White wartyback (*Plethobasus cicatricosus*)

5-Year Review:
Summary and Evaluation

Photo provided by Jeff Garner, Alabama DNCR

U.S. Fish and Wildlife Service
Southeast Region
Tennessee Ecological Services Field Office
Cookeville, Tennessee

5-YEAR REVIEW
White wartyback (*Plethobasus cicatricosus*)

I. GENERAL INFORMATION

A. Methodology used to complete the review

This 5-year review was completed by the lead recovery biologist Ken McDonald in the U.S. Fish and Wildlife Service's (Service) Ecological Services Field Office in Cookeville, Tennessee. This 5-year review was accomplished using pertinent status data obtained from the recovery plan, peer-reviewed scientific publications, unpublished research reports, and experts on this species. We published a notice in the *Federal Register* on September 21, 2007 (72 FR 54057) announcing the 5-year status review for the white wartyback and requesting new information on the speces. A 60-day public comment period was opened. A draft of the 5-year review was peer reviewed by experts familiar with the mussel from various Federal and State government agencies, universities, and other organizations. Comments received were evaluated and incorporated as appropriate (see Appendix A). No comments were received on this mussel from the public.

B. Reviewers

Lead Region – Southeast Region, Atlanta, Georgia - Kelly Bibb, 404/679-7132.

Lead Field Office – Ecological Services Field Office, Cookeville, Tennessee - Ken McDonald. (Since Ken moved to a new position in the USFWS, Stephanie Chance finalized this review for this office, (931) 528-6481 x. 211. After completion of this review, recovery lead will be transferred to our Alabama Field Office, to Anthony Ford.)

Cooperating Field Office – Ecological Services Field Office, Daphne, Alabama – Anthony Ford; 251/441-5838

Cooperating Regions – Northeast Region – Mary Parkin, 617/417-3331. Virginia Field Office, Cindy Schulz, 804-824-2426; Midwest Region – Laura Ragan, 612/713-5157.

C. Background

1. **Federal Register Notice citation announcing initiation of this review:** 72 FR 54057; September 21, 2007

2. **Species status:** The white wartyback is declining. This decline is likely driven by multiple factors, chief among them being habitat destruction by impoundments and low reproductive success within the last known population (2014).

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

4. **Listing history:**
FR Notice: 41 FR 24062
Date Listed: June 14, 1976
Entity Listed: species
Classification: endangered

5. **Associated actions:**
A final rule was published on October 15, 2007, for the establishment of non-essential experimental populations of 21 aquatic species including the white wartyback in the lower reach of the French Broad River (below Douglas Dam) and the lower reach of the Holston River (below Cherokee Dam) in Tennessee (72 FR 52434).

6. **Review history:**
1984: Final Recovery Plan published
1998-2015: Annual review of listed species information to benefit the Recovery Report to Congress. Through 2013, we placed status recommendations like "Declining" for this mussel. We continue to identify these recommendations in our 5-year reviews.
A previous 5-year review for this species was published on November 6, 1991 (56 FR 56882)). In this 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. The published notices summarily listed these species and stated that no changes in the designation of these species were warranted at that time. In particular, no changes were proposed for the status of the species in this review. A similar 5-year review was completed in 1987 (52 FR 25523) and no changes were proposed for the status of the white wartyback mussel.

7. **Species recovery priority number at start of review (48 FR 43098):**
The recovery priority number for white wartyback is 5. A priority number of 5 indicates a species has a high degree of threat, low recovery potential, and the taxonomy is species level.

8. **Recovery plan:**
Name of Plan: White Wartyback Pearly Mussel Recovery Plan
Date Issued: September 19, 1984

II. REVIEW ANALYSIS

A. Application of the 1996 distinct population segment (DPS) policy

The white wartyback is an invertebrate and is not covered by the DPS policy.

B. Recovery Criteria

1. **Doe this species have a final, approved recovery plan containing objective, measurable criteria?** Yes.

2. **Adequacy of recovery criteria**
   a. **Does the recovery criteria reflect the best available (i.e., most up-to-date) information on the biology of the species and their habitats?** No.

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

3. **Recovery criteria**
   (1) A viable population of *P. cicatricosus* exists in the Tennessee River. This population is dispersed to an extent that it is unlikely that any one event would cause the loss of the entire population.

   This criterion has not been met. The species has been extirpated from its entire range (the Tennessee River (Tennessee, Alabama, Kentucky), Holston River (Tennessee), Cumberland River (Tennessee, Kentucky), Ohio River (Ohio, Illinois, Indiana, Kentucky, West Virginia), Wabash River (Indiana, Illinois), and Kanawha River (West Virginia)) with exception of a small population in the Tennessee River downstream of Wilson Dam between Tennessee River mile (TRM) 245 to TRM 256 in Lauderdale and Colbert counties, Alabama (Bogan and Parmalee, 1983; Garner and McGregor 2001; Williams et al., 2008). This population was apparently once reproducing at this location as several young individuals were collected there in 1997. However, survey results of this area of the Tennessee River since 1997 indicate the population, if it persists, exists at extremely low density and may be comprised largely of aging individuals (J. Garner, ALDCNR, personal communication, 2013) (Listing Factor A and D).

   (2) Through reestablishment and/or by discoveries of new populations, viable populations exist in two additional rivers. Each river will contain a viable population that is distributed such that a single event would be unlikely to eliminate *P. cicatricosus* from the river system. For reestablished populations, surveys must show that three year-classes including one year-class 10 years old or older have been naturally produced within the river system.

   This criterion has not been met. The white wartyback has not been collected recently from any river other than the lower Tennessee River. Regardless, the lower French Broad River and the lower Holston River were designated for establishment of nonessential experimental populations of the species (72 FR

52434). Therefore if individuals can be found and propagated, we could attempt to establish populations in those rivers in the future. (Listing Factors A and D).

However, surveys of freshwater mussels in the Tennessee River indicate the sole known population of white wartyback is unlikely to serve as a viable source population for the reestablishment for new populations in two additional rivers. Survey results indicate this population persists at low density, advanced age, and has a low rate of recruitment or reproduction (J. Garner, personal communication, 2013). Though little is known about this species' ecology or biology (Williams et al., 2008) it is still possible that successful propagation of this species to additional rivers could be undertaken; a sufficient number of white wartyback individuals were found elsewhere and collected for this purpose. Without the discovery of additional populations likelihood recovering this species remains low.

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

This criterion has not been met. Threats to the species' continued existence persist and it is unlikely that the species can be completely protected from threats (Listing Factors A and D). Listing factors C (Disease and Predation) and E (Natural or Man-made Factors Affecting Species Survival) were not cited in the final listing rule as being relevant to listing of the white wartyback though recent information indicates these factors may be inhibiting recovery of the species. Specifically, since listing of this species several annual surveys of freshwater mussels in the Tennessee River have detected apparent die-offs of non-listed species below Wilson Dam; these being tentatively attributed to the water release schedule at Wilson Dam and the discharge of treated wastewater from a treatment plant located at Seven-mile Island, downstream of Wilson Dam (Garner 2012). It is reasonable to believe factors contributing to die-offs of non-listed mussel species may have similarly affected white wartyback, contributing to its apparent decline in this area.

As a consequence of past consultations between the Tennessee Valley Authority (TVA) and the Service, TVA altered the water release schedule at Wilson Dam in 2006 (USFWS 2006) to improve water quality for federally listed threatened and endangered species. Specifically, water more frequently flushed over mussel beds in the Tennessee River during summer months was expected to improve water quality parameters known to be important to freshwater mussel species (e.g., discharge, water temperature, and dissolved oxygen) and to dilute those parameters known to be limiting for mussels (e.g., copper, zinc, aluminum, arsenic, manganese, ammonia and chlorine concentrations). Since TVA altered the water release schedule to improve

water quality in the Wilson Dam tailwater, mussel densities for most non-listed species have progressively increased (Garner 2012). However, because they are rarely detected in any annual surveys of this area and because some species have declined since TVA amended the water release schedule at Wilson Dam, it is impossible to determine or infer whether white wartyback is responding favorably to this action.

We do not believe that factor B (Overutilization for Commercial, Recreational, Scientific, or Educational Purposes) is relevant. We believe this because white wartyback currently exists in such low numbers that it is highly unlikely that individuals are collected during commercial harvest. No individuals are currently known to be held in laboratories or propagation facilities.

C. Updated Information and Current Species Status

1. Biology and habitat

The white wartyback prefers flowing water in medium to large rivers, with substrates composed of sand and gravel with minimal silt accumulation. Its presumed brooding is short, gravid spring and summer with unknown fish hosts (Williams et al., 2008).

The species range once included major rivers in Alabama, Illinois, Indiana, Kentucky, Ohio, Tennessee, and West Virginia. These include the Tennessee River (Tennessee, Alabama, Kentucky), Holston River (Tennessee), Cumberland River (Tennessee, Kentucky), Ohio River (Ohio, Illinois, Indiana, Kentucky, West Virginia), Wabash River (Indiana, Illinois), and Kanawha River (West Virginia)). Despite decades of surveys by numerous federal agencies, state agencies, and partners individuals of this species have not been found in these systems in contemporary times (Williams et al., 2008; Garner, 2013).

The only known extant members of this species are presently confined to a small population in the Tennessee River downstream of Wilson Dam between Tennessee River mile (TRM) 245 to TRM 256 in Lauderdale and Colbert counties, Alabama (Bogan and Parmalee, 1983; Garner and McGregor 2001; Williams et al., 2008).

Though white wartyback closely resembles *Plethobasus cyphyus*, and may superficially resemble *Fusconaia subrotunda* or *Pleurobema sintoxia,* no new genetic information has been introduced to suggest similarities to other species reflect anything more than the coevolution of similar characters; thus no change in taxonomy is merited at this time.

2. Five factor analysis

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

The white wartyback is threatened by habitat destruction and modification resulting from impoundment, sand and gravel dredging/mining, navigation activities, operation of water control facilities, and construction and operation of barge loading and fleeting facilities on the Ohio River and lower Tennessee River. A combination of these stressors may have contributed to the extirpation of this species from much of its former range in the Tennessee River (Tennessee, Alabama, Kentucky), Holston River (Tennessee), Cumberland River (Tennessee, Kentucky), Ohio River (Ohio, Illinois, Indiana, Kentucky, West Virginia), Wabash River (Indiana, Illinois), and Kanawha River (West Virginia). The only known extant population of white wartyback presently appears to be comprised of individuals occurring at low densities in a sole remaining population found in the tail-waters of Wilson Dam in Tennessee River.

Though they have not been observed outside of the Tennessee River since 1885 cold water releases from Wolf Creek Dam (Cumberland River, Kentucky), Dale Hollow Dam (Obey River, Tennessee), and Center Hill Dam (Caney Fork River, Tennessee) could still adversely affect rare, undetected white wartybacks among resident mussel populations in the middle reach of the Cumberland River (between Old Hickory Dam and Cordell Hull Dam). These releases have adversely affected other listed and non-listed mussels by inhibiting reproduction (Layzer et al., 1993). However, increased water temperatures of three to seven degrees Fahrenheit during drawdowns for dam repairs on some dams and through cooperative agreements at others have enabled non-listed mussels in that reach of the river to spawn (i.e., gravid females are being collected) (Layzer and Madison, 1995). It is possible that if white wartyback persist undetected at low density in these waterways they too might be benefiting from the change in temperature below these dams.

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

The white wartyback occurs in areas that are open to commercial harvest of mussels. This species is not, however, commercially valuable. Rare mussels may sometimes be taken incidentally by inexperienced commercial mussel dealers, but there is no evidence to indicate that incidental catch has resulted in significant declines in numbers of white wartybacks or is threatening survival of the species.

c. Disease or predation:

We do not consider disease or predation to be threats at this time. Though muskrat, mink, and raccoons are likely the primary predators of freshwater mussels in the Southeast, it is unlikely these species prey on white wartyback mussels if individuals still occurred in the deeper waters of the Tennessee, Cumberland, or Ohio rivers. Freshwater drum likely also consume mussels, but we have no information indicating drum predation is causing significant declines in large river mussel populations, including the white wartyback.

d. The inadequacy of existing regulatory mechanisms:

Given that the white wartyback is extremely rare and the population has been determined to be declining, we do not know at this time if existing regulation and enforcement to protect the species are adequate. State laws prohibit take of the species for scientific purposes without a collecting permit, but the species are not protected from take for other purposes. States are looking where it could occur through other survey work but no one is taking a project specially geared to locating this mussel. Also, implementation of best management practices (BMPs) to reduce sedimentation in streams is inconsistent (i.e., it is voluntary for some activities and mandatory for others) and unproven to be effective with respect to this species.

Other activities which may affect white wartyback, such as sand and gravel mining, are regulated in Alabama, the only state with a known extant population of the species. In Tennessee, where the species was once known to occur, sand and gravel mining has been approved for certain areas within the Tennessee and Cumberland rivers and prohibited in others because of the absence or presence of other federally listed mussels. It is unclear whether regulations for these activities are sufficiently protective because a) the loss of even a small number of individuals from exceptionally small populations can substantially reduce genetic variation within the species; b) the destruction of otherwise suitable habitat for white wartyback may inhibit population growth and dispersal necessary for the recovery of the species. Because this species prefers habitat consisting of sand/gravel/cobble substrate in medium to large rivers, where current keeps silt accumulation to a minimum, even regulated sand and gravel mining in river beds where this species could be present or might be able to colonize in the future may deprive white wartyback of habitat necessary for its survival or remove habitat necessary for its recovery. The amount of illegal sand and gravel mining currently taking place is not known.

Inconsistent application of the Endangered Species Act (Act) with respect to freshwater mussels may itself be a source of inadequacy in existing regulatory mechanisms (Biber, 2000). For example, a 2007 formal consultation for operation and maintenance (O&M) activities at the Tennessee Valley Authority (TVA) water control structures on the Tennessee River identified flow rate, temperature as contributing to the decline of listed species, generally, but did not identify other specific cumulative effects which might also be impacting populations of white wartyback, specifically. So though the formal consultation led to experimental changes at Wilson Dam to benefit listed freshwater mussels it did not take into account the potential, additional, adverse contributions to water quality produced from a treated wastewater release point downstream at Seven-mile Island. Had the consultation identified this other source of impact to white wartyback its possible changes to flow regime implemented at Wilson Dam might have been further designed and fully mitigated the impact of pollution from this source, as well. Failure to fully capture all potential impacts to water quality for the white wartyback during this and other consultations may explain why monitoring by the Alabama Division of Conservation and Natural Resources (ADCNR) find a mixed, not entirely positive, response among mussel species downstream of the dam since the changes were implemented (Garner, 2012).

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

Because the white wartyback is only known to occur in this single stretch of river and has been extirpated from most, if not all, of its former range its existence is likely much more dependent on the quality and quantity of water released by Wilson Dam and the surrounding landscape than at any time in its past or since its listing. Since 2007, TVA has been implementing an experimental hydropower

generation schedule at Wilson Dam to provide more consistent flows and better water quality to most mussel species in the tail-waters, generally, but further monitoring and investigation are needed to determine how the altered flow regime affects white wartyback, specifically.

The white wartyback is likely in an extreme genetic bottleneck and experiencing inbreeding depression. Due to the low haplotype diversity that is most likely present, the species is susceptible to climate change and other changes within its habitat. Climate change is altering weather patterns leading to greater incidence of flood and drought. Even though, this mussel historically occurred in larger rivers, climate change may contribute to factors like altered mainstream river temperatures due to diversion for different partner use.

D. Synthesis.

Surveys performed by state and federal agencies, as well as partners, have failed to identify white wartyback in most portions of its former range. The only known extant population of white wartyback is known from a reach of the Tennessee River downstream, of Wilson Dam in Alabama. Surveys only infrequently detect individuals of this species and evidence of reproduction is scant. Those individuals that persist in this reach of river do so in suboptimal habitat that is at perpetual risk of alteration by activities at Wilson Dam, other sources of point and area discharge into the Tennessee River, or, potentially, by extreme weather events and climate change. Thus we conclude the white wartyback has low estimated viability or potential for recovery.

III. RESULTS.

A. Recommended Classification:

__X__ No change is needed.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

A. The Service should continue working with TVA to ensure hydropower and flood control operations at Wilson Dam and associated monitoring are implemented in compliance with the Biological Opinion for Reservoir Operations and Maintenance. Pertinent information from the BO (p. 32) includes the following:

For a period to be determined by a technical working group, TVA will operate Wilson Dam during the summer months to provide water exchange (flush) over mussel beds between river miles 259.0 and 247.0 by pulsing at least one unit for an hour every four hours. TVA will monitor discharge, water temperature, dissolved oxygen (at the substrate level), copper, zinc, aluminum, arsenic, manganese, ammonia, chlorine, and some measure of epi-benthic drift at the dam and at least three sampling stations between Wilson Dam (TRM 259.0) and the

downstream end of Seven Mile Island (TRM 247.0). Sampling stations will be identified in coordination with biologists from the Service's field office in Daphne, Alabama. Annual reports will be provided to the Cookeville, Tennessee, and Daphne Field Offices. TVA should monitor white wartyback populations below Wilson Dam in order to detect response of this population to changes in the hydropower generation schedule.

B. Increase the probability of successful reproduction and propagation by collecting adults and placing them in aggregations below Wilson Dam to increase the odds it will increase their reproductive success during spawning. Consider use of in vitro propagation.

C. Initiate efforts aimed at identifying potential fish hosts, obtaining individuals, and improving techniques necessary for captive propagation of the species.

D. Once captive propagation techniques have been tested using a surrogate species, pursue captive propagation efforts when individuals of this species are found.

E. Initiate a study of the dietary needs and metabolism of large river obligate species to better understand the niche and needs of white wartyback in the system.

F. Improve utilization of existing legislation and regulations (federal and state endangered species laws, water quality requirements, stream alteration regulations, etc.) to protect the species and its habitat.

G. Continue efforts to reduce non-point pollution from agricultural activities by working through the Partners for Fish and Wildlife, Farm Bill, and other landowner incentive programs to implement BMPs.

H. Investigate role of point source pollution impacts to freshwater mussel species in the Wilson Dam tailwater, specifically those emanating from the wastewater treatment plant located at Seven-mile Island.

V. References

Biber, E. 2002. The Application of the Endangered Species Act to the Protection of Freshwater Mussels: A Case Study. *Environmental Law* 32(1), 91-174.

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Garner, J. T., and S. W. McGregor. 2001. "Current status of freshwater mussels (Unionidae, Margaritiferidae) in the Muscle Shoals area of Tennessee River in Alabama (Muscle Shoals revisited again)." *American Malacological Bulletin* 16, no. 1-2:155-170.

Garner, J.T. 2012. Tennessee River Freshwater Mussel Recovery, Section 6 Fiscal Year 2011-2012 Annual Report. Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Fisheries Section. 9pp.

Garner, J.T. 2013. personal communication August 26, 2013.

Layzer, J.B., M.E. Gordon, and R.M. Anderson. 1993. Mussels: The forgotten fauna of regulated rivers. A case study of the Caney Fork River. *Regulated Rivers: Research and Management* 8:63-71.

Layzer, J.B., and L.M. Madison. 1995. Microhabitat use by freshwater mussels and recommendations for determining their instream flow needs. *Regulated Rivers: Research and Management* 10:329-345

Williams, J.D., A.E. Bogan, and J.T. Garner. 2008. Freshwater Mussels of Alabama & the Mobile Basin in Georgia, Mississippi & Tennessee. Tuscaloosa, Alabama, The University of Alabama Press. 908pp.

U.S. Fish and Wildlife Service. 1984. Recovery plan white-wartyback pearly mussel (*Plethobasus cicatricosus*). 48 pp.

U.S. Fish and Wildlife Service. 2006. "Biological opinion on Routine Operations and Maintenance of TVA's Water Control Structures in the Tennessee River Basin" Cookville, Tennessee.

U.S. FISH AND WILDLIFE SERVICE
5-Year Review of the
White wartyback (*Plethobasus cicatricosus*)

Current Classification: Endangered

Recommendation resulting from the 5-year review:

_____ **Downlist to Threatened**
_____ **Uplist to Endangered**
_____ **Delist**
__X__ **No Change is Needed**

Review Conducted By: Ken McDonald, South Florida Ecological Services Field Office

FIELD OFFICE APPROVAL
Lead Field Supervisor, Fish and Wildlife Service

Approve Mary E Jennings Date 5/5/16

REGIONAL OFFICE APPROVAL
for **Lead Regional Director, Fish and Wildlife Service**

Approve Lee Ellis Date 7/13/16

REGIONAL OFFICE APPROVAL
for **Cooperating Regional Director, Fish and Wildlife Service**

Approve Sam D Marcum Date 9/2/16

REGIONAL OFFICE APPROVAL
For **Cooperating Regional Director, Fish and Wildlife Service**

Approve Martin Miller Date 9-9-16

APPENDIX A

Summary of Peer Review for the 5-Year Review of the White wartyback (*Plethobasus cicatricosus*)

Reviewers:

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A. **Peer Review Method:** A draft 5-year review of the white wartyback was sent to each of the reviewers, as an attachment to an email, requesting a critical review and any other changes or additions that should be included in the document. All reviewers have extensive knowledge of this and similar species. The reviewer from outside the USFWS has close knowledge of the last remaining population.

B. **Peer Review Charge:** Reviewers were charged with providing a review of the document, including any other comments and/or additions deemed appropriate. Reviewers were not asked to comment on the status recommendation of the species.

C. **Summary of Peer Review Comments/Report:** Reviewers responded by email. All reviewers agreed that the information in the document provided to them was accurate. They did provide some additional references and recommendations that were incorporated into the 5-year review as deemed appropriate.

D. **Response to Peer Review:** Recommendations from the reviewers were incorporated into the document. These consisted primarily of editorial changes and additional information concerning the status of certain populations.