

Boulder Darter
(Nothonotus (=Etheostoma) wapiti)

**Status Review:
Summary and Evaluation**



Photo Credit: Todd Amacker

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

July 2023

STATUS REVIEW
Boulder Darter (*Nothonotus (=Etheostoma) wapiti*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Tennessee Ecological Services, Anthony Ford, (931) 319-7747

Reviewers:

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

Cooperating Field Office: Alabama Ecological Services, Evan Collins, (251) 441-5837

Date of original listing: September 1, 1988 (53 FR 33996): Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status of the Boulder Darter.

Experimental population designation: April 8, 2005 (70 FR 17916): Establishment of a Nonessential Experimental Population for Two Fishes (Boulder Darter and Spottfin Chub) in Shoal Creek, Tennessee and Alabama.

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 ([50 CFR 424.11](#)). The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the boulder darter to inform this status review.

We announced initiation of this review in the Federal Register on May 13, 2022 (87 FR 29364) with a 60-day comment period and received one comment. The primary sources of information used in this analysis were the 1988 final listing rule (53 FR 33996), the 1989 recovery plan, peer-reviewed reports, agency reports, unpublished survey data and reports, and personal communication with recognized experts. All literature and documents used for this review are on file at the Service's Tennessee Ecological Services Field Office (TNFO). All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the boulder darter. No part of this review was contracted to an outside party. This review was completed by the Service's lead recovery biology for the boulder darter in the TNFO.

We have not received significant new information, interpreted previously reviewed information in a new, significant light since the last review of the species and the level of public interest is low and non-controversial; therefore, no peer review was conducted.

FR Notice citation announcing the species is under active review:

May 13, 2022 (87 FR 29364)

Species' Recovery Priority Number at start of 5-year review ([48 FR 43098](#)):

The boulder darter's recovery priority number is 5, indicating a high degree of threat and low potential for recovery.

Review History:

Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, we did a recovery data call that included status recommendations such as "Stable, Decreasing or Increasing" for this animal. We continue to show that species status recommendation as part of our 5- year reviews. The most recent evaluation for this animal was completed in 2017.

Previous 5-Year Reviews:

5-Year Review of November 6, 1991 (56 FR 56882). In this review, different species were simultaneously evaluated with no species-specific, in-depth assessment of the five factors as they pertained to the different species' recovery. No changes were recommended to the species' endangered status.

5-Year Review noticed on July 28, 2006 (71 FR 42871) and completed on September 18, 2009. The Service did not recommend a change to the species' endangered status.

5-Year Review noticed on August 30, 2016 (81 FR 59650) and completed on October 4, 2017. The Service did not recommend a change to the species' endangered status.

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

The species was originally described as *Etheostoma wapiti* by Etnier and Williams (1989, entire). The genus *Nothonotus* was previously designated as a subgenus within *Etheostoma*, but Near and Keck (2005) proposed elevating it to genus, and additional darter phylogenetic studies have supported this (Near et al. 2011). The upcoming edition of the Common and Scientific Names of Fishes from the United States, Canada, and Mexico will include *Nothonotus* as a genus and the boulder darter will be recognized as *Nothonotus wapiti* (Dr. Larry Page, Curator of Fishes, Florida Museum, pers. comm. 2022). This name change is currently supported by the Integrated Taxonomic Information System (ITIS 2023) as the valid genus for boulder darter. This updated nomenclature does not impact our assessment of the listed entity, and it is still considered a valid entity by the Service. Until we finalize a technical correction of the name, we will continue to reference the species using the name as it was listed, *Etheostoma wapiti*.

Distinct Population Segment (DPS) ([61 FR 4722](#))

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 was not listed as a DPS, and we have no new information that would indicate the species should be listed as a DPS under the Service's 1996 DPS Policy.

Recovery Criteria

Recovery Plan or Outline

Final Recovery Plan for the Boulder Darter (*Etheostoma sp.*), July 27, 1989

Recovery plans are not regulatory documents and 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](#)).

Downlisting Criteria

The species will be considered for reclassification to threatened status when the likelihood of the species' becoming extinct in the foreseeable future has been eliminated by achievement of the following criteria:

1. *Through protection of the existing population in the Elk River and its tributaries and successful establishment of a reintroduced population in Shoal Creek or other historic habitat, or by discovery of an additional population, two distinct viable populations exist.*
2. *Studies of the fish's biological and ecological requirements have been completed, and the implementation of management strategies developed from these studies have been or are likely to be successful.*

Delisting Criteria

The species will be considered for removal from Endangered Species Action protection when the likelihood of the species' becoming endangered in the foreseeable future has been eliminated by the achievement of the following criteria:

1. *Through protection of the existing population and successful establishment of reintroduced populations or discovery of additional populations, three distinct viable populations* exist. The existing Elk River population, including the two tributary segments, must be secure from river mile 90 downstream to river mile 30.*
2. *Studies of the fish's biological and ecological requirements have been completed, and the implementation of management strategies developed from these studies has been successful.*
3. *No foreseeable threats exist that would likely threaten survival of any of the populations.*

**Viable populations: A reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes. The number of individuals needed and the amount and quality of habitat required to meet this criterion for the species as one of the recovery tasks.*

The Service believes these criteria are appropriate and relevant; however, no criteria have been fully met. We have gained a better understanding of the fish’s biological and ecological requirements through the captive breeding, husbandry, and rearing of young boulder darters for Shoal Creek, though efforts to establish a viable population in Shoal Creek have not yet been achieved. An update of each population (Elk River and Shoal Creek) is available below in the Biology and Habitat Summary section of this document. The Tennessee Valley Authority (TVA) modified releases below Tims Ford Dam following a 2006 formal consultation to benefit native warm-water fishery, especially the boulder darter and listed mussels, below the dam, however the reestablishment of boulder darter in the portion of the Elk River (between the dam and Fayetteville) been slow to respond, even though other native warm-water fish species seem to have responded positively and reoccupied this area. See additional discussion of this below in Five-Factor Analysis (Factor A) section.

Biology and Habitat Summary

The boulder darter is currently known from approximately 104 river kilometers (rkm) of the Elk River in Giles and Lincoln counties in Tennessee, and Limestone County in Alabama (Figure 1). The current distribution in the Elk River extends from confluence with Wells Creek in Lincoln County (TN) downstream to Shoal Creek in Limestone County (AL). Boulder darter current distribution also includes the lower portions of three Elk River tributaries: the lower 3.4 km of Richland Creek (Giles County, TN); the lower 0.8 km of Indian Creek, (Giles County, TN); and 0.8 km of Shoal Creek (Limestone County, AL). In 2005, the Service also designated a portion (44.7 km) of Shoal Creek (Lawrence County, TN and Lauderdale County, AL) as a Nonessential Experimental Population (NEP) (Service 2005), to allow reintroduction of boulder darter into this portion of its historical range (Petty 2020). A propagation and reintroduction program has been on-going in the Shoal Creek NEP since 2005 (Table 1).

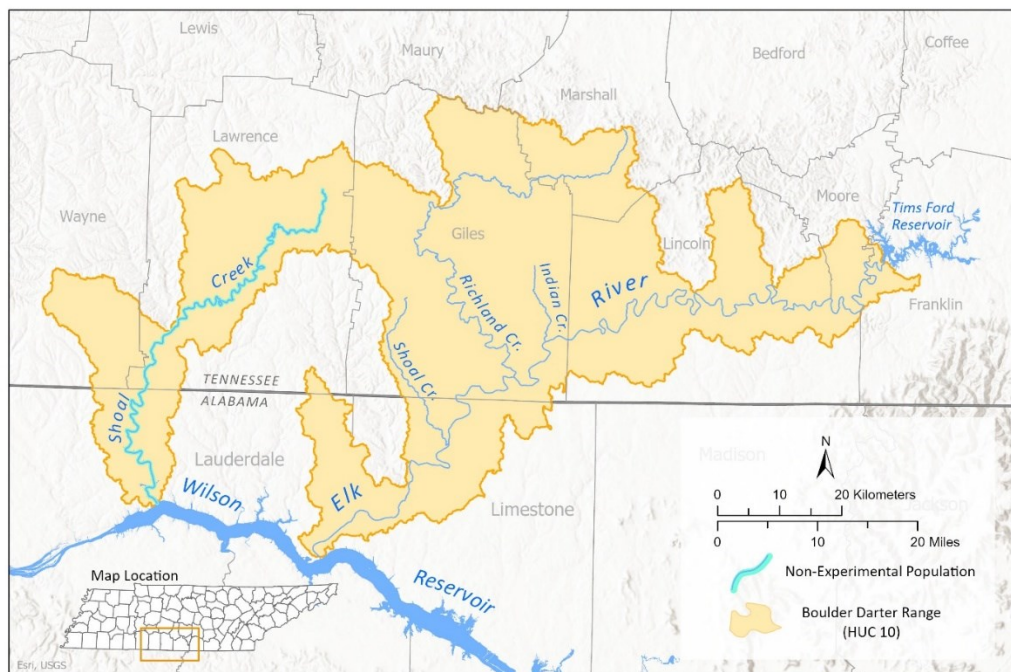


Figure 1. Current range of the boulder darter.

For boulder darter reintroduction efforts in the Shoal Creek NEP, Conservation Fisheries (CFI) continues to work with the Service on controlled propagation and population monitoring which includes the collection of wild boulder darters as breeders from the Elk River for captive breeding, husbandry, and rearing of young for stockings and reintroduction efforts into this NEP unit (Lawrence County, TN) (Petty et al. 2023). Since 2005, CFI has reintroduced 14,142 boulder darters (Elk River brood stock) into about 16 km of the Shoal Creek NEP. (Petty et al. 2023; Table 1). Though some reproduction and recruitment has been observed in the Shoal Creek NEP since 2009, annual monitoring still indicates low population numbers with an average observation rate of 1.7 individuals per person hour of search time. Continued efforts and monitoring is still required before this NEP can be determined to be viable and self-supporting as outlined in the Recovery Plan (Service 1989). While propagated boulder darters have been released into the Elk River prior to the establishment of the Shoal Creek NEP, no efforts to augment the Elk River population have taken place since 2003.

Table 1. Summary of boulder darter releases and snorkel survey observations by Conservation Fisheries in Shoal Creek, Lawrence County, Tennessee (Petty et al. 2023).

Year	Individuals Stocked	Individuals Observed	Populations Effort (p-hr)	# / (p-hr)
2005	335	4	2.60	1.54
2006	630	10	5.00	2.00
2007	628	14	7.50	1.87
2008	1268	19	21.25	0.89
2009	1282	24	5.25	4.57
2010	326	20	18.25	1.10
2011	--	14	17.55	0.80
2012	633	8	7.83	1.02
2013	760	12	23.50	0.51
2014	821	13	16.08	0.81
2015	1186	5	9.50	0.53
2016	989	8	7.00	1.14
2017	1500	7	18.50	0.38
2018	1166	16	9.00	1.78
2019	541	1	2.00	0.50
2020	176	1	1.00	1.00
2021	670	0	4.00	0.00
2022	1231	3	7.20	0.40
Total	14,142	179	183.0	1.70

CFI continues to conduct population monitoring in both Elk River and the Shoal Creek NEP. Since 2005, CFI has observed 179 boulder darters during annual monitoring of the Shoal Creek NEP (Petty et al. 2023; Table 1). These observations represent both stocked animals and their progeny. Since the previous review (Service 2017), monitoring as a way of collecting breeders from the Elk River population has documented 41 boulder darters in the Elk River (39) and Richland Creek (2) (Rakes et al. 2020 & 2021; Petty et al. 2023). Many of these were removed and brought back for propagation efforts at CFI to increase the genetic diversity of the captive breeding groups (Petty et al. 2023). Population monitoring efforts were not conducted in the Elk River in 2018 and 2021 due to poor sampling conditions (Rakes et al. 2019; Petty et al. 2021).

The habitat downstream of Harms Mill Dam is thought to be some of the best habitat for the boulder darter in the Elk River. The Harms Mill Dam has been proposed for removal by the Tennessee Wildlife Resources Agency (TWRA). As a way of assisting TWRA with their biological assessment for this proposed action, CFI developed an estimate of boulder darter occupancy in the habitat immediately downstream of the dam based off of previous monitoring and by making some habitat usage assumption based on their experience with the fish. CFI estimated that approximately 450-650 total individual boulder darters (adult and juveniles) may occupy the 3,000 square meters of habitat downstream of this dam (Baxter 2023, pers. comm.).

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 summary of this assessment is detailed below.

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

The recovery plan (Service 1989) indicated that cold water releases from Tims Ford Reservoir suppressed the Elk River population of boulder darter, especially the segment of the Elk River population upstream of Fayetteville. In coordination with the Service, the Tennessee Valley Authority (TVA) began addressing the deteriorated ecological conditions in the Tennessee River watershed in 1991 with the implementation of their Reservoir Release Improvement (RRI) program. Operational modifications at Tims Ford Dam successfully improved some aspects of water quality such as dissolved oxygen, but the RRI program did not establish a natural flow regime, and Tim's Ford Dam tailwaters still experienced large fluctuations in discharge associated with peaking hydropower operations (Bednarek and Hart 2005; Scott et al. 1996). In consultation with the Service (Service 2006), TVA further modified discharges below Tims Ford Dam by incorporating other ecologically meaningful parameters (e.g., flow and temperature) into their operational practices to better mimic natural conditions that existed before the dam was constructed and that native warm-water species, such as the boulder darter, are adapted to. These modified discharges combined sluicing, spilling and hydropower generation into operational practices and have warmed temperatures by about 10° F near Fayetteville from April to October (with negligible increases at the dam). Notable increases in fish diversity (native warm-water fish species), especially upstream of Fayetteville (Montgomery 2022, pers. comm) demonstrate that modifications to dam operations are improving the ecological integrity of the Elk River.

Although blended temperature discharges below the Tims Ford have increased habitat for boulder darter upstream of Fayetteville, occupancy modeling has indicated that rare and less-mobile species like boulder darters (a crevice-spawning species) may be slow to recover to these improved conditions. This is due to its limited ability to exhibit substantial migration and as a result the boulder darter may require reintroduction via propagation or translocations to more quickly utilize improved habitat resulting from these altered dam operations (Potoka et al. 2016).

Further downstream in the Elk River, in-stream habitat and connectivity is affected by a mill dam. Harm's Mill Dam is a 12 foot high and 325 foot long low-head concrete dam on the Elk

River, originally built as a textile mill (wood framed) in 1870 and later reconstructed for power generation (concrete dam and powerhouse) in 1922. This structure is located near Harms to the south-west of Fayetteville (Lincoln County, TN) (near Elk River rkm 124.1) and currently is a major movement barrier to the boulder darter and other aquatic organism. The shoal immediately downstream of the dam is recognized as some the best habitat for the boulder darter and is utilized as one of the most reliable brood stock collection spots for CFI's propagation efforts. The Tennessee Wildlife Resources Agency recently purchased Harm's Mill Dam in 2021 for the purpose of removing this barrier and as a way to restore habitat connectivity for a number of native fish and mollusk species including the boulder darter (Wisniewski 2022). Permitting and an environmental review is currently underway with multiple state, local, federal, and non-governmental agencies partnering on the deconstruction of this dam with the intent of removing this structure. The proposed removal of this structure will restore connectivity to 90 rkm between Harm's Mill Dam and Tim's Ford Dam.

We anticipate that the improved flow and temperature conditions below Tims Ford Dam and the proposed removal of Harms Mill Dam will likely improve the resiliency of the Elk River population.

We have no new information on the other threats to the boulder darter associated with water quality (e.g., pollutants resulting from agricultural and municipal waste and sedimentation/siltation) and that were previously mentioned in the recovery plan (Service 1989) and previous status reviews (Service 2009, 2017), but we believe impairments continue to persist in both the Elk River and Shoal Creek NEP drainages as evidenced by their continued designation as impaired under Section 303d of the Clean Water Act (CWA) in these watersheds (ADEM 2022; TDEC 2022)

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

The boulder darter is not known to have any commercial value, and overutilization has not otherwise been identified as a problem. The boulder darter propagation plan for the Shoal Creek reintroduction allows for no more than 5% of the source population from the Elk River to be removed as breeders for the captive propagation and reintroduction efforts (Petty 2020). This level of removal from the Elk River has been utilized since the establishment of the Shoal Creek NEP in 2005 and is considered acceptable/insignificant as evidenced by stable population trends of the Elk River population.

Disease or predation:

We have no evidence to suggest that disease and predation are limiting factors, or contributed in the decline of this species.

Inadequacy of existing regulatory mechanisms:

Major stressors identified in the boulder darter listing rule such as, sedimentation, nutrients, and non-point source pollutants, are influenced by the efficacy of State and Federal regulations. Protections afforded to the boulder darter through regulatory mechanisms appear to be improving some conditions for the boulder darter. TVA has invested approximately \$60 million in improving the ecological integrity of the Tennessee River watershed since the early 1990s through their authorities under the TVA Act and towards achieving their environmental

stewardship mission. In 2021, the TVA strengthened their commitment as a steward of the Southeast's natural resources and in fulfilling responsibilities that all Federal agencies share under the Endangered Species Act (Act) for recovering threatened and endangered species by establishing a Biodiversity Policy. This policy recognizes the importance of biodiversity to the quality of life experienced by residents of the electricity provider's service area, and commits TVA to, among other things, "minimize the adverse impact of TVA operations on biodiversity and ecosystems, including by protecting endangered species" (TVA 2023). The CWA and the Tennessee Water Quality Control Act have also provided some improvements in water quality and habitat conditions. These regulatory mechanisms, however, remain inadequate in fully protecting the species and its habitats, as the Elk River and many of its tributaries and the Shoal Creek NEP continue to be listed as impaired (ADEM 2022; TDEC 2022). The information available to us at this time does not indicate that the magnitude or imminence of this threat is likely to be appreciably reduced in the foreseeable future.

Other natural or manmade factors affecting its continued existence:

We have not identified any additional natural or manmade factors affecting the boulder darter since the previous review for the species (Service 2017).

Synthesis

The boulder darter is currently known from approximately 104 river kilometers of the Elk River in Giles and Lincoln counties in Tennessee, and Limestone County in Alabama. The boulder darter continues to persist at low numbers within the Elk River and within the reintroduced Shoal Creek Nonessential Experimental Population. Recent Elk River observations (n=41 darters) have largely be limited to brood stock collections by Conservation Fisheries Inc. (CFI), and the population in the Elk River appears to be stable. The Service continues to work with the Tennessee Wildlife Resources Agency and CFI to facilitate captive propagation of boulder darter for reintroduction efforts into the Shoal Creek (tributary of the Tennessee River), where 14,124 individuals have been released since 2005. While the reintroduced population appears to be persisting in Shoal Creek, annual monitoring indicates low population resiliency relative to other similar darter species occupying similar stretches of river that are more commonly observed. Annual observations since the previous review (2017-2022) have varied between 0 and 1.78 observations per person hour (averaging 0.43 individuals per person hour since 2017).

Protections afforded to the boulder darter through the Clean Water Act and the Tennessee Water Quality Control Act, along with significant investments by the Tennessee Valley Authority to incorporate ecological meaningful parameters into their operational practices are improving the ecological conditions of the Tennessee River watershed. Major stressors identified in the boulder darter listing rule such as sedimentation, nutrients, and non-point source pollutants, however, are not adequately regulated to fully protect the species and its habitats. The Elk River and many of its tributaries and the Shoal Creek NEP continue to be listed as impaired waters.

Due to its limited distribution, low resiliency, and continued threats, the boulder darter continues to be in danger of extinction throughout its range. Therefore, the status of the species as endangered remains appropriate. Thus, the recovery priority number for the boulder darter should remain 5, as the degree of threat remains high and the potential for recovery is low.

Recommended Future Activities

Implement conservation actions recommended in the Boulder Darter Recovery Plan (Service 1989), the Tennessee Wildlife Action Plan (<https://www.tn.gov/content/tn/twra/wildlife/action-plan.html>), and Alabama Wildlife Action Plan (<https://www.outdooralabama.com/research/state-wildlife-grants>).

RESULTS / SIGNATURES

U.S. Fish and Wildlife Service Status Review of Boulder Darter

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 Act.

- Downlist to Threatened
- Uplist to Endangered
- Delist:
 - 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

FIELD OFFICE APPROVAL:

Field Supervisor, Tennessee Ecological Services Field Office, Fish and Wildlife Service

Approve _____

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