

Smoky Madtom
(Noturus baileyi)

**5-Year Status Review:
Summary and Evaluation**



Photo courtesy of Conservation Fisheries, Inc.

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

June 2024

STATUS REVIEW

Smoky Madtom (*Noturus baileyi*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Tennessee Ecological Services Field Office (TNFO), Anthony Ford, 931-319-7747 and Warren Stiles (previous species lead, current Atlanta Regional Office, Recovery Planning Team)

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Lead Regional Office: Atlanta Regional Office, Carrie Straight (404) 679-7226

Date of original listing: November 26, 1984. Determination of Endangered Status and Designation of Critical Habitat for the Smoky Madtom (*Noturus baileyi*) (49 FR 43065).

Critical Habitat: November 26, 1984. Determination of Endangered Status and Designation of Critical Habitat for the Smoky Madtom (*Noturus baileyi*). (49 FR 43065).

Experimental Population Rule: August 12, 2002 Establishment of Nonessential Experimental Population status and Reintroduction of Fish in the Tellico River. (67 FR 52420)

Methodology used to complete the review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the Smoky madtom to inform this status review. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the madtom. We received data and information from state and federal agencies which were incorporated into this document. We did not receive any public comments. All recommendations resulting from this review are the result of thoroughly reviewing the best available information about the Smoky madtom.

FR Notice citation announcing the species is under active review: Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews for 67 Southeastern Species. May 11, 2023 (88 FR 30324).

Species' Recovery Priority Number at start of 5-year review (48 FR 43098): 8, indicating that the Smoky madtom is categorized as a species with a moderate degree of threat and a high recovery potential.

Review History:

The Service has published two 5-year reviews one on January 27, 2012, and another on June 15, 2020, both recommended no change in status for the Smoky madtom (Service 2012, 2020).

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature: The common name for *Noturus baileyi*, “Smoky madtom”, should be capitalized and treated as a proper noun as it refers to the Smoky Mountains, from which area the species was described (Nelson et al. 2006). The Common and Scientific Names of Fishes from the United States, Canada, and Mexico (Seventh Edition) notes that the 1970 list treated the name as a proper noun and capitalizes the spelling, and even though the 1980, 1991, and 2004 lists’ spelling as “smoky madtom”, the seventh edition (2013) notes that this was an orthographic error (Page et al. 2013). As such, we update the nomenclature in this review to capitalize “Smoky”, regarding it as a proper noun in reference to the Smoky Mountains. There are no known changes to the species taxonomy, and it is still considered valid by the Service.

Distinct Population Segment (DPS)

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This species has not been listed as a DPS and there is no new information that would inform us that the species needs to be listed as a DPS under the Service’s 1996 DPS Policy.

Recovery Criteria

Recovery Plan or Outline:

Final Recovery Plan for the Smoky Madtom (*Noturus baileyi*), August 1985 (Service 1985).

Recovery plans are not regulatory documents and are intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. If the recovery criteria defined in the plan are still valid, meeting recovery criteria can indicate that the species no longer requires protections under the Act. However, when recommending whether a listed species should be delisted, the Service must apply the factors in section 4(a) of the Act (84 FR 45020).

The Smoky madtom (*Noturus baileyi*) will be considered for delisting when all of the following four criteria are met:

1. *Through protection of the existing Citico Creek population and by introductions of the species back into Abrams Creek, viable¹ populations exist in both creeks.*

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.

2. *The U.S. Forest Service and National Park Service have implemented management plans for these two populations and have documented that management activities are successfully protecting and managing the species.*
3. *Through introductions and/or discoveries of new populations, there exists viable populations in two other creeks within the species historical range, (It is believed that at least two additional populations are required to ensure that the species will not become threatened in the foreseeable future).*
4. *All four populations and their habitat are protected from present and foreseeable human related natural threats that may interfere with the survival of any of the populations.*

We believe these criteria are appropriate and relevant. At the time of this review, Citico Creek and Abrams Creek populations are considered viable, the latter due to a successful reintroduction program in partnership with Conservation Fisheries Inc. and the Cherokee National Forest (CNF). The Smoky madtom has also been established in Tellico River as a nonessential experimental population (NEP). The National Park Service (NPS) and U.S. Forest Service (USFS) have implemented a management plan that ensures fish passage within the Little Tennessee River watershed and outlines translocation procedures that conserve and augment genetic diversity. A fourth population has not been identified, but it currently occurs with all known historically occupied streams.

Biology and Habitat Summary

The Smoky madtom is a small madtom species endemic to the Little Tennessee River basin. The species was thought to be extinct when first described from specimens collected in 1957 (Dinkins and Shute 1996). In 1980 the species was rediscovered in Citico Creek and was listed as federally endangered in 1984 (Bauer et al. 1983; 49 FR 43065).

The Smoky madtom can now be found in three tributaries of the Little Tennessee River: Abrams Creek, Citico Creek, and Tellico River (Figure 1). There are viable, self-sustaining populations in Citico Creek and Abrams Creek.

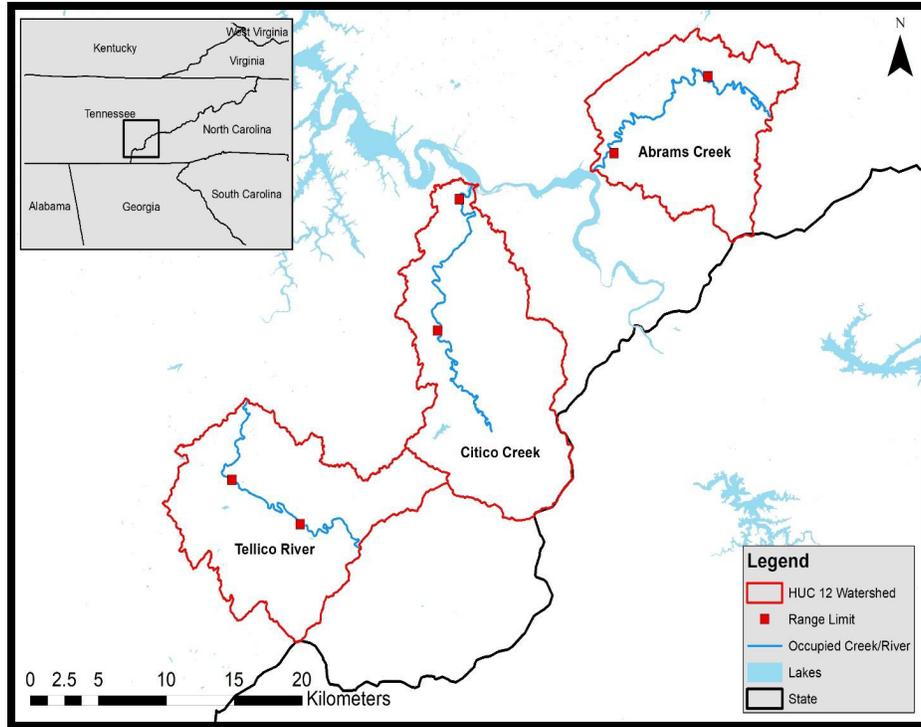


Figure 1. Smoky madtom current range in Tennessee, including Abrams Creek, Citico Creek, and Tellico River.

Abrams Creek. This population was considered extirpated when the recovery plan was written in 1985 (Service 1985). In 1987 CFI started stocking in Abrams Creek; from 1987 to 2003 over 3,000 individuals were stocked (Service 2012). This population has continued to maintain itself for the last 20 years without additional augmentation. In 2022 in Abrams Creek monitoring efforts detected 115 individuals and indicated an approximate density of 3.17 fish per 100m² and an approximate capture rate of 3.73 fish per person-hour (CFI 2022). In 2021, surveys indicated an upstream expansion in Abrams Creek (CFI 2022). The Abrams Creek population occupies 16.6 kilometers (km) of stream and occurs entirely within the Great Smoky Mountains National Park (GSMNP) (Figure 2).

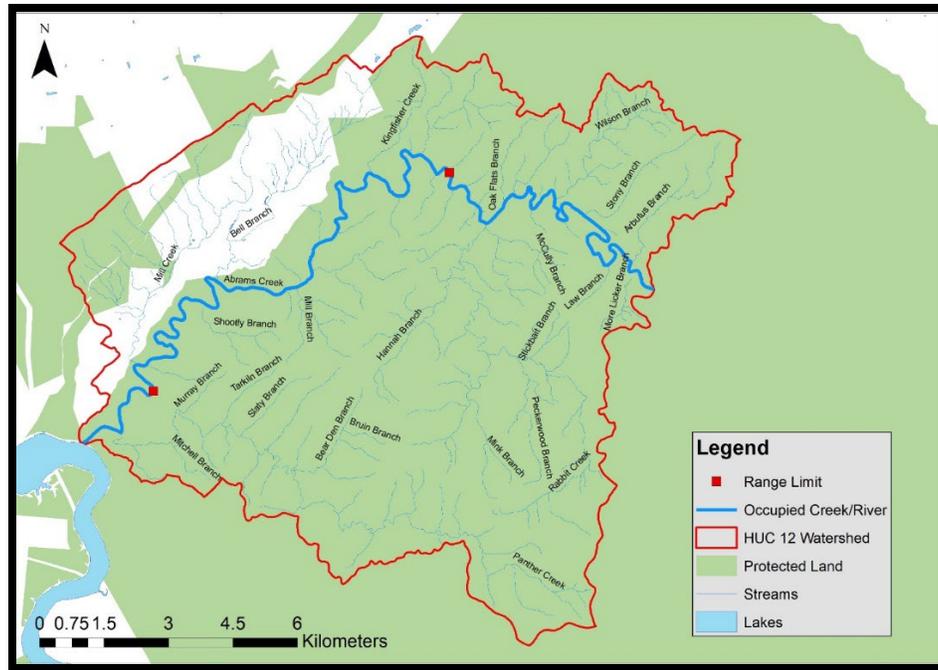


Figure 2. Smoky madtom range within Abrams Creek. Protected land surrounding Abrams Creek (green) and has been managed by the NPS as recommended and proposed wilderness since 1987 to maintain its: natural, undeveloped, untrammeled, and primitive characters; other ecological or geological features; or scientific, educational, scenic, or historical values (NPS 2016).

Citico Creek. At the time the recovery plan was written in 1985, the only known population of Smoky madtom was restricted to approximately 10.5 km of Citico Creek (Service 1985). Monitoring in Citico Creek in 2020 resulted in a total of 95 individuals observed and indicated an approximate 6.23 fish per person-hour and 6.18 fish per 100m² (Rakes et al. 2021). The Citico Creek population occupies 14.6 km of habitat almost entirely within the CNF (Figure 3).

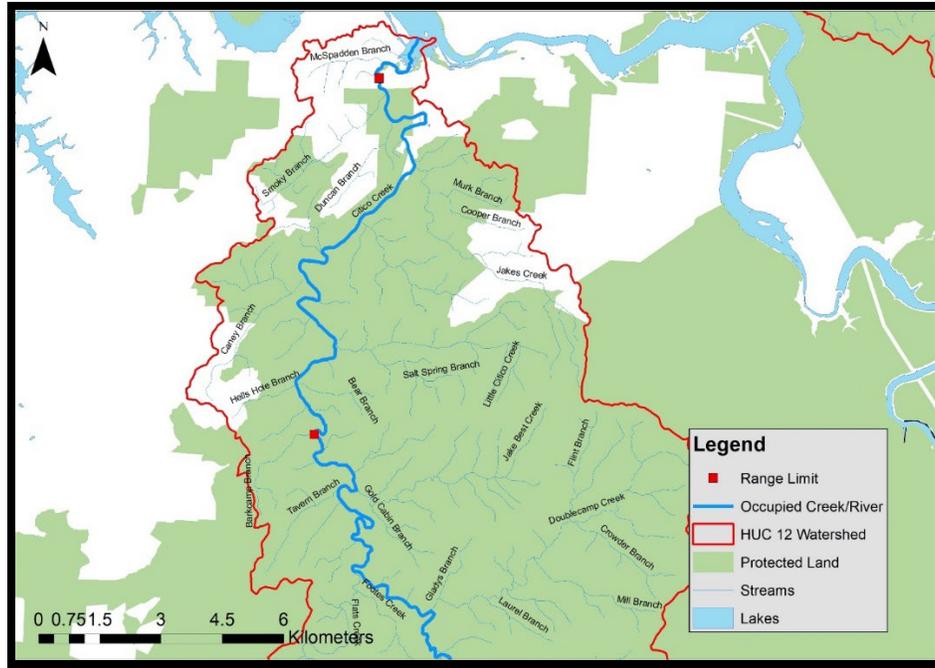


Figure 3. Smoky madtom range within Citico Creek. Protected land surrounding Citico Creek (green) is primarily managed by the USFS as part of the Citico Creek Wilderness Area to protect and preserve the natural environment from human influences and allow ecological and biological processes to progress naturally (USFS 2004). In the Citico Creek watershed, the USFS prioritizes and implements treatments to improve riparian condition and reduce sediment transport to streams and provide high water quality (USFS 2004).

Tellico River. Reintroduction of Smoky madtoms into the Tellico River began in 2002 (Service 2012). From 2002 to 2019 over 3,000 individuals were reintroduced into the Tellico River (Service 2012, 2020). The NEP in the Tellico River continues to be augmented by CFI (CFI 2022). Natural reproduction has been documented in the Tellico River population; however, it is still uncertain if this population is self-sustaining. In 2022 the Tellico River monitoring efforts detected 39 individuals and indicated an approximate capture rate of 2.42 fish per person-hour (CFI 2022). Stocking efforts were paused starting in 2023 to determine if these population levels will be maintained independently. The NEP within the Tellico River occupies 8.1 km occurring primarily within the CNF (Figure 4).

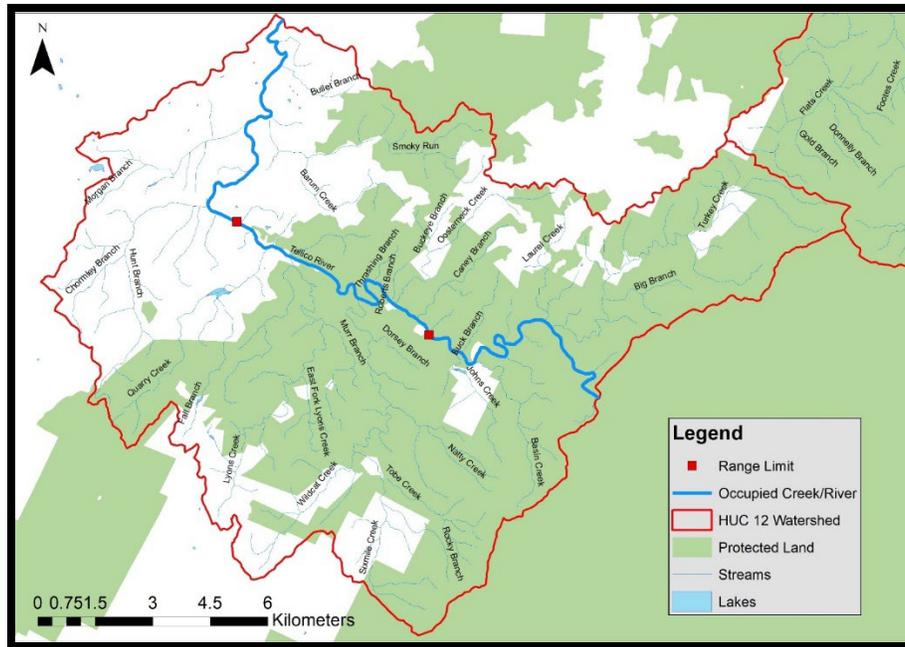


Figure 4. Smoky madtom range within the Tellico River. Protected land surrounding Tellico River (green) is primarily managed by the USFS to protect and perpetuate the outstandingly remarkable values of the river such as the river’s beauty and diversity of life within and outside of its banks (USFS 2004). In the Tellico River watershed, priority Forest Service roads are maintained or improved to reduce the sediment transport from roads to tributary streams and provide high water quality (USFS 2004).

A gene exchange program was initiated in response to a 2012 study that showed divergence between the Abrams and Citico Creek populations (Moyer and Williams 2012). In 2015, Kulp et al. (2015) designed and started the implementation of a gene exchange and monitoring program in Abrams Creek and Citico Creek. The purpose of the program is to reduce the influence of genetic drift (i.e., random variation in the number of gene variants in a population over time) on genetic diversity of the Abrams Creek and Citico Creek populations. The translocation and genetic monitoring plan include translocation of four adult Smoky madtoms biannually between the two systems with the goal of achieving a 5 percent migration rate (Kulp et al. 2015; CFI 2022). A recently published study reported success in creating a species-specific probe to use environmental DNA (eDNA) methods to test for the presence of the Smoky madtom. The results showed no evidence of species occurrence outside of its known locations (Aunins et al 2022).

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act, including: Factor A: the present or threatened destruction, modification, or curtailment of its habitat or range; Factor B: overutilization for commercial, recreational, scientific, or educational purposes; Factor C: disease or predation; Factor D: the inadequacy of existing regulatory mechanisms; Factor E: other natural or manmade factors affecting its continued existence. A detailed summary of threats to Smoky madtom can be found in the

Service's 2012 and 2020 5-year reviews (Service 2012, 2020). A summary of this assessment is detailed below.

Historical threats to habitat that affected Smoky madtom populations and their habitat have been largely addressed (Factor A). Most of the species' current habitat lies within lands managed by the USFS and the NPS, which have restoration, monitoring, and forest management programs with the potential to benefit the species and reduces some impacts from sedimentation and water quality (Service 2020). Sedimentation poses only a minor threat to Smoky madtom populations due to active management by USFS and NPS. For example, in 2015, CNF personnel developed and implemented a monitoring protocol to document the level of success of standards for water quality protection stated in the CNF's LRMP (USFS 2016). The overall implementation rate in 2015 was 93.1 percent. There was a minor departure from the standards 4.3 percent of the time and a major departure from the standards 2.6 percent of the time. Visible sediment did not enter streams 98.3 percent of the time, while non-critical visible sediment reached streams only 1.7 percent of the time and critical visible sediment flow was not detected during this assessment.

The CNF, for example, is also a vital partner in upgrading and improving road-stream crossings on the Forest to benefit species like the Smoky madtom. The CNF is investing in a series of projects within the Citico Creek watershed through the USFS's Collaborative Aquatic Landscape Restoration program that will promote the sustainability of the CNF's infrastructure, as well as the long-term conservation of aquatic biodiversity on the national forest. In addition to implementing actions such as low head dam removals and replacement of undersized culverts, the USFS also maintains streamside filter zones (riparian buffers) that minimize the impacts of logging and other activities that could cause sedimentation. Important objectives of the CNF's initiative include restoring aquatic organism passage, increasing aquatic connectivity, and restoring aquatic and riparian ecosystems.

Exposure to Anakeesta shale was historically a concern for Smoky madtom populations, as this rock formation is associated with high levels of sulfates, heavy metals, and acidity in streams. This threat has since decreased in Abrams Creek and Tellico River. There are still concerns about Anakeesta shale erosion causing increases in acid leaching into Citico Creek, but the CNF has implemented management practices to minimize those effects.

The Smoky madtom is not believed to be utilized for commercial, recreational, or educational purposes (Factor B). Smoky madtom nests and breeders are collected for captive propagation under Service permits and oversight. This work has resulted in several thousand individuals being introduced in the Smoky madtom populations in Abrams Creek and the Tellico River.

We are not aware of any information indicating that disease or predation is a significant factor affecting the Smoky madtom (Factor C).

Most of the range of the Smoky madtom exists within federal lands falling under the management of the USFS (CNF) and NPS (GSMNP). For instance, the Smoky madtom occurrences within the CNF receive management and protection through the National Forest Management Act of 1976 (16 U.S.C. 1600 et seq.) and the CNF's Land and Resource Management Plans (USFS 2004). In addition, the Smoky madtom is listed as Endangered by the State of Tennessee. The Tennessee Nongame and Endangered or Threatened Wildlife Species

Conservation Act of 1974 (Tennessee Code Annotated §§ 70-8-101-112) bars unpermitted take of the species. Further, regulations included in the Tennessee Wildlife Resources Commission Proclamation 00-15 Endangered or Threatened Species additionally add a level of protection to the species habitat. The existing regulatory mechanisms outside of the Act (Factor D) do provide some protections from the threats to the species, but do not eliminate all threats and risks to the species because of limited population size occurring in areas heavily utilized by the public for recreational usage. The public that may be unaware of the occurrence of Smoky madtom or the mechanisms in place to protect the fish and its habitat.

Recreational activities (swimming, wading, horse access to the water; Factor E) within the CNF and the GSMNP can and have resulted in visitors disturbing rocks, impacting nests and dislodging eggs (Shute et al. 2005, Shute per. comm. 2014). The level of disturbance resulting from these recreational activities has the potential to impact multiple nests during single or multiple events throughout the nesting phase, and particularly in areas adjacent to hiking and horseback riding trails and where visitors stop to swim. To mitigate for this impact, both the USFS and the NPS have implemented educational signage and coordinate with local media to raise public awareness of critical fish habitats. The NPS has also established policy that places a moratorium on disturbing and moving rocks in the GSMNP to further protect spawning aquatic species.

Impoundments continue to be a threat to the three Smoky madtom populations. There are five major impoundments on the Little Tennessee River and one smaller impoundment. These impoundments limit fish species' ability to reestablish populations and prevent gene flow among populations (Shute et al. 2005). The Chilhowee Dam and Tellico Dam are of particular concern because they separate the extant populations. Currently, the small size of Smoky madtom populations leave them vulnerable to environmental and demographic stochastic events (Factor E).

Smoky madtom populations are also vulnerable to climate change due to the potential of increased frequency of intense flooding and severity of drought (Factor E). Climate change is expected to result in increased temperatures, increase in droughts, and increases in extreme weather events (Runkle et al. 2022), which has the potential to impact species. Reduced water availability may be a significant threat to the Smoky madtom in the long term because an increase in the frequency and duration of dewatering events of suitable habitat may lead to reduced reproduction, nest success, or increase mortality due to the shallow-water habitat occupied by this species.

Species Status Summary (3 Rs)

The Species Status Assessment (SSA; <https://www.fws.gov/project/species-status-assessment>) Framework is an analytical approach developed by the Service to deliver foundational science for informing all decisions under the Act. Part of the SSA framework is to assess the listed entity's ability to sustain populations over time. To sustain populations over time, a species must have the capacity to withstand:

- (1) environmental and demographic stochasticity and disturbances (Resiliency),
- (2) catastrophes (Redundancy), and

(3) novel changes in its biological and physical environment (Representation).

Although this entity does not have a formal SSA, we have briefly assessed Resiliency, Redundancy, and Representation below.

Resiliency of a population describes its ability to withstand stochastic events and highly resilient populations are better able to endure major local disturbances (e.g., variations in rainfall, anthropogenic activities, toxic spills). Below we summarize the various factors described above which relate to resilience of each population. These conclusions are based on mainly qualitative information regarding the habitat for each location and any data available for Smoky madtoms in each population.

Abrams Creek

Detections of Smoky madtoms in Abrams Creek are consistent and natural reproduction is consistent. The population occurs entirely on land managed by the NPS and water quality is good. Generally, the habitat is in good condition but is slightly limited in spatial extent and, therefore, is considered moderate. Overall resilience for this population is High.

Citico Creek

Detections of Smoky madtoms in Citico Creek are consistent and natural reproduction is consistent. The population occurs entirely on land managed by the USFS and water quality is good. Generally, the habitat is in good condition but is slightly limited in spatial extent and, therefore, is considered moderate. Overall resilience for this population is High.

Tellico River

Detections of Smoky madtoms in Tellico River have increased over time and are now relatively high. Additionally, natural reproduction is consistent within the river which is surrounded mostly by USFS managed land and water quality is good and improving within occupied habitat. Overall resilience for the Tellico River population is Moderate.

Redundancy refers to the ability of a species to withstand catastrophic events and is measured by the amount and distribution of resilient populations across the species range. Each Smoky madtom population occurs within one watershed. Catastrophic events that could severely impact or extirpate entire Smoky madtom populations include chemical spills, changes in upstream land use that alters stream characteristics and water quality downstream, new impoundments, and potential effects of climate change such as drought and increases in occurrence of flash flooding events. The likelihood of many of these events are low given the Federal protections afforded to the populations by the NPS and USFS.

Representation refers to the ability of species to adapt to changing environmental conditions and is typically measured as the breadth of genetic or ecological diversity across the species. Moyer and Williams (2012) compared the genetic diversity between Abrams Creek and Citico Creek and found that overall genetic diversity was low, but different between these two populations. There is very little information regarding the historical distribution of Smoky

madtoms and it is impossible to know if populations were once more genetically distinct. Therefore, it is unknown if historical representation has been lost or if it remains the same as it was historically. Low representation may limit the species ability to adapt to environmental changes, especially those created by climate change, and a translocation and genetic monitoring plan is being implemented to manage gene flow between populations and preserve what genetic representation remains (Kulp et al. 2015).

Synthesis

The Smoky madtom is a small madtom species endemic to the Little Tennessee River basin. At listing, only a single population (Citico Creek) was known to exist. Currently, there are three known populations, all occur within tributaries of the Little Tennessee River. Two of the populations, Abrams Creek and Citico Creek, are within the known historical range. The Service designated a nonessential experimental population for the Smoky madtom in Tellico River that has been stocked from captive propagated individuals from the Citico Creek population. The Abrams Creek and Citico Creek populations appear to be stable. The Tellico River population has documented natural reproduction since 2010 and may also be getting close to be fully self-sustaining. Threats to Smoky madtom habitat have been greatly reduced by management actions by the USFS and NPS as most of the range occurs within the CNF and GSMNP. While the species continues to be isolated by impoundments, a genetic plan is being implemented to manage gene flow between populations. Source and nonpoint source pollution pose a minor threat to populations due to conservation efforts and watershed management practices of federal land management agencies. Because of the successful establishment of two additional populations (Abrams Creek and Tellico River), active management of the Smoky madtom in the CNF and GSMNP, and due to all current populations being stable or increasing, we believe this species may no longer meet the definition of an endangered species and recommend the species be reclassified as threatened.

RECOMMENDED FUTURE ACTIVITIES

Recovery Activities

Continue to implement recovery actions identified in the Smoky Madtom Recovery Plan (Service 1985), such as assisting the USFS and the NPS in developing and implementing a program to manage the Smoky madtom and its habitat that improves and/or maintains the physical and biological conditions needed by the species and that promote long-term viability of the Smoky madtom. Continue implementation of the GSMNP translocation and genetic monitoring plan (Kulp et al., 2015).

Monitoring / Research Activities

Continue USFS sponsored annual monitoring programs to track populations in Citico Creek and Tellico River and assess the results and effectiveness of reintroduction efforts (USFS 2004). Continue the long-term ecological monitoring programs at the GSMNP (e.g., All Taxa Biotic Inventory, Vital Signs, etc.) that aid in determining NPS-wide status and trends of macroinvertebrate and fish communities and assessing water quality and stream health of the GSMNP's freshwater resources (NPS 2016). Assess the feasibility and effectiveness of eDNA to inform our understanding of Smoky madtom occurrence outside of the three currently known populations. Aunins et al. (2022) concluded that the eDNA methodology they developed could

be useful in future monitoring in the GSMNP and especially within habitat in the Little Tennessee River watershed that could potentially support Smoky madtoms.

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RESULTS / SIGNATURES

U.S. FISH AND WILDLIFE SERVICE Status Review of the Smoky Madtom

Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the ESA.

- Downlist to Threatened
- Uplist to Endangered
- Delist (*Indicate reasons for delisting per 50 CFR 424.11*):
 - The species is extinct.*
 - The species does not meet the definition of an endangered or threatened species.*
 - The listed entity does not meet the statutory definition of a species.*
- No change needed.

New Recovery Priority Number ([48 FR 43098](#)):

The species Recovery Priority Number at the beginning of this review was 8, indicating a species with moderate degree of threats and a high recovery potential. Our new recovery number, 14, indicating a species with a low degree of threat and a high recovery potential. As described in this document, threats to Smoky madtom habitat have been greatly reduced by management actions by the U.S. Forest Service and the National Park Service as most of the range occurs within the Cherokee National Forest and the Great Smoky Mountain National Park.

FIELD OFFICE APPROVAL:

Field Supervisor, Tennessee Ecological Services Field Office, U.S. Fish and Wildlife Service

Approve _____

LEAD REGIONAL OFFICE APPROVAL:

Assistant Regional Director – Ecological Services, U.S. Fish and Wildlife Service

Approve _____