Pale Lilliput
(*Toxolasma cylindrellus*)

5-Year Review:
Summary and Evaluation

Photo Credit: Thomas Tarpley, ADCNR, Alabama Aquatic Biodiversity Center

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

5-YEAR REVIEW

Pale Lilliput / *Toxolasma cylindrellus*

I. GENERAL INFORMATION

A. Methods used to complete the review:

This review was completed by the Alabama Ecological Services (ES) Field Office, Daphne, Alabama. The sources of information used in this analysis were the original listing rule (41 FR 24062), peer-reviewed reports, agency reports, unpublished survey data and reports, the species' recovery plan, and personal communication with recognized experts. All literature and documents used for this review are on file at the Alabama ES Field Office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the pale lilliput. Comments and suggestions regarding this review were received from peer reviewers from outside the Service (see Appendix A). No part of the review was contracted to an outside party. In addition, this review was announced to the public on April 9, 2010 (75 FR 18233) with a 60-day comment period. Comments received were evaluated and incorporated as appropriate.

B. Reviewers

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C. Background

Federal Register Notice citation announcing initiation of this review: 75 FR 18233, April 9, 2010.

Species status: Uncertain (2010 Recovery Data Call). Data suggests severely imperiled.

Recovery achieved: 1 (0-25% recovery objectives achieved)

Listing history:
Original Listing
FR notice: 41 FR 24062
Date listed: June 14, 1976
Entity listed: species
Classification: endangered

Associated rulemakings: N/A

Review History:
Recovery Data Call**:** 1998-2010
Recovery Plan: 1984

A previous 5-year review for this species was noticed on November 6, l991 (56 FR 56882). In that review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors, threats, etc. as they pertained to the individual species. In particular, no changes were proposed for the status of the pale lilliput in that review.

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

Recovery Plan: "Recovery Plan for the Pale Lilliput Pearly Mussel *Toxolasma* (=*Carunculina*) *cylindrellus* (Lea, 1868)"
Date issued: August 22, 1984

II. REVIEW ANALYSIS

A. 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.

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?** No. Given that the recovery plan is over 25 years old, recent population data are not incorporated into the recovery criteria. The plan lacks recent published and unpublished scientific information on the pale lilliput and its habitat.

b) **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?** No. Although the population/habitat protection criterion is applicable to listing factor A (the present or threatened destruction , modification, or curtailment of habitat or range), the recovery criteria do not address factors B-E (overutilization, disease or predation, inadequacy of existing regulatory mechanisms, or other natural or manmade factors affecting the species' continued existence). Further, although the recovery plan generally describes threats to the species and its habitat (USFWS 1984, pp. 14-27), the threats are not categorized under the five Endangered Species Act (ESA) listing factors.

3. List the recovery criteria as they appear in the recovery plan (USFWS 1984), and discuss how each criterion has or has not been met, citing information:

1. A viable population[1] of *Toxolasma cylindrellus* exists in the Paint Rock River, Estill Fork, and Hurricane Creek. These three populations are dispersed throughout each river so that it is unlikely that any one event would cause the total loss of either population.

The most recent extensive mussel survey in the Paint Rock River (PRR) system (Figure 1) was conducted by the Alabama Department of Conservation and Natural Resources (ADCNR), between June and August of 2008 (Fobian et al. 2008). A total of 47 sites were surveyed, 42 within the PRR mainstem and 5 sites in the Estill Fork. Thirty-nine species of mussels were collected live or fresh-dead (FD), including the pale lilliput (*Toxolasma cylindrellus*). However, the pale lilliput was only collected live at one site in the Estill Fork, and relic shells were collected at two other sites in the Estill Fork.

Prior to Fobian et al. (2008), the last extensive mussel survey of the PRR mainstem was completed in 1991 (Ahlstedt 1998), and the last extensive surveys within the headwaters of the system were

[1] The recovery plan defines a viable population as, "a reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes" (USFWS 1984).

completed in 1995 (McGregor and Shelton 1995) and 2002 (Godwin 2002). McGregor and Shelton (1995) collected one live and three FD individuals of pale lilliput in the Estill Fork; and also collected several relic specimens from both the Estill Fork and the PRR mainstem. Godwin collected five individuals of the pale lilliput live from the Estill Fork (two sites) (Godwin 2002), while Ahlstedt (1998) found only one live specimen from the Estill Fork and one relic specimen in Hurricane Creek.

Godwin (2002) noted that the upper reach of the Estill Fork near the Alabama-Tennessee state line may be the best locality remaining for the pale lilliput. Doug Shelton noted collecting up to 30 live specimens of pale lilliput in a half-mile stretch of the upper Estill Fork during a single day in 1994, and subsequent trips have continued to indicate a relatively healthy population (D. Shelton pers. comm. 2011).

Other miscellaneous surveys (as recorded in the Alabama ES Field Office species database, museum, or Heritage databases) have recorded a small number of additional records between 1980 to present in the PRR mainstem, Estill Fork, Hurricane Creek, and Larkin Fork. The last (since the late 1960's) pale lilliput collected from Larkin Fork was found by Don Manning in 1990 (Ahlstedt 1998, S. Ahlstedt pers. comm. 2011).

Based upon these survey data, it appears that Estill Fork may be the only one of the three populations that likely supports a viable population (reproducing population large enough to maintain genetic variation). Hurricane Creek could support a viable population as well, but most likely only supports a relict population, while Larkin Fork's population is likely relict or extirpated.

2. **Through reestablishments and/or discoveries of new populations, viable populations exist in two additional rivers. Each of these rivers will contain a viable population that is distributed such that a single event would be unlikely to eliminate *T. cylindrellus* from the river system.**

No new populations have been discovered or reintroduced since the listing of the pale lilliput in 1976.

Two attempts (Johnson 2004, P. Johnson unpublished data) have been made since 2004 to propagate and culture the pale lilliput. Both attempts have had only limited success. In 2004, the Tennessee Aquarium Research Institute was able to culture four

individuals (Johnson 2004), and in 2009 the ADCNR's Alabama Aquatic Biodiversity Center (AABC) was able to produce three juveniles in culture (T. Fobian unpublished data). All seven cultured individuals died in culture systems before being reintroduced (P. Johnson pers. comm. 2011).

Biologists from the AABC and Service conducted additional surveys within the upper PRR drainage in May 2011, in hopes of collecting pale lilliput brood stock for additional propagation and host study efforts. While four individuals were collected (three males, 1 female) from Estill Fork, no gravid females were found (A. Ford pers. obs. 2011). Additional efforts to collect brood stock for propagation and host study efforts for reintroduction work will continue in the near future (P. Johnson pers. comm. 2011).

3. The species and its habitat are protected from present and foreseeable human-related natural threats that may interfere with the survival of any of the populations.

The pale lilliput is currently restricted to the upper reaches and tributaries of the PRR watershed. Considerable effort has been made over the last decade to identify and repair problematic areas in the PRR watershed (Figure 2). Development in this area is relatively low and many of the land use practices (row crop and pasture) have remained unchanged over the last several decades (Godwin 1995).

The majority of land ownership in the PRR watershed is in private ownership, is mostly rural, and has little proposed urban development (Barbour 2003). The land use cover (Figure 3) is predominately forested: 89.9% in the upper watershed and 62.2% in the lower watershed. Agricultural production (row crop and pasture) makes up 32.5% of the land cover in the lower watershed and 9.1% in the upper watershed (Barbour 2003). While the total percentage of agricultural lands is relatively low in the upper watershed (where the pale lilliput is extant), agricultural land is usually adjacent to flowing water when present (Barbour 2003).

Godwin (1995) identified non-point source pollution within the PRR watershed. The most prevalent impacts were lack of riparian vegetation (47%), livestock intrusion (19%), and vehicle fording sites (14%) (natural shallow places in a river that can be crossed by wading or a vehicle). The remaining impacts included: sedimentation from mining, off-road vehicle use in streams, cropland erosion, timber harvest, dumping, sewage, logjams, construction, and drainage pipe discharges into the streams.

Beginning in 2001, The Nature Conservancy (TNC) and ADCNR began acquiring land for nature preserves, wildlife management areas (Alabama Forever Wild), and conservation easements (Figure 2). TNC currently owns and manages two preserves in Jackson County: Sharp and Bingham Mountains Preserve (3,400 acres) and the Roy B. Whitaker Preserve (323 acres). TNC has also acquired and transferred several properties to the ADCNR including: the Walls of Jericho (12,500 acres in Alabama, 9,000 acres in Tennessee), Henshaw Cove (1,579 acres), and the Sims/Swaim/Johnson Walls of Jericho additions (539 acres) (D. Fears pers. comm. 2011). Conservation easements are held by the Alabama Land Trust on approximately 1,000 acres of land within the PRR watershed (D. Fears pers. comm. 2011).

4. Noticeable improvements are made in substrate quality with regard to siltation from agricultural land use practices in the Paint Rock River watershed.

Restoration and enhancement projects (Figure 2) have been conducted in the PRR basin by multiple agencies and non-profit environmental groups over the past decade. Projects have included: streambank stabilization, riparian restoration, low water crossings, cattle exclusionary fencing, alternate water source development, and stream channel restoration (restoring natural meanders) (D. Fears pers. comm. 2011). During this time, TNC has participated in 24 such projects (Figure 2) (D. Fears pers. comm. 2011). The FWS Partners for Fish and Wildlife Program has participated in approximately 12 such projects.

The Natural Resource Conservation Service (NRCS) has a project specifically targeting the PRR and its two primary headwater streams (Estill Fork and Hurricane Creek) (NRCS 2011). Under this program, property owners adjacent to the PRR or one of its main tributaries are encouraged to enter into a Wetland Reserve Program (WRP) easement (30 year or permanent easement). The program takes cropland, pastureland, fallow land, or forestland and restores these areas by planting hardwood trees to reduce erosion and sediment in the stream, as well as minimize pesticides and excess nutrients in the streams (NRCS 2011).

In addition to WRP, NRCS also administers several other conservation programs (e.g., Environmental Quality Incentives Program) under the Farm Bill that have direct benefit to aquatic species. The following practices (S. Weaver pers. comm. 2011) have been implemented, between 2000 to 2010, by the NRCS in

the Estill Fork, Hurricane Creek, and Larkin Fork drainages: cattle access control (4 sites, 69 acres), conservation cover (1 site, 1 acre), forage and biomass planting (8 sites, 93 acres), prescribed grazing (10 sites, 175 acres), residue management, no-till/strip-till farming (2 sites, 36 acres), riparian forest buffer (2 sites, 6.3 acres), streambank and shoreline protection (2 sites, 607 feet), tree/shrub establishment (2 sites, 57 acres), cattle watering facility (5 sites, benefiting 75 acres), wetland restoration (1 site, 62.2 acres), and wetland wildlife habitat management (4 sites, 67.5 acres).

Although these criteria have not been met, progress has been made in certain areas; such as, propagation/reintroduction plans and habitat improvements through restoration and enhancement projects.

C. Updated Information and Current Species Status

1. Biology and Habitat

a) **Biology and Life History:**

The pale lilliput is a small freshwater mussel usually measuring less than 44 mm (1.7 inches) in length with a moderately thin and somewhat compressed shell that is tawny to yellowish green and without rays (Williams et al. 2008). The nacre is often purple to coppery in color (Parmalee and Bogan 1998, Williams et al. 2008). The pale lilliput is elongate and elliptical, becoming somewhat cylindrical in shape (Parmalee and Bogan 1998), with the female having an outline more oval in shape than that of the male.

It historically occurred in small creeks to large rivers; however, it currently seems to persist in only small to moderate sized streams in areas of slow to moderate current, usually in less than three feet of water, within sand and gravel substrates (Parmalee and Bogan 1998, Williams et al. 2008).

This species is a long-term brooder and is gravid from late summer or autumn into the following summer (Williams et al. 2008). Although the host is unknown, Paul Johnson (pers. comm. 2011) has had limited success with the bluegill sunfish (*Lepomis macrochirus*) in transforming juveniles (P. Johnson unpublished data, T. Fobian unpublished data).

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

NatureServe (Heritage Ranking System) has assigned the pale lilliput a global ranking of G1 and a state ranking, in Alabama and Tennessee, of S1 (Alabama Natural Heritage Program 2007, TDEC 2009). These ranks indicate that the species is critically imperiled, and at very high risk of extinction due to extreme rarity (often 5 or fewer populations). State protection has also been afforded to the pale lilliput in Alabama by the Invertebrate Species Regulation (Alabama Administrative Code 220-2-.98), and in Tennessee by the Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act (1974) (Tennessee Code Annotated 70-8-101 through 70-8-112). A review of imperiled wildlife in Alabama by Mirarchi et al. (2004) indicates that the pale lilliput is a Priority 1 species and a species of highest conservation concern.

The pale lilliput is restricted to the headwaters of the PRR (Figure 1) (USFWS 1984) and appears to occur in extremely low numbers (McGregor and Shelton 1995, Ahlstedt 1998, Godwin 2002, Fobian et al. 2008). For additional information refer to Section II.B.3.1. of this review.

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

The pale lilliput is in relatively low numbers among even the best remaining extant populations, so genetic flow and diversity is a concern.

The AABC has attempted to work with and will continue to work with the pale lilliput in the future with the goal of being able to culture and reintroduce new or augment existing populations (Cumberlandian Region Mollusk Restoration Committee 2009, P. Johnson pers. comm. 2011). AABC will continue to preserve genetic material from excess glochidia and propagated cohorts (that do not survive) for later use (65 FR 56916). For example, the AABC has provided the USGS and the University of Florida material for four different mussels in 2009 (*Lampsilis teres*, *Lampsilis fasciola*, *Villosa iris*, and *Villosa nebulosa*) for mitotyping to verify the actual number of males that fertilized the females used in culture trials (Fobian and Johnson 2010, Johnson and Hubbs 2010).

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

A member of the freshwater mussel family Unionidae, the pale lilliput was originally described as *Unio cylindrellus* (Lea, 1868). According to Lea (1868), the type localities are Duck Creek (presumably the Duck River), Tennessee; Swamp Creek, Whitfield

County, Georgia; and north Alabama (Figure 4) (Ortmann 1924, Parmalee and Bogan 1998, Williams et al. 2008). Parmalee and Bogan (1998) summarized the synonomy of the pale lilliput; it has been considered a member of the genera *Carunculina*, *Unio*, *Toxolasma*, *Margaron*, and *Lampsilis* at various times in history. It was reassigned to *Toxolasma* by Stansbery in 1971 (Parmalee and Bogan 1998).

No changes to taxonomic classification or nomenclature have occurred since this species was listed. Nomenclature is consistent and follows that in Turgeon et al. (1998).

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

The pale lilliput historically (Table 1) occurred from the middle reaches of the Tennessee River system, across northern Alabama and Tennessee, and the Duck River system in central Tennessee (Ortmann 1924, Ortmann 1925, Parmalee and Bogan 1998, Mirarchi 2004, Williams et al. 2008). It was last collected from the Duck River mainstem in 1980 by Herb Athearn, (Ahlstedt et al. 2004) and from Big Rock Creek (a tributary to the Duck River) by Don Manning in 1989 (Ahlstedt pers. comm. 2011); multiple collection efforts since have failed to produce additional records and it is now considered extirpated from the Duck River (Ahlstedt et al. 2004). The pale lilliput is now believed to be limited to only the upper reaches of the Paint Rock River system, Jackson County, Alabama, and potentially into Franklin County, Tennessee (Parmalee and Bogan 1998), where it is rare (Mirarchi 2004).

The pale lilliput record reported from Swamp Creek, Whitfield County, Georgia, a Mobile River system tributary, by Lea (1856) is either the one exception to its Cumberlandian distribution (Parmalee and Bogan 1998); or it is merely a mistaken or an invalid record (P. Johnson pers. comm. 2011).

Table 1. Historical records for Toxolasma cylindrellus prior to 1970.

River	Source
Swamp Creek (Whitfield County, Georgia)	Lea (1868)
Paint Rock River	Stansbery (1976)
Hurricane Creek (tributary to Paint Rock)	Athearn (personal communication) - Collected specimens in 1966
Larkin Fork (tributary to Paint Rock)	Stansbery (1976, 1971) Athearn (personal communication) - Collected specimens in 1966
Flint River	Ortmann (1925)
Elk River	Ortmann (1925) Athearn (personal communication) - Collected specimens in 1954 and 1963
Duck River	Marsh (1885) Ortmann (1924, 1925) Athearn (personal communication) - Collected specimens in 1956 van der Schalie (1973) Stansbery (1976)
Buffalo River	Ortmann (1924) van der Schalie (1973)
Sequatchie River	Bogan and Parmalee (1983) - Specimens collected by Athearn in 1955
Little Sequatchie River	Bogan and Parmalee (1983) - Specimens collected by Athearn in 1955

Source: USFWS 1984

f) **Habitat or ecosystem conditions:**

The PRR flows southwest 60 miles along the southern edge of the Cumberland Plateau physiographic province before it enters the Tennessee River (TRM 343.2); the last 13 river miles are within the impounded reaches of Wheeler Reservoir (Ahlstedt 1998, Fobian et al. 2008). The PRR watershed is sparsely populated and encompasses 458 square miles (Fobian et al. 2008). The landscape is predominately karst with about 760 known caves within the watershed (Godwin 2002). The upper PRR lies predominately within the Tuscumbia Limestone geologic formation, while the lower PRR lies primarily within Monteagle Limestone.

The PRR generally contain streamside zones that are well to moderately forested (Godwin 2002). The upper sections of the PRR are primarily narrow floodplains that are forested along the

stream with slopes that may rise as much as 300 meters above the stream (Godwin 2002), while lower reaches primarily consist of wide alluvial river valley floodplains with a narrow riparian zones adjacent to pastures and row crops (Godwin 2002, Fobian et al. 2008). The PRR is surrounded by forested mountains with heavy agricultural production in the adjacent floodplain, primarily for soybeans, cotton, corn, milo, and beef cattle (Ahlstedt 1998, Fobian et al. 2008).

Godwin (Godwin 1995, Godwin 2002) describes stream habitat conditions within the PRR watershed, and his notes are paraphrased below:

> The PRR and tributaries (Estill Fork, Hurricane Creek, and Larkin Fork) are generally shallow with depths less than a meter; however depth will range from a few centimeters in riffles to over a meter in pools. Substrates are coarse sand, gravel, cobble, and bedrock. Water clarity ranges from very clear in the headwater portions to turbid in the lower reaches of the main stem. The channel widths are often around ten meters in width, but may exceed 30 meters in the lower sections of the PRR. Generally, the water is slow flowing, but water in the headwaters may be swift in places. Large pools in the mainstem are sluggish. Flow is greatly diminished and may at times flow upstream at the lower end of the PRR due to the difference within the water levels in the reservoir and the river. Pools and riffles alternate throughout the drainage basin, and beds of water willow (*Justicia americana*) are interspersed in shallow and riffle areas.

D. Five-Factor Analysis

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

Human-related activities and development continue to strain the PRR system, including the upper PRR, where the only remaining extant populations of pale lilliput occur. Although development has occurred in the PRR, it has certainly not been to the extent of other areas in the Tennessee Valley (Barbour 2003). One of the most damaging in the PRR, may have been the channelization projects of the 1960's, which involved extensive stream channelization and removal of snags and riverbank timber in the PRR mainstem, Larkin Fork, Estill Fork, and Hurricane Creek (Barbour 2003). Ahlstedt (1998) noted that riffle and shoal habitats have never recovered from that event and continue to be aggravated by nonpoint source pollution associated with agricultural runoff. The mussel

fauna may continue to decline until measures are taken to reduce these stream perturbations (Ahlstedt 1998).

In 1995, Godwin reported 100 potential non-point source impacts at 85 sites. Of the 100 impacts, 75 were within the PRR, 18 in Estill Fork, five in Hurricane Creek, and two within Larkin Fork. The most common (47%) impact was lack of riparian vegetation, followed by cattle access to the stream (19%) and fording sites for agricultural vehicles (14%). Other documented impacts were sedimentation from mining and off-road vehicles (4% each), cropland erosion and timber harvest sites (3% each), and dumping of debris (2%). Godwin (1995) noted a single occurrence of the following potential impacts: sewage inflow, major logjam, siltation from construction, and drainage pipe, during the survey. As of present, these threats continue to impact the basin and the pale lilliput to much the same degree as there has been little change in the landscape since the study was conducted.

Pale lilliput habitat has also been disturbed and degraded by unauthorized removal of creek gravel from within the stream channel at several locations within the PRR drainage basin (D. Fears pers. comm. 2011).

Between 1999 through 2010, the FWS consulted (Section 7 of Endangered Species Act) informally on 16 projects within the PRR drainage. Projects included bridge replacements, new water lines, and creation of recreational trails; however, the majority (12 projects) involved habitat enhancement or bank stabilization that resulted in beneficial actions.

Outside of the historic channelization projects of the 1960s, development and non-source impacts in the upper PRR has continued to much the same degree, but remain low, as this land is for the most part undeveloped.

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

The pale lilliput is not known to have any commercial value and overutilization has not been a problem. Based on the best available data, overutilization is not believed to be a threat at this time. However because of this mussel's rarity any inadvertent collection could be a threat and could disturb natural reproduction.

3. Disease or predation:

Diseases of freshwater mussels are practically unknown. Grizzle and Brunner (2009) indicate that while some parasites and bacteria have been found in freshwater bivalves, these do not appear to be infectious between individuals.

While information is limited, measures are being taken in the propagation of freshwater mussels to limit their risk from parasites or bacteria or other pathogen, especially when hatchery reared animals are being released into the wild. For propagation activities at the AABC, groundwater is the only source water used because it likely contains fewer pathogens than are found in surface water (Fobian and Johnson 2010, Johnson and Hubbs 2010). To further reduce the risk of pathogens, all the water in mussel grow-out ponds is exchanged every 60 days, and no resident native mussels occur on site. Adult brood stock are segregated from juveniles to lessen the chance of introducing disease from the brood stock's native stream. No other mussel culture facility has reported any disease issues in a hatchery environment, and other mussels have grown rapidly in culture systems and appear healthy at AABC (Fobian and Johnson 2010, Johnson and Hubbs 2010). Little is known about freshwater mussel disease in the wild so at this time the degree of threat to the pale lilliput is unknown.

Several animals sympatric with the pale lilliput are known to eat freshwater mussels. The muskrat (*Ondatra zibethicus*) is probably the most common mammal predator of freshwater mussels and piles of shells are often seen near muskrat dens and feeding stations (Parmalee and Bogan 1998). Other mammals like mink (*Mustela vison*), raccoons (*Procyon lotor*), and river otters (*Lutra canadensis*) are also known to predate on mussels. Some birds (especially waterfowl) and turtles are known to feed on mussels; and freshwater drum (*Aplodinotus grunniens*) feed almost exclusively on them (Parmalee and Bogan 1998). These natural predators have evolved with the pale lilliput; they appear to be randomly opportunistic in their foraging, usually foraging on whatever mussel or clam (e.g., the exotic Asian clam) is most prevalent and easy to obtain. Due to the low number of individuals, predation on the pale lilliput could pose a threat but it occurs at a natural rate in their environment.

4. Inadequacy of existing regulatory mechanisms:

The pale lilliput is afforded protections against take under Section 9 of the ESA, by the State of Alabama under their Invertebrate Species Regulation (Alabama Administrative Code 220-2-.98), and in Tennessee by the Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act (1974) (Tennessee Code Annotated 70-8-101 through 70-8-112). While the pale lilliput may have species protections afforded to it by both state and federal governments, the majority of people are unaware of its presence and protected status and fail to take any additional precautionary measures to aid in the recovery of this species. Impacts still exist such as lack of riparian vegetation, cattle access to the stream, and fording sites for agricultural vehicles.

The Clean Water Act (CWA) is the primary federal law in the United States governing water pollution. One primary role of the CWA is to regulate the point source discharge of pollutants to surface waters. This is regulated by the permit process with a permit from the National Pollutant Discharge Elimination System (NPDES)**.** The NPDES permit process is usually delegated by the Environmental Protection Agency (EPA) to its state cohort; in Alabama this authority has been delegated to the Alabama Department of Environmental Management (ADEM) and in Tennessee to the Tennessee Department of Environment and Conservation (TDEC). Currently ADEM (Alabama Administrative Code, Title 22, Section 22-22-1 et seq.) and TDEC (Tennessee Code Annotated, 69-3-101 et seq.) require 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 pale lilliput.

Section 303d of the CWA requires each state to list its polluted water bodies and to set priorities for their clean up with a watershed restoration action plan called a "Total Maximum Daily Load" (TMDL) for each impaired water body. Currently Guess Creek (a tributary to the Paint Rock River) has been identified as impaired for water quality under Section 303d under the CWA. Guess Creek was listed for unknown toxicity, organic enrichment (CBOD, NBOD) and pathogens associated with unknown sources and pasture grazing.

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

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

While a single project (e.g., Section 404 or Section 26a permit) will usually not jeopardize the continued existence of pale lilliput, the collective encroachment on the pale lilliput's finite habitat may have a larger impact and is usually not assessed on a permit-by-permit case either due to no federal nexus or no combined assessment of all project impacts.

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

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 pale lilliput. 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 pale lilliput.

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

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

Natural factors, such as drought, can potentially threaten the continued existence of the pale lilliput. Natural droughts can potentially have negative impacts on water quality (e.g., dissolved oxygen) and waste dissemination of point source discharges. Droughts may also reduce the amount of habitat available to mussels by dewatering habitat, and may also lead to direct mortality by stranding mussels. Drought may also fragment sections of stream into isolated pools. However, in some cases, droughts can also concentrate host fish and therefore, increase the probability of glochidia (larval mussel) to host contact.

Human-induced random events such as toxic spills could also jeopardize the pale lilliput if pollutants are spilled within the drainage since the range of the pale lilliput is already reduced to two creeks (Estill Fork and Hurricane Creek). A kill associated with a major spill in the upper tributaries could potentially reduce the occupied range by half. A kill in occupied habitat of any magnitude would have impact due to the small population size.

Fish barriers, such as those caused by poorly designed road crossings, can limit fish movement as well as distribution of freshwater mussels. In 2010, the Service assessed over 51 river miles in the PRR basin and identified five high priority road crossings that likely function as fish barriers (B. Bouthillier, pers. comm. 2011). Three of these crossings were at locations known to support the pale lilliput, and therefore, possibly limiting its distribution. These barriers may also impact instream and riparian habitat by altering flow direction and velocity, leading to scour holes and bank collapse (D. Fears pers. comm. 2011).

E. Synthesis

The existence of the pale lilliput continues to be threatened by its highly restricted range, small population size, and continued impacts to its habitat. Its range is limited to the upper reaches of the PRR drainage system. Because the pale lilliput is limited geographically within the PRR drainage, catastrophic events such as spills or natural events (e.g., drought) could greatly reduce the geographic or genetic viability of the pale lilliput.

Habitat destruction or modification is presently the largest threat to this species. Since agriculture is the predominant stream side land use, partnerships with these private landowners to implement conservation practices, easements, and/or best management practices on their properties are vital to the continued existence of the pale lilliput.

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

III. RESULTS

A. Recommended Classification: No change is needed

IV. RECOMMENDATION FOR FUTURE ACTIONS

- Continue working with local landowners to preserve the integrity of stream banks and the riparian zone, and address problem areas by utilizing cost-shares and other conservation initiatives.
- Conduct systematic population monitoring of extant and reintroduced populations (if a reintroduction is achieved) including the documentation of potential threats.
- Specific life history and habitat needs have not been well documented; examine unknown components of life history and ecology, especially as it relates to host fish identification.
- Update the recovery plan for the species with best available information and to include the importance of propagation/culture, enhancing our knowledge of basic biological processes (host fish identification, life history), and identify reintroduction as a primary recovery objective.
- Develop a contingency plan to respond to a spill or natural disaster within occupied habitat.

- Provide public outreach and education for the pale lilliput, targeting property owners and farmers along the extant range.
- Continue to develop new partnerships and utilize conservation initiatives with landowners along the riparian habitats and within the recharge zone of the PRR drainage basin.
- Conduct genetic and histology research to support fitness of propagation and culture work.
- Conduct a detailed analysis of habitat requirements, including physiochemical parameters of the stream habitat used by the pale lilliput.
- Encourage EPA and ADEM to develop water quality criteria for pollutants based on responses of native mollusk species, including the pale lilliput.

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Peer-Reviewers - See Appendix A

Provided new/updated information

Mr. Steve Ahlstedt, Malacologist
U.S. Geological Survey (Retired), Norris, TN

Mr. Bill Bouthillier, Fishery Biologist
USFWS, Warm Springs National Fish Hatchery, Warm Springs, GA

Mr. Michael Buntin, Aquatic Biologist
ADCNR, Alabama Aquatic Biodiversity Center, Marion, AL

Mr. Doug Fears, Paint Rock River Program Director
TNC, Paint Rock River Office, Paint Rock, AL

Mr. Todd Fobian, Aquatic Biologist

ADCNR, Alabama Aquatic Biodiversity Center, Marion, AL

Mr. Paul Freeman, Aquatic Ecologist
TNC, Birmingham, AL

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

Mr. Rob Hurt, Assistant Refuge Manager
Fish and Wildlife Service, Wheeler National Wildlife Refuge, Decatur, AL

Doug Shelton, Malacologist
Alabama Malacological Research Center, Mobile, AL

Ms. Shannon Weaver, Assistant State Conservationist - Technology
Natural Resources Conservation Service, Auburn, AL

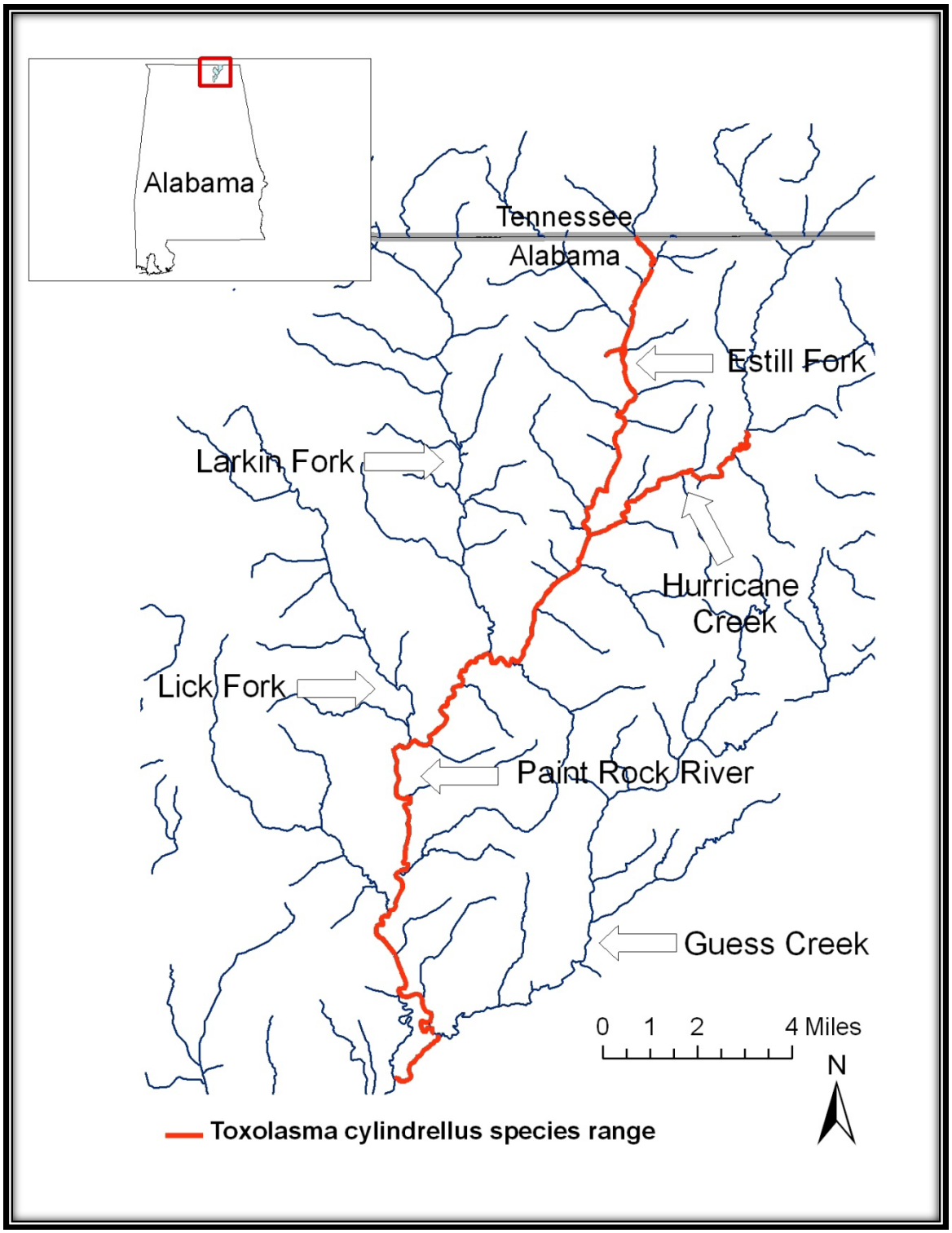

Figure 1: Current extant range of the pale lilliput (*Toxolasma cylindrellus*). Created by the USFWS Alabama Ecological Services Field Office (March 2011).

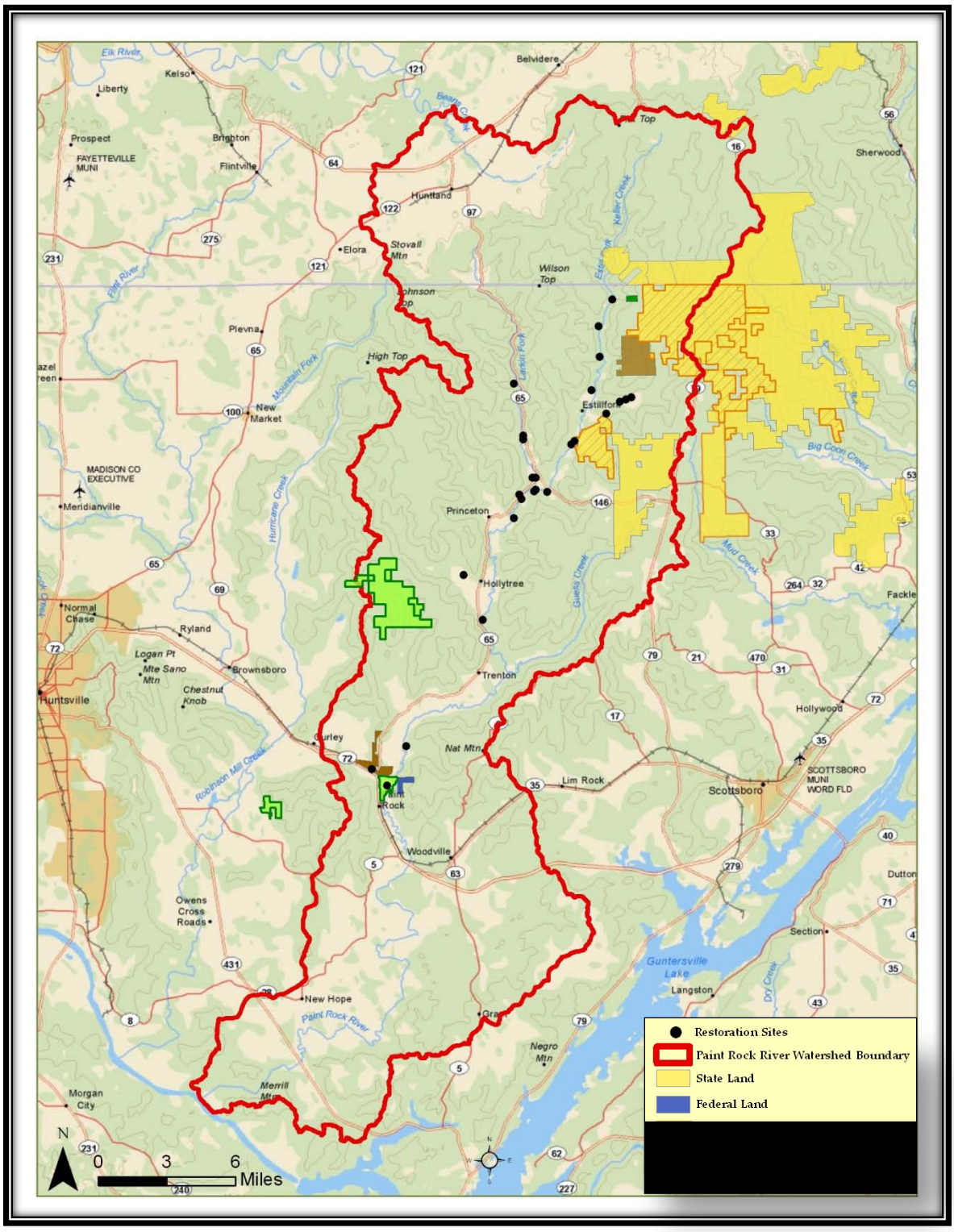

Figure 2: Protected lands and restoration sites within the Paint Rock River Watershed. Created by Georgia Pearson, The Nature Conservancy (February 2011).

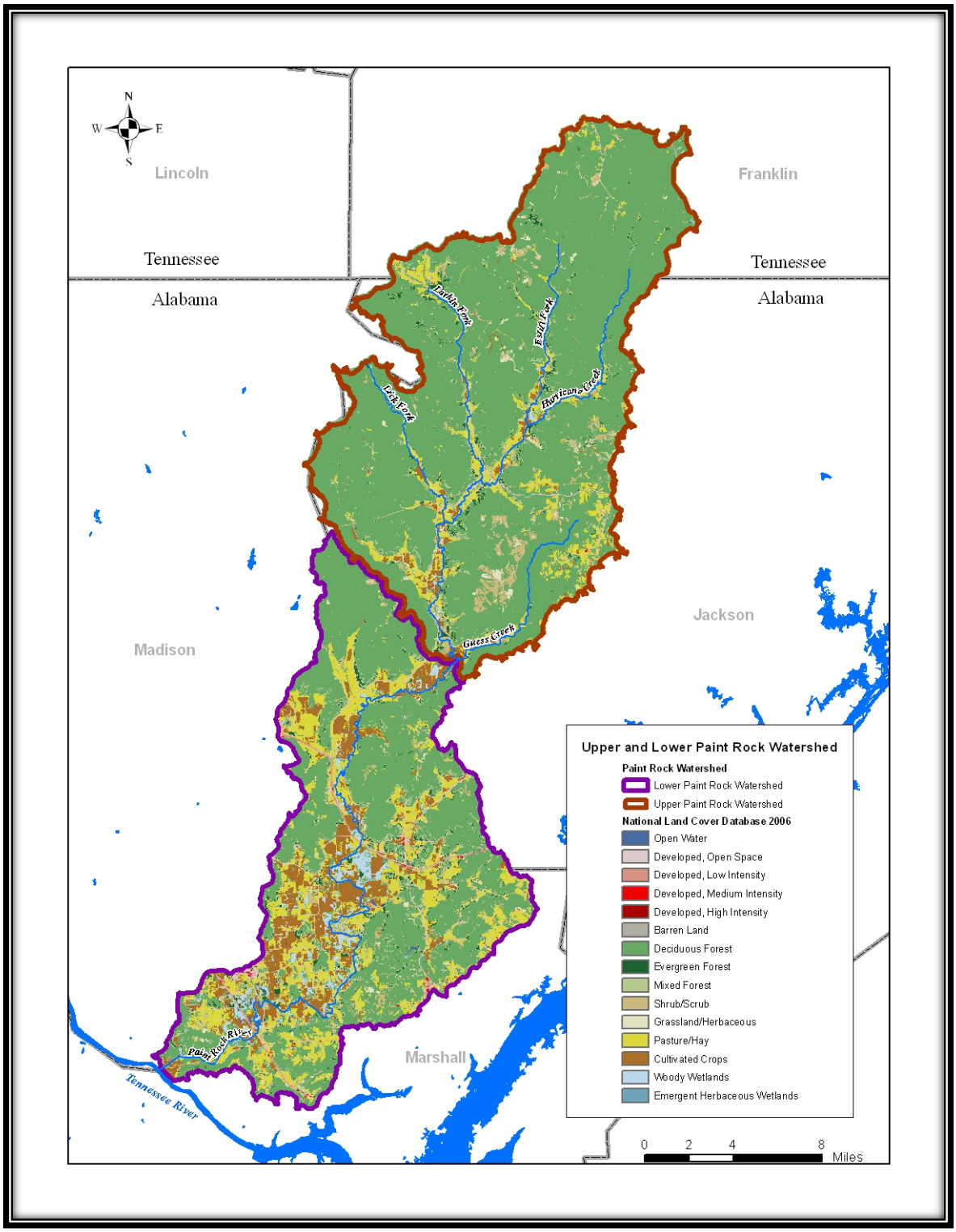

Figure 3: Land use coverage map within the Paint Rock River Watershed. Created by the USFWS Alabama Ecological Services Field Office (June 2011).

Photo Credit: Daniel Graf, Smithsonian Institution Department of Invertebrate Zoology

Figure 4: Type specimen of the pale lilliput collected from north Alabama located in the Smithsonian National Museum of Natural History (USNM 85300).

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of the Pale Lilliput (*Toxolasma cylindrellus*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

__X__ No change needed

Review Conducted By: Anthony D. Ford, USFWS Alabama ES Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 8-19-2011

The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.

REGIONAL OFFICE APPROVAL:

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

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 8/31/11

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

APPENDIX A: Summary of peer review for the 5-year review of the Pale lilliput (*Toxolasma cylindrellus*)

A. Peer Review Method: see below

B. Peer Review Charge:
Requests were made to each peer reviewer of the 5-year review via personal phone conversation and email request (March 18, 2011). We chose peer reviewers based on the expertise that each of them possess and the broad ranging knowledge that they could offer in giving a complete and thorough review. Each reviewer was asked to give a complete review with focus on areas of personal expertise, but not to review the status recommendation.

Peer reviewers included: (1) Mr. Doug Fears - the Program Director for TNC Paint Rock River Office. Mr. Fears has intimate knowledge of the Paint Rock River watershed, including land manager responsibilities for two TNC nature preserves. Mr. Fears has firsthand knowledge of impacts to the watershed and has developed a good rapport and working relationship with many of the private landowners within the watershed; (2) Mr. Jim Godwin - zoologist with the Alabama Natural Heritage Program. Mr. Godwin has conducted multiple surveys within the Paint Rock River watershed including an extensive survey of rare and federally protected mussels within the Paint Rock River watershed; (3) Dr. Paul Johnson - program supervisor of the ADCNR's Alabama Aquatic Biodiversity Center (AABC) and recognized mollusk expert. Dr. Johnson also has broad ranging knowledge and experience in mollusk propagation and reintroduction; and (4) Mr. Stuart McGregor - malacologist with the Geological Survey of Alabama. Mr. McGregor has expert knowledge of mussels in Alabama and has extensive survey experience in the Paint Rock River drainage.

C. Summary of Peer Review Comments/Report

Doug Fears, TNC:
Mr. Fears identified gravel dredging as an additional threat in the basin and expounded on the threats associated with instream fish barriers.

Jim Godwin, Alabama Natural Heritage Program:
The majority of his comments were editorial corrections/suggestions.

Dr. Paul D. Johnson:
Dr. Johnson suggested that the historic collection record of pale lilliput by Lea (1868) in Swamp Creek, Whitfield County, Georgia, may have been a spurious record.

Stuart McGregor, Geological Survey of Alabama:
The majority of his comments were editorial corrections/suggestions.

D. Response to Peer Review: All comments were reviewed and incorporated as appropriate into the document.