonomic classification or changes in nomenclature:

The slender campeloma was originally described as *Melantho decampi* (see Figure 3 for original plate), in recognition of its discoverer, W. H. DeCamp (Binney 1865). It is a member of the ovoviviparous family Viviparidae (USFWS 2000). Clench and Turner (1955) suggest that the type locality for the species is Decatur, Alabama, and that the type locality given by Binney (1865) in the original description (Huntsville or Stevenson) was in error. Clench and Turner (1955) state that the original label on the specimens by W. H. DeCamp lists Decatur, Alabama, as the locality. A recent systematic review of snails in the genus *Campeloma* found in the Tennessee River basin has indicated that cryptic biodiversity may be present within the slender campeloma (Campbell undated). Preliminary results suggests that the populations from Beaverdam Creek may represent an undescribed species. Until more information is available regarding this taxonomic uncertainty, we will continue to evaluate or consider the population in Beaverdam Creek as slender campeloma.

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

The slender campeloma's occurrence has been well documented in Limestone, Piney, and Round Island Creeks (Burch 1989, Garner 2004b). As of the previous 5-year review in 2012, only a single occurrence of the snail had been documented in each Beaverdam Creek (Campbell personal communication 2007 as citied in USFWS 2012), Little Piney Creek (AST 2012), and Cypress Creek (Garner personal communication 2012 as citied in the USFWS 2012) (Figure 2).

Between 2014 and 2017, numerous observations of slender campeloma have been documented in Beaverdam Creek within the first 4 miles (6.4 km) upstream of the crossing of Alabama Highway 20 (AST 2014-2017) suggesting that the population in Beaverdam Creek is viable and self-sustaining.

In 2012, the slender campeloma was observed in Little Piney Creek at its intersection with Huntsville Brownsferry Road. This site was defined using the USGS Tanner, Alabama 7.5 minute quadrangle map. Upon closer investigation, the surveyed site appears to be a secondary channel to Piney Creek. This location is within the expected range of the slender campeloma within Piney Creek, known to be occupied at the time of listing.

During the summer of 2019, Garner observed slender campeloma at six sites (including the original) in Cypress Creek over a 1.86 mi (3 km) reach. Juveniles were observed at most sites during the 2019 survey, suggesting that viable and self-sustaining populations exist in Cypress Creek.

While the slender campeloma has been documented in Williams Spring, data is sparse from this habitat and the full range of occurrence here has not been fully assessed. However, Williams Spring is proximal to Byrd Spring, a historically occupied site. We believe this occurrences needs to be further investigated with additional surveys to complete our understanding about the species' range and the number and status of probable extant populations in Madison County, Alabama.

At the time of listing, the range of the slender campeloma snail was estimated to be reduced, by as much as three-quarters of its historical distribution (USFWS 2000). Historically, the snail was also known from Bass and Swan Lakes in Limestone County, Brim (=Braham) Lakes, Madison County, and an unspecified location within Jackson County (Clench and Turner 1955, USFWS 2000). The construction of the Tennessee River impoundments significantly reduced its historic range, and caused the remaining populations to be isolated (USFWS 2000).

f) Habitat:

The slender campeloma is found in Beaverdam Creek, Limestone Creek, Piney Creek, Round Island Creek, and Cypress Creek-Tennessee River watersheds, which lie north of the Tennessee River within the Tennessee Valley District of the Interior Low Plateau Physiographic Province in Alabama. The underlying geology of the creeks is similar. They are primarily dominated by Tuscumbia Limestone in the lower reaches, and Fort Payne Chert in the middle and upper reaches. Some of the upper reaches within Limestone Creek also have exposed undifferentiated sediments of the Ordovician System (Haggerty and Garner 2007, 2008).

The slender campeloma snail is typically found burrowing in soft sediment or detritus (ARC 1997). It may sometimes be found burrowing in gravel substrates, where it may occur anywhere from the margins to midstream (USFWS 2012). It is often found burrowing at shallow depths in substrates composed of clay and mud or in relatively large patches of water willow (*Justica virginiana*) (Haggerty and Garner 2007, 2008).

Haggerty and Garner (2007) characterized and compared the general habitat conditions used by the slender campeloma snail within Limestone, Piney, and Round Island creeks using the following 11 physical and chemical measurements: stream width, stream depth, stream velocity, temperature, dissolved oxygen, dissolved oxygen percent saturation, specific conductance, total hardness, calcium hardness, magnesium hardness, and pH. The depth (0.46-0.77 cm), width (13.3-13.9 m), and velocity (0.17-0.35 m/s) of the three creeks were similar. The water chemistry was also similar, with mean temperature (26-27.7 °C), dissolved oxygen (4.2-6.4 mg/l), dissolved oxygen percent saturation (45.7-77.3 %), pH (7.5-8.3 units), specific conductance (128-138 µS/cm), total hardness (58-69 ppm), calcium hardness (43-47 ppm), and magnesium hardness (12-24 ppm), comparable among all sites.

In 2010, Haggerty and Garner (2014) continued their work on slender campeloma microhabitat selection by utilizing an information theoretic approach to identify relationships between population density and a set of environmental features. Their study considered the following features: amount of clay and silt in the substrate; distance from the bank, water depth, current velocity, distance to emergent vegetation, mean sediment grain size, and percentage of organic matter. The initial results and subsequent model averaging in their study found that only distance from bank,

percent of silt and clay in the substrate, and current velocity had an effect on snail density. The percent of silt and clay in the substrate had a positive effect on snail density and the distance from bank and current velocity had a negative effect on snail density. These results were supported by field observations.

2. Five-Factor Analysis

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

Urban growth and development continues to pose a threat to the slender campeloma. Expansion from the City of Huntsville and its annexation of lands in Limestone County has led to an increase in residential and industrial development near Limestone and Beaverdam creeks. For instance, in January 2018, Mazda Motor Corp. and Toyota Motor Corp. announced a joint venture to manufacture automobiles at a shared facility to be located between Beaverdam Creek and Limestone Creek North of Old Highway 20 in Limestone County, Alabama. The proposed automotive manufacturing facility is estimated to encompass approximately 2,400 acres of land historically used primarily for agriculture. This facility includes portions of a 2,010 acre TVA Megasite. Such a large scale development has the potential to encroach upon and degrade habitat on which the slender campeloma depends. However, parties involved in this project (Toyota and the City of Huntsville) have been coordinating with the Service to develop site plans that would be compatible with conservation of imperiled and listed species adjacent to the manufacturing facility. Other examples of urban growth currently threatening slender campeloma habitat include water/sewer pipeline crossings, oil/natural gas pipeline crossings, bridge replacements and other infrastructure updates, commercial and residential building activity, discharge of fill material, and other point and nonpoint pollution discharge.

Analysis of land use land coverage (LULC) data from 2001 to 2016, provides support for a trend in habitat modification resulting from urban encroachment. Figure 5 provides a categorical representation of LULC, Landsat imagery from 2016. The six watersheds that constitute the known slender campeloma range including the Cypress Creek, Round Island Creek, Piney Creek, Limestone Creek, Beaverdam Creek, and Williams Springs watersheds cover approximately 320,820 acres and are dominated by agricultural activities, natural landscapes, and commercialized land. Since 2001, natural and agricultural spaces have incrementally declined whereas acreage classified as developed and/or barren have steadily increased (Table 1). Urban land cover is most noticeable in the Piney

Creek, Limestone Creek, Beaverdam Creek, and Williams Springs watersheds.

While the agricultural footprint in the watersheds has decreased since 2001, pastures and farmland still cover approximately 50 percent of the watersheds making agriculture the dominant land type in the area (Table 1). Agriculture poses a threat to slender campeloma through pesticide and fertilizer runoff, excessive water withdrawal and irrigation, and introduction of sedimentation (Garner 2004b, Haggerty and Garner 2007). Little toxicological research has been done on snails in general (Johnson, et al. 2013) so the total ramifications of pesticide and fertilizer exposure on slender campeloma is not fully understood. This combined with the limited knowledge of the slender campeloma's environmental and physiological tolerances, impairs our ability to develop comprehensive management and recovery plans for the species (Johnson, et al. 2013).

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

The slender campeloma is not known to have any commercial value and overutilization has not historically been a problem, therefore, overutilization is not believed to be a threat at this time. However, because this snail is generally found in low numbers (Haggerty and Garner 2008) and occurs in specific habitat, collection in general could pose a threat to small populations and could disturb natural reproduction. Therefore, we will continue working with partners in evaluating and minimizing this potential threat.

c. Disease or predation:

Diseases of aquatic snails are for the most part unknown. Several fishes, mammals, and potentially birds, consume snails, and are undoubtedly a normal aspect of the population dynamics of the slender campeloma. At this time, we do not believe disease or predation to be a significant factor threatening this species.

d. Inadequacy of existing regulatory mechanisms:

The slender campeloma is afforded protection through Section 7 and Section 9 of the ESA. It is also afforded protection by the State of Alabama under their Invertebrate Species Regulation (Alabama Administrative Code 220-2-.98), which prohibits taking, capturing, killing, or attempting to take, capture, or kill; possession, selling, trading for anything of monetary value, or offering to sell or trade for anything of monetary value without a permit. While the slender campeloma has species protections afforded to it by both state and federal governments,

people may be unaware of its presence and protected status, and fail to take any additional precautionary measures to aid in the recovery of this species unless they specifically contact the Service for technical assistance.

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

Section 303d of the CWA requires each state to list its polluted water bodies and to set priorities for their clean up with a watershed restoration action plan called a "Total Maximum Daily Load" (TMDL) for each impaired water body. TMDLs establish the maximum amount of a pollutant that a water body can assimilate without causing exceedances of water quality standards. Under CWA's Section 303d, water quality impairment has been identified for Limestone Creek (mercury), Cypress Creek (nutrients and mercury), and Round Island Creek (nutrients and mercury) (ADEM 2018). TMDLs have been developed for Limestone Creek and Round Island Creek for siltation and for both carbonaceous and nitrogenous biochemical oxygen demand (ADEM 2002).

Section 404 under the CWA is administered by the U.S. Army Corps of Engineers (USACE) and regulates the discharge of dredged or fill material into waters of the United States, including wetlands. Any activities in waters of the United States are regulated under this program, and often include fill related to development, such as water resource projects, infrastructure development, and mining projects.

Section 26a of the TVA Act requires TVA's approval be obtained prior to the construction, operation, or maintenance of any dam, appurtenant works, or other obstruction affecting navigation, flood control, or public lands or reservations along or in the Tennessee River or any of its tributaries. Within these Tennessee River drainages where slender campeloma occur, TVA's Section 26a permits are usually applied for concurrently with the USACE Section 404 permits.

While a single project (e.g., Section 404 or Section 26a permit) may have discountable or insignificant effects on the species and therefore not require formal consultation, the collective effects of such projects may result in more substantial and measurable effects on the slender campeloma's finite habitat. Because these individual projects would not be evaluated or recorded through a formal consultation process with the Service, they are not typically included in a cumulative effects analyses. Therefore, these activities may have a broader impact on the species than is currently known.

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 media (e.g., honey bees, daphnia, bluegill sunfish, rainbow trout, and mice) for toxicity, this information may not relate well to the slender campeloma. 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 slender campeloma.

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

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

Climate change is also considered a potential threat to the slender campeloma. The Fifth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) concluded that the warming of the climate system is unequivocal (IPCC 2014). Numerous long-term climate changes have been observed including changes in arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns, and aspects of extreme weather including droughts, heavy precipitation, heat waves, and the intensity of tropical cyclones (IPCC 2014). There is uncertainty about the specific effects of climate change (and its magnitude) on the slender campeloma; however, climate change is almost certain to affect aquatic habitats in their watersheds. Climate change has the potential to increase the vulnerability of the campeloma to random catastrophic events, primarily through more intense or frequent droughts. Droughts can potentially have negative impacts on water quality (e.g. dissolved oxygen) and waste dissemination of point source discharges. Droughts may also reduce the amount of habitat available to the snail by dewatering habitat, and may also lead to direct mortality by stranding snails. Drought may also isolate sections of stream into stagnate pools. In Alabama, moderate to extreme drought conditions were recorded in 26% of months between the years 2010 and 2019 and

approximately 8% of the months in this time period were considered severe droughts (NOAA 2020).

Human-induced random events such as toxic spills could also jeopardize the slender campeloma if pollutants are spilled within its watersheds. The known extent for the slender campeloma is already extremely limited and a spill event could potentially reduce this range even further.

4. Synthesis

The existence of the slender campeloma continues to be threatened by stressors and impacts to habitat in its limited range. Its current range includes the lower 14.5 miles (23.3 km) of Limestone Creek, the lower 19.3 miles (13.1 km) of Piney Creek, the lower 7.8 miles (12.6 km) of Round Island Creek (Garner 2008), the upper portions of Beaverdam Creek, and 1.86 mi (3 km)of Cypress Creek (Garner personal communication 2019). While slender campeloma has been collected from Williams Spring, this observation is limited to a single individual and the full range extent in this habitat is not currently known. Because the slender campeloma is still only known to occupy few stream reaches, catastrophic events such as spills or natural events (e.g. drought) could greatly reduce the geographic or genetic viability of the snail.

Habitat destruction and modification is presently the largest threat to this species. Agriculture and development continue to reduce the quality of streams as evidenced by sections of the range being listed as impaired under Section 303d of the CWA. As human activities migrate out from the growing cities of Huntsville, Madison, Decatur, and Athens, forested lands and agricultural (present and historic) fields are increasingly becoming converted to commercial or residential developments ever encroaching on the slender campeloma's limited habitat range.

Based on the information in this review gathered since the 2012 five-year review, we believe the slender campeloma continues to meet the definition of endangered under the Endangered Species Act and we do not recommend a change in its listing status. This is based on our knowledge of the species' life history, its limited distribution, and its threats.

III. RESULTS

Recommended Classification: No change is needed

IV. RECOMMENDATION FOR FUTURE ACTIONS

- Complete and finalize a recovery plan for this species.

- Conduct quantitative surveys within known habitats; survey Cypress Creek, Williams Spring, and Beaverdam Creek to establish population size and status, survey the tributaries of both Limestone and Piney creeks for occurrences, and survey additional streams within northern Alabama for additional populations.

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

- Develop partnerships and utilize conservation initiatives with landowners along the riparian habitats and within the recharge zone of the known range.

- Conduct genetic work to draw comparisons between closely related species within the known range of the slender campeloma, and examine the genetics of the populations throughout its range with specific focus on Beaverdam Creek.

- Verify the identity of snail populations within the Flint River and Williams Spring (Redstone Arsenal).

- Provide public outreach and education on the slender campeloma snail to property owners and farmers along the creeks.

- Pursue opportunities including land acquisition, conservation easements, etc. to secure and protect habitat.

- Continue a detailed analysis of habitat requirements, including physicochemical parameters of the stream and more specific measurements of the microhabitat used by the snail.

- Develop propagation techniques.

- Conduct life history studies.

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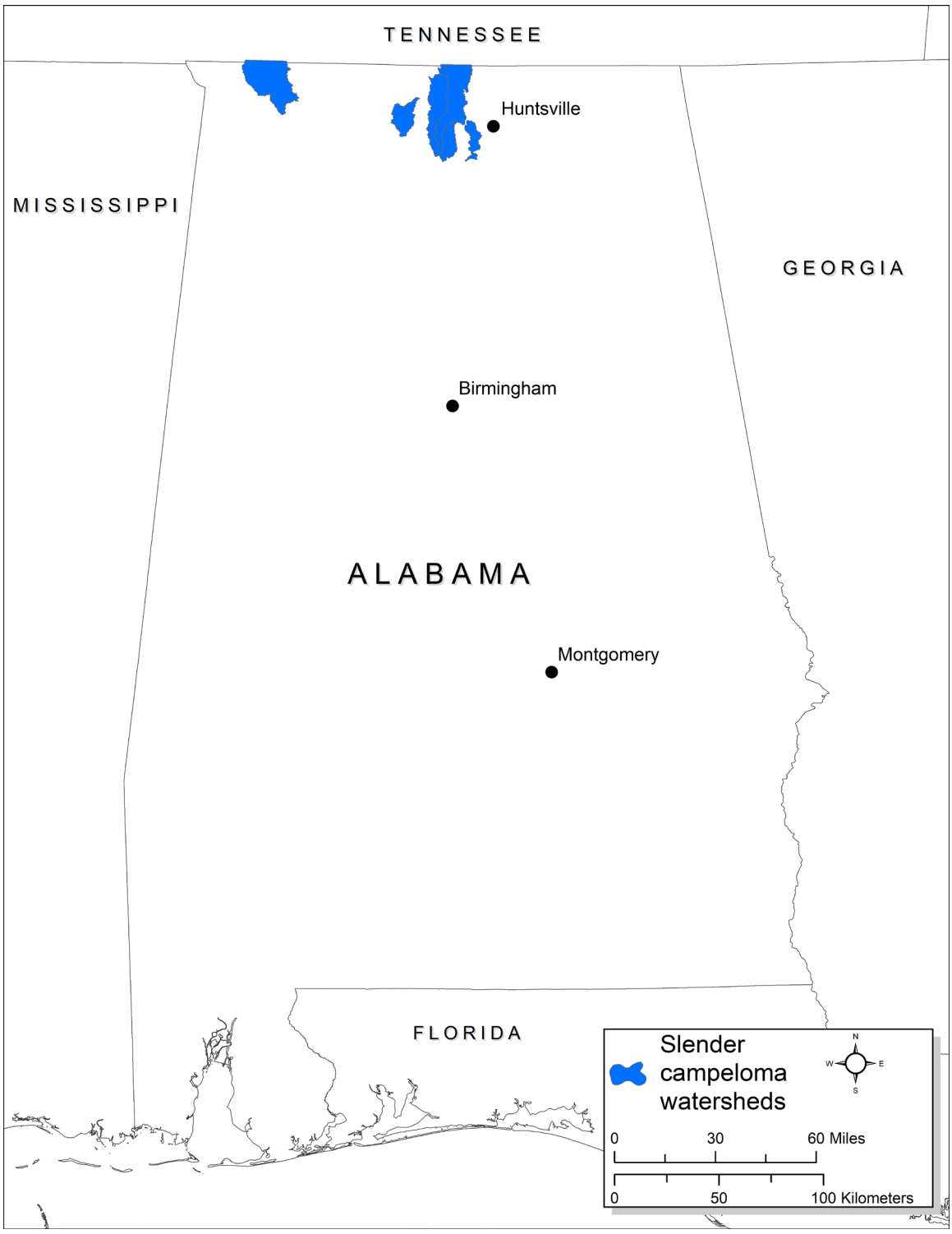

Figure 1. Regional location for slender campeloma watersheds. Map created by the U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama.

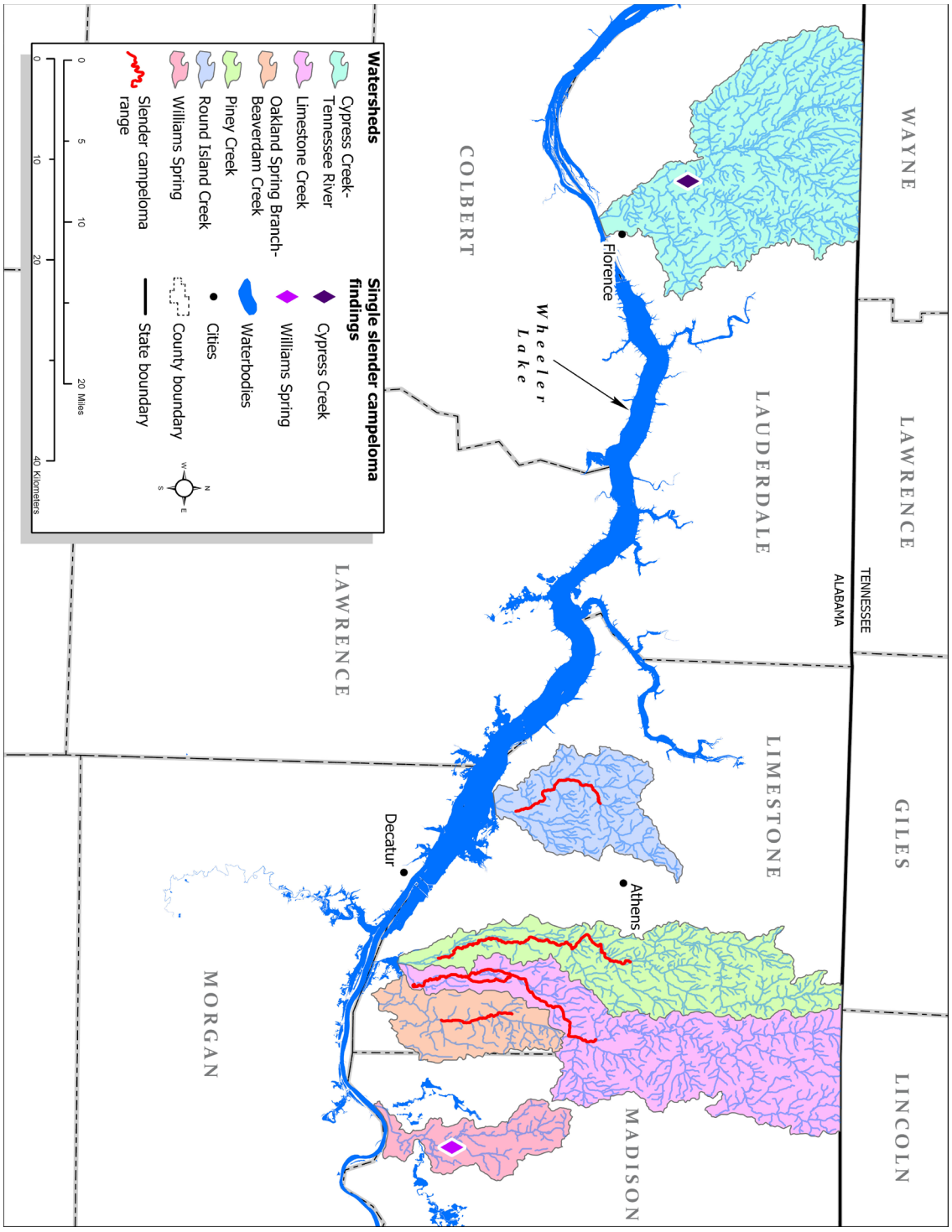

Figure 2. Range of slender campeloma. Map created by the U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama

"Description. – Shell ovate, oblong, imperforate, rather thick, irregularly roughened by occasional coarse wrinkles of growth, decussated by delicate revolving and longitudinal striae; greenish olive, with revolving dark broad lines when young, darker when old; suture impressed, spire elevated, but truncated; remaining whirls, three, of which the two upper are flattened, the lower sub-convex, with a median obtuse carina, reaching to and modifying the peristome: aperture higher than broad, roundly lunate, produced below: bluish within: peristome simple, acute, sinous, angular above at the termination of the carina.

Greater diameter, including aperture, 22 mill.; length, 35 mill.; length of the aperture, 20 mill.; diameter, 10 millimeters."
(Binney 1865)

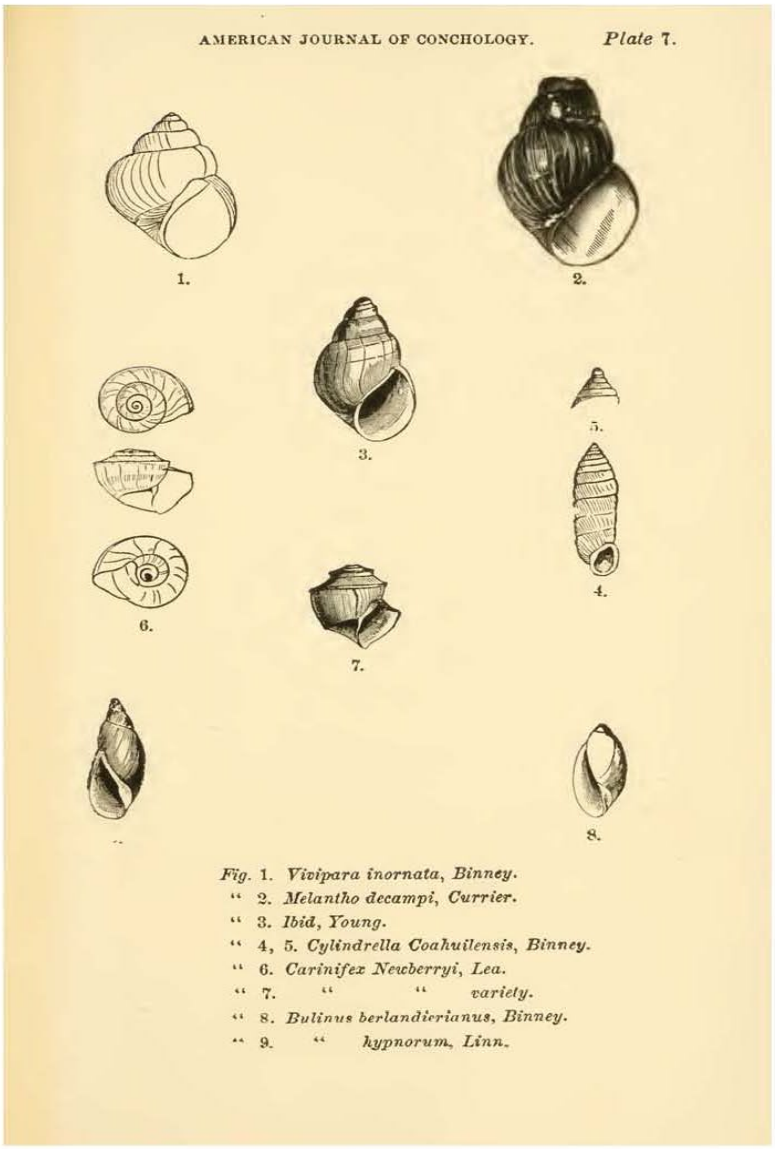

Figure 3. Original species description (pages 49-50) and illustrations (Plate 7, Figures 2 and 3) for *Melantho* (ie *Campeloma*) *decampi* published in the Journal of Conchology by W.G. Binney (Binney 1865).

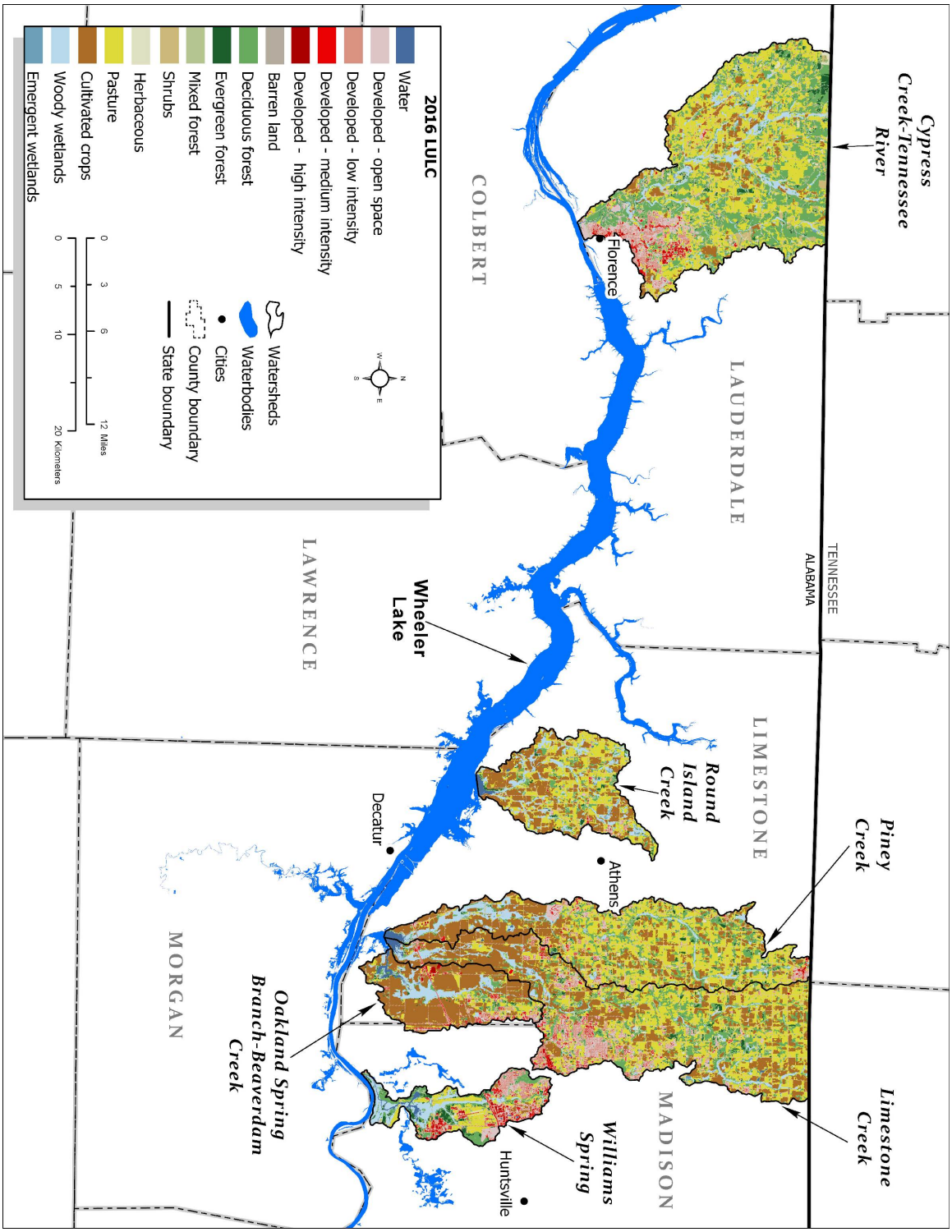

Figure 5. 2016 LULC data within the slender campeloma watersheds. Map created by the U.S. Fish and Wildlife Service, Alabama Field Office, Daphne, Alabama. Landsat satellite data obtained from National Land Cover Database (Yang et al. 2018).

Table 1. Analysis of land use land cover changes between 2001 and 2016 for the six watersheds associated with slender campeloma. 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, and 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, 2011, and 2016 Landsat satellite data (Homer, et al. 2007 and 2015; Yang et al. 2018 .
***Land Use Land Cover groups have been consolidated from original data to form these four similar land type classifications.**

			Cypress Creek Watershed	Round Island Creek Watershed	Piney Creek Watershed	Limestone Creek Watershed	Beaverdam Creek Watershed	Williams Spring Watershed
Land Use Land Cover*	Agriculture	2001 Acreage	46135	22577	38993	52550	17038	5224
		% in 2001	46.41	68.11	64.49	63.11	69.26	26.50
		2006 Acreage	45065	22488	38379	50504	16538	4837
		% in 2006	45.34	67.84	63.47	60.65	67.23	24.54
		2011 Acreage	44022	22369	37879	49687	16203	4172
		% in 2011	44.29	67.48	62.65	59.67	65.87	21.16
		2016 Acreage	43676	22350	37823	49410	15753	3975
		% in 2016	43.94	67.42	62.55	59.34	64.04	20.16
	Developed/ Barren	2001 Acreage	13015	2058	5437	10457	2121	5557
		% in 2001	13.09	6.21	8.99	12.56	8.62	28.19
		2006 Acreage	13371	2158	6043	12761	2593	6055
		% in 2006	13.45	6.51	9.99	15.32	10.54	30.71
		2011 Acreage	13587	2164	6433	13585	2962	6799
		% in 2011	13.67	6.53	10.64	16.31	12.04	34.49
		2016 Acreage	13682	2170	6482	13920	3468	7040
		% in 2016	13.76	6.55	10.72	16.72	14.10	35.71
	Forested/ Vegetated	2001 Acreage	33040	3442	11071	15528	2250	5285
		% in 2001	33.24	10.38	18.31	18.65	9.15	26.81
		2006 Acreage	33809	3465	11089	15264	2240	5170
		% in 2006	34.01	10.45	18.34	18.33	9.11	26.23
		2011 Acreage	34618	3569	11196	15253	2233	5097
		% in 2011	34.83	10.77	18.52	18.32	9.08	25.86
		2016 Acreage	34853	3572	11157	15135	2209	5051
		% in 2016	35.06	10.78	18.45	18.18	8.98	25.62
	Wetlands	2001 Acreage	6951	4634	4482	4228	2769	3154
		% in 2001	6.99	13.98	7.41	5.08	11.26	16.00
		2006 Acreage	6905	4591	4477	4177	2738	3112
		% in 2006	6.95	13.85	7.40	5.02	11.13	15.79
		2011 Acreage	6911	4592	4461	4176	2726	3106
		% in 2011	6.95	13.85	7.38	5.01	11.08	15.76
		2016 Acreage	6955	4603	4522	4233	2744	3124
		% in 2016	7.00	13.89	7.48	5.08	11.16	15.85

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of the Slender Campeloma (*Campeloma decampi)*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

__X__ No change needed

Review Conducted By: Erin Padgett and Evan Collins, Alabama Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve WILLIAM PEARSON Digitally signed by WILLIAM PEARSON Date: 2020.02.05 15:30:56 -06'00' Date _____

APPENDIX

Summary of peer review for the Slender Campeloma (*Campeloma decampi)*: 5 Year Review

Peer Review Method:

This document was peer-reviewed internally by Jeff Powell in the ES Field Office, Daphne, AL.

No formal public comments were received. Since minimal new information was obtained since the last 5-year review in 2012, we did not seek external independent peer review of this document. As we continue to support recovery actions with partners, we look forward to having additional data and surveys for our next 5-year review and its peer review.