Rush darter
(Etheostoma phytophilum)

5-Year Review:
Summary and Evaluation

Photo by Dr. Mike Howell

U.S. Fish and Wildlife Service
Mississippi-Basin Region
Mississippi Ecological Services Field Office
Jackson, Mississippi

5-YEAR REVIEW

Species reviewed: Rush darter (*Etheostoma phytophilum)*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:	**Atlantic-Gulf Region (R 2)** Kelly Bibb, (404) 679-7132
Lead Field Office:	Mississippi ES Field Office, Cary Norquist, (601) 321-1128
Cooperating Field Office:	Alabama ES Field Office, Evan Collins, (251) 441-5837

1.2 Methods Used to Complete the Review

We provided public notice of this five-year review in the *Federal Register* on June 30, 2017 (82 FR 29916), and opened a 60-day comment period. During this comment period, we obtained information on the status of this species from several experts; additional data was obtained from peer-reviewed scientific literature, and our state partners. Once all known literature and information was collected for this species, the review was completed by the Mississippi Ecological Services Field Office (MFO). The draft document was peer-reviewed, and reviewers and comments received were incorporated as appropriate (see Appendix A).

1.3 Background

1.3.1 Federal Register Notice citation announcing initiation of this review:

82 FR 29916 29916 (June 30, 2017)

1.3.2 Species Status: There has been little change in status since the rush darter was listed as endangered in 2011. Threats to its habitats have not diminished. The rush darter remains rare, restricted in distribution, and poorly known.

1.3.3 Recovery Achieved: 1 (1=0-25% species' recovery objectives achieved)

1.3.4 Listing history:
Original Listing Rule
FR notice: 76 FR 48722
Date listed: August 9, 2011
Entity listed: Species
Classification: Endangered, Entire Range

1.3.5 Associated rulemakings:
Final Critical Habitat Rule
FR notice: 77 FR 63603
Date: October 16, 2012

1.3.6 Review History:

Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, we submitted information for the annual recovery data call that included a "Declining" status recommendation for the Rush Darter. The most recent evaluation for this fish was completed in 2019.

1.3.7 Species' Recovery Priority Number at start of 5-year review (48 FR 430980): 5, indicating that the Rush darter is taxonomically categorized as a species, has a high degree of threat, and has a low recovery potential.

1.3.8 Recovery plan or outline:

Name of outline: Recovery Outline for Rush Darter (*Etheostoma phytophylum*)
Date issued: August 2011

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) Policy

2.1.1. Is the species under review listed as a DPS? No.

2.1.4. Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy? No.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? No. We are in the process of developing a draft recovery plan for the rush darter.

2.3 Updated Information and Current Species Status

2.3.1 Biology and habitat:

2.3.1.1 Distribution, abundance, population trends, demographic features, or demographic trends:

Distribution

The rush darter is endemic to spring fed creeks and spring runs in North Central Alabama. The species inhabits tributaries and spring systems of the Clear Creek Drainage, Winston County, Alabama (Wildcat Branch, Doe Branch, Mill Creek); Turkey Creek drainage, Jefferson County, Alabama (Beaver Creek, Tapawingo/Penny Springs, Cunningham Creek, and several unnamed tributaries); and upper Locust Fork drainage, Etowah County, Alabama (Little Cove, Bristow, and Dry Creeks).

When listed, the rush darter was known from localized collection sites within approximately 14.5 km (9 mi) of stream channel. Since listing, rush darters have been collected from 12 sites within approximately 17.9 km (11.1 mi) of stream or spring runs. All collection sites are separated geographically.

Three population clusters of rush darter are known:

Clear Creek Drainage of the Sipsey Fork, Winston County, Alabama
The rush darter is known from Wildcat Branch, Doe Branch, Mill Creek in the Clear Creek drainage of the Sipsey Fork (Johnston and Kleiner 2001; Stiles and Mills 2008, Kuhajda, pers. comm., 2018). Recently, Kuhajda (pers. comm. 2018) found only two specimens in Wildcat Branch, and only a few scattered specimens in Mill Creek.

Turkey Creek Drainage of the Locust Fork, Jefferson County, Alabama
In the Turkey Creek drainage of the Locust Fork, rush darters are known from Tapawingo/Penny Springs and at the type locality for the species (an unnamed spring run on Highway 79 in Pinson, Alabama) (Bart and Taylor 1999); however, the species has not been collected in Penny Springs since 2001 (George *et al*. 2009). The rush darter is also known from the head waters of Cunningham Creek (Howell *et al.* 2016), one site in Turkey Creek proper, localized portions of Beaver Creek, an unnamed spring run,

as well as another unnamed tributary to Turkey Creek in Pinson, Alabama (Stiles and Blanchard 2001; Drennen pers. obsv. 2006 to 2010; Kuhajda, pers. comm., 2008-2009). Both young of year and adult rush darters were collected from a large swampy area to the southwest of Tapawingo Springs in 2015; however, a subsequent search of this area by Kuhajda did not relocate the species (Stiles, pers. comm., 2019). The species was most recently discovered in an unnamed tributary of Turkey Creek, near the entrance of the Turkey Creek Nature Preserve (Kuhajda, pers. comm., 2018).

Upper Locust Fork Drainage, Etowah County, Alabama
In the upper Locust Fork drainage, rush darters have been collected from Little Cove Creek, and there is one historical record from Bristow Creek (Bart and Taylor 1999; Bart 2002; Kuhajda, pers. comm., 2008-2009; Spazgenski, pers. comm., 2008 to 2009). Rush darters were recently discovered in Dry Creek, a tributary to Bristow Creek (Kuhajda 2017).

Abundance / Population Trends

The rush darter is currently found in low densities (Johnston and Kleiner 2001), and individual rush darters may only be sporadically collected at specific sites within their range. No quantitative population estimates are available for the species; however, where it occurs it is usually uncommon and in low numbers (Bart and Taylor 1999; Johnston and Kleiner 2001; Stiles and Blanchard 2001; Stiles and Mills 2008; Kuhajda, pers. comm., 2008-2009; Rakes and Shute, pers. comm., 2010; Drennen, pers. obsv. 2006 to 2010; Howell *et al.* 2016; Kuhajda *et al.* 2018). There is little information on trends within the individual populations, however, Kuhajda (pers. comm. 2018) has noted the absence of rush darters and a corresponding increase of watercress darters at the Tapawingo/Penny Springs site in the Turkey Creek drainage.

Life History

Stiles and Mills (2008) have reported gravid rush darter females in February, and fry (newly hatched larval fish) in late April. Howell *et al.* (2016) collected adult females in February with enlarged genital papillae and abdomens distended with eggs. In captivity the rush darter spawns at water temperatures within the low 50°'s F (10° C) (Rakes and Shute, pers. comm., 2010). The females scatter their eggs among the fine leaves of aquatic plants, and they provide no parental care (Rakes and Shute 2005). The eggs are approximately 1.1 mm (0.04 in) in diameter, clear to translucent, and moderately adhesive (Rakes and Shute, pers. comm., 2010). Rush darter larvae at their first feeding in captivity are approximately 5 to 6 mm (0.22 in) in length, pelagic, and depend on a

benthic environment or vegetative cover (Rakes and Shute pers. comm. 2010). Larvae tend to stay in lentic waters. Preferred food items for the darter may include midge (Chironomidae), blackfly (Simulidae), and mayfly (Ephemeroptera) larvae and nymphs, beetles (Coleoptera), and microcrustaceans. The lifespan is estimated to be 2 to 3 years (Rakes and Shute, pers. comm., 2010).

2.3.1.2 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

In general, spring endemic fish have small population sizes, naturally fragmented distributions, and low genetic diversity (Fluker *et al.* in press). Three genetically distinct populations of the rush darter have been identified (Fluker *et al.* 2007, 2010, *et al.* in press). These include: (1) Clear Creek (Mill Creek and Wildcat Branch; no genetic testing has occurred for the Doe Branch population); (2) Turkey Creek (no genetic testing has occurred for the Cunningham Creek population); and (3) upper Locust Fork (Little Cove Creek). Populations in Turkey Creek and upper Locust Fork showed lower levels of genetic diversity compared to the Clear Creek (Sipsey Fork) population.

2.3.1.3 Taxonomic classification or changes in nomenclature:

Rush darter was described by Bart and Taylor (1999) from Turkey Creek, Jefferson County, Alabama, and is considered a valid species (Boshung and Mayden 2004).

2.3.1.4 Spatial distribution, trends in spatial distribution, or historical range:

All rush darter populations are located above the Fall Line (the inland boundary of the Coastal Plain physiographic region) in the Black Warrior River drainage and in portions of the southern Appalachian Plateau and Valley and Ridge physiographic provinces, Alabama (Boshung and Mayden 2004, Warren *et al.* 2000). The species continues to persist in all stream systems it is known to have historically occupied.

2.3.1.5 Habitat:

Rush darters prefer springs, spring-fed reaches of relatively low-gradient small streams, and wetland pools which are generally influenced by springs (Stiles and Mills 2008, Fluker *et al.* 2007, Bart 2002, Johnston and

Kleiner 2001, Stiles and Blanchard 2001, Bart and Taylor 1999). They have been collected from root masses of vegetation in very shallow, clear, cool, and flowing water, including both small clumps and dense stands of bur reed (*Sparganium* sp.), coontail (*Ceratophyllum* sp.), watercress (*Nasturtium officinale*), and rush (*Juncus* sp.). Substrates have included silt, sand, sand and silt, woody material, muck, and gravel with sand. Water depth at all collection sites ranged from 3.0 cm to 0.5 m (0.1 ft to 1.6 ft), with moderate water velocity in riffles and little to no flow flow in pools. Rush darters have not been found in higher gradient streams with bedrock substrates and sparse vegetation (Stiles and Mills 2008, Bart 2002, Johnston and Kleiner 2001, Stiles and Blanchard 2001, Bart and Taylor 1999).

Species commonly associated with the rush darter during surveys include creek chub (*Semotilus atromaculatus*), northern hogsucker (*Hypentelium nigricans*), and stripetail darter (*E. kennicotti*).

2.3.2 Five Factor Analysis:

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

When listed, primary threats to rush darter included stormwater runoff and siltation, spring head alteration, and hydrological changes (Service 2011). Sources of these threats may include housing and urban development, road maintenance, mining, and logging, depending upon the drainage.

Clear Creek Drainage
Land use within the Clear Creek Drainage (Doe and Wildcat Branches, Mill Creek, Winston County) is primarily silviculture related. Local clear cuts, as well erosion of roadside ditches can be sources of sediment. Since listing, some housing development has occurred within the drainage, which may have had temporary and localized effects as sources of sedimentation (Drennen, pers. obs., 2016). One eroding road crossing on Wildcat Branch has been paved to reduce sediments entering that stream (Drennen, pers. obs,. 2016).

Coal mining continues to be a factor within the Clear Creek drainage. Coal mining can disrupt spring recharge and discharge, decrease their flow, and affect their water quality (Fogg *et al.* 1991). The National Coal Company of Alabama Poplar Spring mine project area footprint is less than 1.6 km (1 mi) from Clear Creek. The Birmingham Coal and Coke Company, Inc. has coal leases throughout the Nauvoo and Double Springs area of the Clear Creek watershed (Weaver 2013). Direct impacts to the rush darter

and its habitats due to mining, however, remain unknown and difficult to assess.

Turkey Creek Drainage
Suburban and urban development, and industrialization continue to be primary threats to spring and stream habitats of rush darters in the Turkey Creek drainage, Jefferson County (Drennen, pers. obs., 2007 to 2018). Construction of new subdivisions has continued, increasing stormwater runoff into spring and stream channels, and potentially decreasing recharge (water storage) of their aquifers (Drennen, per. obs.,2018). Turkey Creek populations also continue to be affected by bridge, road, and sewer line construction, industrialization, and road and utility maintenance, particularly near the type locality for the rush darter (Drennen, pers. obs., 2007 to 2018). For example, the occupied reach of Cunningham Creek is less than 0.2 km (0.1 mi) from four active industrial sites.

Upper Locust Fork Drainage
In the upper Locust Fork drainage in Etowah County, geomorphic and hydrological alterations appear to be primary impacts to rush darter habitats. Little Cove Creek and Bristow Creek spring heads have been channelized, along with much of the Bristow creek channel (Kuhajda pers. comm. 2018; Drennen, pers. obs., 2018). Effects of large road culverts replaced in the Bristow Creek drainage for flood control in 2016 on the rush darter are unquantified (Drennen, pers. obs., 2018). Cove Spring habitats are affected by a commercial pumping facility that backwashes chlorine treated water into the spring head (Drennen, pers. obs., 2018). Even low levels of chlorine may be detrimental to fish survival at all life stages (Larson *et al.* 1978).

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

The rush darter is not commercially utilized. Individuals have been taken for scientific collections in the past, but collecting requires State and Federal permits, and is not considered a factor in the status of this species.

2.3.2.3 Disease or predation:

Disease is not considered to be a factor in the decline of the rush darter. The species may be consumed by piscivorous fishes; however, this predation is naturally occurring, and a normal aspect of population dynamics. We have no information indicating disease or predation is likely to become a threat to rush darters.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

The rush darter and its habitats are afforded protection from water quality and habitat degradation under the Clean Water Act and the Alabama Water Pollution Control Act, as amended, 1975 (Code of Alabama, §§ 22–22–1 to 22–22–14). However, as demonstrated under Factor A, population declines and degradation of habitat for this species are ongoing despite the protection afforded by these laws. While these laws have resulted in some improvement in water quality and stream habitat for aquatic life, including the rush darter, they alone have not been adequate to fully protect this species; stormwater mismanagement, sedimentation, and non-point source pollutants continue to be a significant problem. In addition, these laws have not adequately addressed water quantity issues that are a problem throughout the range of the species.

The State of Alabama maintains water-use classifications through issuance of NPDES permits to industries, municipalities, and others that set maximum limits on certain pollutants or pollutant parameters. For water bodies on the 303(d) list, States are required under the Clean Water Act to establish a TMDL for the pollutants of concern that will bring water quality into the applicable standard. The State of Alabama has not identified any impaired water bodies in Jefferson, Winston, and Etowah counties in the immediate or upstream portion of the rush darter range or in any watersheds in Winston or Etowah counties. However, sedimentation events are usually related to stormwater runoff episodes, and are usually not captured by routine water quality sampling.

As demonstrated under Factor A, flow alterations associated with stormwater runoff reduce the amount and complexity of rush darter habitat by eroding stream banks, destabilizing substrates and aquatic vegetation, and decreasing overall water quality. Recognizing that the expansion of impervious surfaces in the Turkey Creek Drainage Basin has caused an increase in flood heights and water velocity during stormwater events, Jefferson County now tracks and monitors construction and maintenance sites within the Turkey Creek and City of Pinson area (Storm Water Management Authority 2010).

In summary, rush darter populations and habitats remain vulnerable to common land use and water practices despite the protections of regulatory mechanisms afforded by State and Federal laws and regulations (Service 2011). Sedimentation, flow alterations, and non-point source pollution continue to adversely affect the species and its habitats. Information available to us since listing does not indicate that the magnitude or imminence of this threat has changed.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Rush darter populations remain vulnerable to localized extinctions from intentional or accidental toxic chemical spills, rapid urbanization and habitat modification, progressive degradation from runoff (non-point source pollutants), natural catastrophic changes to their habitat (e.g., flood scour, drought), other stochastic disturbances, and to decreased fitness from reduced genetic diversity (Soule 1980, Hunter 2002, Allendorf and Luikart 2007). It remains unknown if any of the rush darter populations are below the effective population size required to maintain long-term genetic and population viability (Soule 1980, Hunter 2002).

Competition from Introduced Species

In 1988, to assist recovery of the endangered watercress darter (*E. nuchale*), this species was translocated outside of its native range and introduced into Tapawingo/Penny Spring (Moss 1995) where it is appears to be competing with the rush darter (Drennen, pers. obs., 2004; George *et al*. 2009). Recently, the absence of rush darters and an increase of watercress darters has been reported at this site (Kuhajda, pers comm., 2018). Howell *et al*. (2016) also found watercress darters in the Cunningham Creek drainage; however, there is no indication of any displacement of rush darters by watercress darters in this drainage.

Climate Change

In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) concluded that warming of the climate system is unequivocal (IPCC 2014). Numerous long-term climate changes have been observed including changes in arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves, and the intensity of tropical cyclones (IPCC 2014). Species that are dependent on specialized habitat types, limited in distribution, or at the extreme periphery of their range may be most susceptible to the impacts of climate change; however, while continued change is certain, the magnitude and rate of change is unknown in many cases.

Climate change has the potential to increase the vulnerability of the rush darter to random catastrophic events, primarily through more intense or frequent droughts (e.g., Cook *et al*. 2004). Fluker *et al*. (2007) reported that drought conditions, coupled with rapid urbanization in watersheds that contain rush darters, render the populations vulnerable, especially during the breeding season when they concentrate in wetland pools and shallow pools of headwater streams. Drought conditions from 2006 to 2007 greatly reduced spawning habitat for rush darter in Jefferson County (Drennen

pers. obs. 2007). Survey numbers for the rush darter within the spring-fed headwaters for the unnamed tributary to Turkey Creek during 2007 were reduced due to a lack of water (Kuhajda, pers. comm., 2008). In Winston County, Stiles and Mills (2008) noted that Doe Branch almost completely dried up during the summer of 2007 (Stiles, pers. comm., 2008).

There is uncertainty about the specific effects of climate change (and their magnitude) on the rush darter; however, climate change is almost certain to affect aquatic habitats in the Turkey Creek watershed of Alabama. Increasing temperatures and the associated increase in frequency, intensity, and duration of extreme heat events will lead to more droughts (Carter *et al*. 2014, Alder and Hostetler 2017), such as the one that occurred in the area in 2007. In addition, the continued urbanization in the Turkey Creek watershed will only further increase water demand in the area and affect the rush darters' unique habitat (Carter *et al*. 2014). Species with limited ranges, fragmented distributions, and small population size are thought to be especially vulnerable to the effects of climate change (Byers and Norris 2011). Thus, we consider climate change to be a potential threat to the rush darter.

2.4 Synthesis

There has been little change in status since the rush darter was listed as endangered in 2011. Threats to its habitats have not diminished. While one spring population in the Turkey Creek drainage may have disappeared, another has been discovered nearby. The rush darter remains rare, restricted in distribution, and poorly known and meets the definition of an endangered species under the Act.

3.0 RESULTS

3.1 Recommended Classification: No change is needed.

3.2 Recommended Recovery Priority Number: No change.

Recovery Priority Number of 5 appropriate and indicates that the rush darter is taxonomically categorized as a species, has a high degree of threat, and a low recovery potential.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The following recovery actions should be made a priority over the next 5 years:

1. Complete a recovery plan.

2. Continue to monitor habitat quality throughout the range of the species. Identify and develop partnerships to restore and protect habitats.

3. Conduct quantitative surveys in each occupied spring and stream segment to determine and monitor population size.

4. Continue research efforts on population genetics; use results of the study to inform recovery efforts.

5. Conduct a life history study for the species.

6. Continue to search for unknown populations.

7. Increase public awareness of the species through outreach efforts, including web-based educational materials, fact sheets, regional publications, and media sources such as public television.

5.0 **REFERENCES**

Alder, J.R. and S.W. Hostetler, 2017. USGS National Climate Change Viewer (tutorial). US Geological Survey website, *https://www2.usgs.gov/climate_landuse/clu_rd/nccv.asp*.

Allendorf, F.W. and G. Luikart. 2007. Conservation and the genetics of populations. Malden, Massachusetts, Blackwell Publishing. 642 pp.

Bart, H.L. 2002. Final Report for Contract 1448-40181-98-G-059. Conservation Status of the Rush Darter, *Etheostoma phytophilum*. Report to U.S. Fish and Wildlife Service Jackson, MS. 20 pp.

Bart, H.L. and M.S. Taylor. 1999. Systematic review of subgenus Fuscatelum of Etheostoma with description of a new species from the Upper Black Warrior System, Alabama. Tulane Studies in Zoo. and Bot. 31:23-50.

Boshung, H. T., Jr., and R. L. Mayden. 2004. Fishes of Alabama. Smithsonian Institution. Washington, D.C. 736 pp.

Byers, E. and S. Norris. 2011. Climate change vulnerability assessment of species of concern in West Virginia. West Virginia Division of Natural Resources, Elkins, West Virginia. 72 pp.

Carter, L.M., J.W. Jones, L. Berry, V. Burkett, J.F. Murley, J. Obeysekera, P.J. Schramm, and D. Wear. 2014. Ch.17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment, J.M. Melilo, T.C. Richmond, and G.W.

Youhe, Eds., U.S. Global Change Research Program, 396-417. Doi:10.7930/JON-P22CB.

Cook, E.R., C.A. Woodhouse, C.M. Eakin, D.M. Meko, and D.W. Stahle. 2004. Long-term aridity changes in the western United States. Science 306:1015-1018.

Drennen, D. 2004-2018. Pers. obsv. of rush darter habitats and threats.

Fluker, B., B.R. Kuhajda and J. Khudamrongsawat. 2007. Molecular Systematics and Taxonomy of the Rush Darter, *Etheostoma phytophilum*, in the Clear Creek System of the Sipsey Fork (Black Warrior River Drainage), Winston County, Alabama. Report. to U.S. Fish and Wildlife Service, Univ. Al. 30 pp.

Fluker, B. L., B. R. Kuhajda, and P. M. Harris. 2008. Status and distribution survey and genetics of the endangered Watercress Darter, *Etheostoma nuchale*. The Alabama Department of Conservation and Natural Resources, Montgomery AL, and the U.S. Fish and Wildlife Service Office, Jackson, MS. 50 pp.

Fluker, B. L., B. R. Kuhajda, N. J. Lang, and P. M. Harris. 2010. Low genetic diversity and small long-term population sizes in the spring endemic Watercress Darter, *Etheostoma nuchale*. Conservation Genetics 11:2267−2279.

Fluker, B., B. Kuhajda and P. Harris. In press. Complex colonization history of spring habitats of the Southern Appalachian Highlands and cryptic development in the endangered rush darter (*Eteostoma phytophylum*). Copeia.

Fogg, J., M. Martin and P. Daddow.1991. Geohydrology and potential effects of coal mining in 12 coal-lease areas, powder river structural basin, northeastern Wyoming. USGS Water Resources Invest. Rep. 87-4102. Cheyenne, WY. 49 pp.

George, A.L., B.R. Kuhajda, J.D. Williams, M. Cantrell, P.L. Rakes, and J.R. Shute. 2009. Guidelines for propagation and translocation for freshwater fish conservation. Fisheries 34:529-545.

Howell, W.M., D.J. Drennen and D.J. Aarons. 2016, A new population of two endangered Alabama fishes: Watercress (*Etheostoma nuchale*) and Rush (*Etheostoma phytophilum*) darters, Jour. of Al. Ac. of Sciences. Vol. 87, No. 3-4, July-Oct., pp. 156-158.

Hunter, M.L., Jr. 2002. Fundamentals of conservation biology, second edition. Blackwell Science, Inc. Malden, Massachussetts. 547 pp.

Intergovernmental Panel on Climate Change (IPCC). 2014. Climate change 2014 synthesis report. Available at http://ipcc.ch/report/ar5/.

Johnston, C.E. and K. J. Kleiner. 2001. Status of the rush darter (*Etheostoma phytophilum*) in the

Clear Creek system, Winston County, Alabama. Report to U.S. Fish and Wildlife Service. Jackson, MS. 9 pp.

Kuhajda, B. 2008-2009. Biologist. University of Alabama, Tuscaloosa, Alabama. Pers. comm. about species biology, threats and habitat information.

Kuhajda, B. 2017. Biologist. Tennessee Aquarium. Chattanooga, TN Pers. comm. Re. discovery of rush darter in Dry Creek.

Kuhajda, B. 2018. Biologist. Tennessee Aquarium. Chattanooga, TN. Pers. comm. Re. conditions of Wildcat Branch, Mill Creek and Doe Branch, Turkey Creek, Bristow Creek drainages

Kuhajda, B. et al 2018. Unpublished field data. Tennessee Aquarium, Chattanooga, TN.

Larson, G., C. Warren, F. Hutchins, L. Lamperti, D. Schlesinger, and W. Seim. 1978. Toxicity of residual chlorine compounds to aquatic organisms. Environmental Protection Agency, Duluth, MN. pp. 105.

Moss, J. 1995. Watercress darter population monitoring, October 1, 1994 through September 30, 1995. Annual Perf. Rep. Al. Dept. of Cons. and Nat. Res. 14 pp.

Rakes, P., and J.R. Shute. 2005. Propagation of the goldstripe darter, *Etheostoma parvipinne,* as a surrogate for the endangered rush darter, *Etheostoma phytophilum*. Conservation Fisheries, Inc. Final report to the U.S. Fish and Wildlife Service, Jackson, MS Field Office, Contract #401814G048. 8 pp.

Rakes, P. and J.R. Shute. 2010. Pers. comm., Rush darter collection and husbandry. Conservation Fisheries, Inc., Knoxville, TN.

Shepard, T. E., P. E. O'Neil, S. W. McGregor, and M. F. Mettee. 2004. Biomonitoring in the Locust Fork watershed, Alabama, 1997-98. Geological Survey of Alabama Bulletin 175.

Soule, M.E. 1980. Threshold for survival: maintaining fitness and evolutionary potential. Pages 151-169 *in*: M.E. Soule and B.A. Wilcox, eds. Conservation biology. Sinauer Associates, Inc., Sunderland, Massachusetts.

Spazgenski, E. 2008-2009. Biologist, U.S. Fish and Wildlife Service. Collection records of rush darter from Locust Fork drainage.

Stiles, R. and P. Blanchard. 2001. Status survey of the rush darter, Etheostoma phytophilum, in the Turkey Creek watershed of Jefferson County, Alabama. Report to U.S. Fish and Wildlife Service. Jackson, MS. 14 pp.

Stiles, R. and D. Mills. 2008. Habitat utilization and distribution of the rush darter, *Etheostoma phytophilium,* in Mill Creek and Wildcat/Doe Branches of Clear Creek of the Sipsey Fork

of the Black Warrior River System in Winston County, Alabama. Report to the U.S. Fish and Wildlife Service. Jackson, MS. 5 pp.

Stiles, R. 2019. Pers. comm. to Paul Hartfield, detailing 2015 rush darter collection from swampy area SW of Tapawingo Springs (Thomas Tract). Samford University (retired), Birmingham, AL.

Storm Water Management Authority and Jefferson County Department of Health 2010 http://rrstormwater.com/city-birmingham-jefferson-county-swma-inc-stormwater-management-regulation-compliance

U.S. Fish and Wildlife Service. 2011. Endangered and Threatened Wildlife and Plants; Endangered Status for the Cumberland Darter, Rush Darter, Yellowcheek Darter, Chucky Madtom, and Laurel Dace; 76 FR 48722-48741.

Warren, M.L., Jr., B.M. Burr, S.J. Walsh, H.L. Bart, Jr., R.C. Cashner, D.A. Etnier, B.J. Freeman, B.R. Kuhajda, R.L. Mayden, H.W. Robison, S.T. Ross, and W.C. Starnes. 2000. Diversity, distribution, and conservation status of the native freshwater fishes of the Southern United States. Fisheries, 25(10): 7-31. American Fisheries Society. Bethesda, MD. 23 pp.

Weaver, J. 2013. Birmingham Coal & Coke Company, Inc., Ninna V Mine P-3675, R-16 Alabama Surface Mining Commission PRT 1, 31 PP.

U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of RUSH DARTER *(Etheostoma phytophilum)*

Current classification: Endangered

Recommendation resulting from the 5-Year review:

__X_ No change needed

Review conducted by: Mississippi Ecological Services Field Office

FIELD OFFICE APPROVAL:

Acting **Lead Field Supervisor, U.S. Fish and Wildlife Service**

Approve Cary Meyer Date 10/21/14

APPEXDIX A.

Summary of peer review for the 5-year review of the rush darter *(Etheostoma phytophilum)*

A. Peer Review Method

The document was drafted by Daniel Drennen; reviewed and revised internally by Cary Norquist and Paul Hartfield, Mississippi ES Office. It was also sent to four outside reviewers via email (see below). The peer reviewers were chosen based on their qualifications and knowledge of the species and its habitat. Individual responses were received from two of the four peer reviewers.

Peer Reviewers:
Dr. Robert Stiles
Samford University (Retired)
Birmingham, AL

Dr. Scott Duncan
Birmingham-Southern College
Birmingham, AL

Dr. Mike Howell
Samford University
Birmingham, AL

Dr. Bernie Kuhajda
Tennessee Aquarium
Chattanooga, TN

B. Peer Review Charge: See attached guidance.

C. Summary of Peer Review Comments:

Dr. Stiles reviewed the document and responded by phone that it was an accurate account of the state of knowledge for rush darter. He also provided information of an unpublished 2015 site collection of rush darter adults and juvenile near Tapawingo Springs.

Dr. Kuhajda provided manuscript corrections and other edits.

D. Response to Peer Review
Peer reviewer comments were evaluated and incorporated into the revised document, as appropriate.

Guidance for Peer Review of Rush Darter 5-Year Review

On June 30, 2017, the U.S. Fish and Wildlife Service published a notice in the Federal Register (82 FR 29916) announcing a five-year review of 23 federally listed species, including the rush darter. The purpose of five-year reviews is to ensure that the classification of species as threatened or endangered is accurate and reflects the best available information.

Following Service current policy and guidelines on the process to conduct independent peer review, we are assisting our Mississippi Ecological Services Field Office to complete peer review of the science in the 5-year review for this small fish. You have provided data used to review the status of the rush darter and are knowledgeable about it or fishes like it. Therefore, in order to ensure that the best available information has been used to conduct this five-year review, we now request your peer review of the attached document.
Specifically we ask for comments on:

• Have we assembled the best available scientific and commercial information?
• Is our analysis of this information correct and properly applied?, and
• Can you identify any additional new information on the rush darter that has not been considered in this review?

Please note that we are not seeking your opinion of the legal status of this species, but rather that the best available data and analyses were considered in reassessing its status.

As part of the peer review process, we must evaluate the potential for conflicts of interest with the subject species or the action. We therefore ask that you fill out the attached Conflict of Interest form and return it with any notes, comments, or questions that you are willing to provide as your peer review.

We appreciate your interest in furthering the conservation of rare plants and animals by becoming directly involved in the review process of our Nation's threatened and endangered species. Your review and comments will become a part of the administrative record for this species, and you can be certain that your information, comments, and recommendations will receive serious consideration.

We hope that you view this peer review process as a worthwhile undertaking. We ask that you review the attached draft and submit comments to the Southeast Regional Office, to our Regional Recovery Coordinator, Kelly Bibb. Your comments can be provided to Kelly by mail at kelly_bibb@fws.gov or by letter (1875 Century Boulevard, 4th Floor, Atlanta, Georgia 30345) and should be received by August 23, 2019, to help us complete the final 5-year review for signature this fiscal year. If you have any questions, please call Kelly Bibb (404) 679-7132, or email her. Thank you in advance for your assistance. We greatly appreciate your help.