

Bayou Darter
Etheostoma rubrum

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



(Photo by: Todd Slack)

**U.S. Fish and Wildlife Service
Southeast Region
Mississippi Ecological Services Field Office
Jackson, Mississippi**

5-YEAR REVIEW
Bayou Darter (*Etheostoma rubrum*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: In conducting this 5-year review, we relied on available information pertaining to historic and current distributions, life histories, and habitats of this species. We announced initiation of this review and requested information in a published *Federal Register* notice on September 8, 2006 (71 FR 53127). We conducted an internet search, reviewed all information in our files, and solicited information from all knowledgeable individuals including those associated with academia and state conservation programs. Our sources include the final rule listing this species under the Act; the Recovery Plan; peer reviewed scientific publications; unpublished field observations by Service, State and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. The completed draft was sent to affected Service offices and three peer reviewers for their review (see Appendix A). Comments are incorporated into this final document as appropriate.

B. Reviewers

Lead Region – Southeast Region: Kelly Bibb, 404-679-7132

Lead Field Office – Jackson, Mississippi Ecological Services Field Office: Daniel J. Drennen, 601-321-1127

C. Background

- 1. Federal Register Notice citation announcing initiation of this review:** September 8, 2006. (71 FR 53127)
- 2. Species status:** Stable (2011 Recovery Data Call) New surveys initiated in Little Bayou Pierre thought to be part of this species' range did not result in any individuals found. Periodic surveys indicate consistent number caught per unit effort but no indication that populations are robust.
- 3. Recovery achieved:** 1 (1= 0-25% recovery objectives achieved)

4. Listing history

Original Listing

FR notice: 40 FR 44149

Date listed: September 25, 1975

Entity listed: Species

Classification: Threatened

5. Review History:

Five Year Review- July 22, 1985 (50 FR 29901), November 6, 1991(56 FR 56882) FWS conducted a 5-year review for bayou darter in 1991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species. The notice stated that FWS was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notice indicated that if significant data were available warranting a change in a species' classification, the Service would consider proposing a rule to modify the species' status. No change in this fish's listing classification was found to be warranted.

Recovery Plan: 1990

Recovery Data Call: 2011, 2010, 2009, 2008, 2007, 2006, 2005, 2004, 2003, 2002, 2001, 2000, 1999, and 1998

6. Species' Recovery Priority Number at start of review (48 FR 43098): 8c

Degree of Threat: Moderate

Recovery Potential: High

Taxonomy: Species

7. Recovery Plan:

Name of plan: Bayou Darter (*Etheostoma rubrum*) Recovery Plan

Date issued: September 8, 1983

Date revised: July 10, 1990

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

- 1. Is this species under review listed as a DPS? No**
- 2. Is there relevant new information that would lead you to consider listing the bayou darter as a DPS in accordance with the 1996 policy? No.**

B. Recovery Plan and Criteria

- 1. Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes**
- 2. Adequacy of recovery criteria**
 - a. Do the recovery criteria reflect the best available (i.e., most up-to date) information on the biology of the species and its habitat? Yes.**
 - 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)?**

The recovery criteria do take into account the 5 listing factors. Threats emphasized in recent surveys suggest that riffle habitats within the Bayou Pierre River represent catchments or islands for the bayou darter and the loss of such habitat by geomorphic changes will impact the gene flow of the species from one riffle population to the next (Slack *et al.* 2004 and Ross *et al.* 2001).
- 3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.**

Criteria: Evidence of a stable or increasing population and habitat over at least a 10-year period in the Bayou Pierre River and Foster Creek.

Status: Criteria not met. Sampling in 2001, indicated a stable population and an increase in catch per unit effort of bayou darters throughout the lower reach of the Bayou Pierre River extending from Hwy 18 downstream to the confluence with the Little Bayou Pierre River based on recruitment, frequency distribution and age class (Slack and Ross 2002).

However, long-term data has been sporadic in the upper and middle reaches of the Bayou Pierre River. Data from 1986 to 1996 suggests that the Bayou Pierre system has been undergoing extensive erosion and the physical position of various river attributes has frequently changed, but the riffle-inhabiting fishes, including the bayou darter, have maintained their population densities (Ross *et al.* 2001).

Cursory surveys for the species during 2003 in the Bayou Pierre River at: the Highway 18 bridge crossing, the Dentville bridge

crossing, the Smyrna Bridge crossing, upstream from Turkey Creek, and the Port Gibson Road crossing at Foster Creek, have revealed sufficient numbers of bayou darters. This may indicate that suitable habitat is still present (Slack, Mississippi Museum of Natural Science, *pers. comm.* 2008, Drennen *pers. obsv.* 2003-2011). In the upper to middle reaches of the Bayou Pierre River, including Fosters Creek, Pierson (2006) found darters in historical collection sites as well.

Criteria: Evidence of the continued existence of the bayou darter in White Oak and Turkey creeks.

Status: Criteria not met. Surveys by Pierson (2006) in upper Turkey Creek and at the Dentville bridge crossing indicated recruitment within the population based on the presence of both juveniles and adults (17-25 total individuals). Habitat in Turkey Creek at that time was good with gravel and sand bars, riffles and pools. Water quality was clear and current was moderate in the riffles. Matthews (1978) listed bayou darters as common in White Oak Creek. However, there is only historical evidence of continued existence of bayou darters in White Oak Creek. Historical locality sites within White Oak Creek, not sampled within 10 years, include the upstream reach beginning at the Highway 18 bridge crossing. In 2002, Slack and Ross did not find bayou darters in White Oak Creek off Highway 27 near Thompsonville.

Criteria: Data on the fluvial geomorphic processes operating in the Bayou Pierre system, which indicates a trend of no net loss, or improving, habitat for the species:

Status: Criteria not met. The Bayou Pierre system is continuing to experience extensive erosion, especially in its headwaters. This erosion is resulting in substantial changes to the streams, including decreases in sinuosity, channel widening and the loss of certain riffle habitats, as well as the creation of new riffle habitats (Ross *et al.* 2001). There is an overall trend for recent erosion to occur in upper reaches of the Bayou Pierre system, with lower reaches characterized by the later recovery stages of the system (Ross *et al.* 2001). Threats emphasized in recent surveys suggest that riffle habitats within the Bayou Pierre River are isolated catchments or islands for the bayou darter and the loss of such habitat by geomorphic changes will impact the gene flow of the species from one riffle population to the next (Slack *et al.* 2004 and Ross *et al.* 2001). Overall, there is a continued decrease in habitat for the bayou darter. Bank-side stabilization activities on riffle stability and bayou darter distribution should be monitored (Slack and Ross

2002). However, despite all of the geomorphic instability caused by erosion, currently there is downstream habitat recolonized by bayou darters (Slack *et al.* 2004). From 1997 to 2001, the numbers of riffle habitat improved by 13% with a corresponding 200% increase of bayou darters surveyed. Whether or not this indicates an improvement in overall habitat is unknown however, it does indicate that the species, at least in these areas is not declining (Slack *pers com.* 2007) and may be adjusting to the changes in the geomorphic structure of the river channel caused by the numerous headcuts.

Criteria: An established continuing plan of periodic monitoring of population trends and habitat stability.

Status: Criteria not met. There has been no periodically scheduled monitoring of population trends and habitat stability since the major efforts of Ross *et al.* (1989) from 1986 to 1988. Since then all studies and monitoring efforts have been temporally erratic based on funding and labor allocations through academic institutions and biological consultation groups. However, the few significant studies and monitoring efforts accomplished since 1991 indicate snapshots of the population's relative density and structure along with other parameters for the species with glimpses of changes in habitat geomorphology and possible threats. Most recently, Pierson (2006) noted bayou darters as thriving in several historical locations in Turkey Creek, Foster Creek and portions of the Bayou Pierre River at the Smyrna bridge crossing. Bayou darters are not known from the Little Bayou Pierre based on recent surveys (Schaffer, 2011).

Criteria: Protection of Bayou darter habitat through full implementation of Task 4 of this recovery plan. Task 4 is to protect darters and their habitat. Steps must be taken to eliminate or reduce the threat of habitat degradation.

Status: Criteria are partially met. Since the listing of the bayou darter as threatened under the Endangered Species Act, ongoing land and waterway alterations are occurring within its habitat. Changes and attempts to alter the geomorphology of the river relative to wildlife and fish species impacts have been noted since 1974 (Teels 1974). Historically, there have been major deleterious attempts for watershed management, flood control, pipelines, channel stabilization and maintenance, gravel and sand mining, and road repair. Since 2006, more than 25 major watershed alteration projects have been proposed, and/or approved, adding

significant disturbance to the watershed. However, not all projects have had harmful results. In 2003, a major bank stabilization project, involving the Natchez Trace Parkway and the Federal Highway Administration, occurred on two locations of the Bayou Pierre River, eliminating major sloughing and sedimentation into known bayou darter habitat. Efforts in the early 2000's by the U.S. Fish and Wildlife Service and the Mississippi Scenic Stream Program have assisted landowners within the Turkey Creek drainage to prevent scouring of the bank sides by erosion. In 2011, a core group of stakeholders (Bayou Pierre River Enhancement Group) met to view ongoing erosion and bank stabilization issues in the watershed. Currently, the beginning of a project ranking system for potential projects and funding is being organized for 2012. In general, bayou darters have been found consistently, but with varying intensity, throughout the known range. As recently as October 2011, the species was collected at: the confluence of Turkey Creek; the Bayou Pierre River close to Willing; and the confluence with Fosters Creek. The species tends to occur more frequently above an ongoing headcut or geomorphic change. However, the species has also been noted to re-establish the stream reach once the headcut has past. Therefore, only partial implementation of task 4 of this recovery plan has been met.

C. Updated Information and Current Species Status

1. **Biology and Habitat** – The bayou darter has been collected only from the Bayou Pierre River (from upstream at the Smyrna Bridge to downstream at Willow) and the immediate portions of the confluences of the Bayou Pierre River with: White Oak Creek, Foster Creek, and Turkey Creek (approximately 40 river miles (64 kilometers)). The distribution of the bayou darter within its historical range changes in response to anthropomorphic alteration of its habitat quality (U.S. Fish and Wildlife Service 1990).

Bayou darters occupy swift (79 cm / sec), shallow riffles or runs over coarse gravel and pebbles. They rarely occur over small gravel and actively select pebble substratum (32 to 64 mm diameter). However, spawning occurs over coarse sand (1 to 2 mm diameter). Even though bayou darters are rarely collected in the headwaters, the over all distribution of the species indicates an upstream movement in response to active erosion into the upper reaches of the watershed (Ross 2001).

Bayou darters spawn from late March to early June at water temperatures of 21 to 29 ° C. Females may produce 80 eggs over the spawning season, which may occur twice within the period. Eggs are buried and unattended (Ross 2001). Downstream drift for

approximately 300 meters of protolarvae and mesolarvae life stages may occur in bayou darters. Metalarvae or juvenile bayou darters may settle out of the drift into the riffles. These downstream riffles may become population catchments or islands connected together by periodic gene flow maintained by the annual drift cycle (Slack *et al.* 2004).

Recent surveys suggest that a single stable population or a series of small subpopulations of bayou darters exists throughout the lower reach of the Bayou Pierre River extending downstream from Highway 18 to the confluence with the Little Bayou Pierre (Slack and Ross 2002). Curiously, the greatest population densities of bayou darters are in areas in or below active erosion areas (Ross *et al.* 2001).

The bayou darter exhibits low genetic diversity which may be best explained by its small range and by recent genetic bottleneck (Slack *et al.* 2010).

2. Five Factor Analysis (threats, conservation measures and regulatory mechanisms)

Present or threatened destruction, modification or curtailment of its habitat or range: The bayou darter is extremely vulnerable to extinction because of its restricted distribution and narrow habitat requirements. The principle threats are habitat alteration, water quality and quantity degradation. The Bayou Pierre River watershed is undergoing major geomorphic changes, especially in the headwaters, affecting the distribution of the bayou darters. Knickpoints are disturbances within the channel that cause an unstable situation where the bottom and sides of the channel may gradually produce a deepening and widening, along with an abundance of suspended sediments, impacting water quality. The process of headcutting may occur simultaneously with supplementary headcutting, which is caused by a variety of knickpoints such as gravel mining, ditching etc., and may venture up tributaries. Headcuts are usually retarded or stopped when the erosional hydrological forces are less than the erosional coefficient of the bottom substrates; such as bedrock or large cobble and boulders. Thus, there may be several headcuts passing through the same river reach over a given time. The rate of knickpoints has varied from 48-750 meters/year (1940-1994) with the main headcut in the Bayou Pierre River currently >3km (1.86 mi) upstream of the Smyrna Bridge. Early surveys within the system (1963-1975) noted the most upstream occurrence of the species was 7.5 km (4.66 mi) downstream of the Smyrna Bridge (Slack *et al.* 2008). Later, work by Matthews (1978) categorized the species as present but uncommon at the Smyrna Bridge while today, the highest densities of the Bayou darter in the

Bayou Pierre River occur upstream of the Smyrna Bridge. The geomorphic development within the last 20 years appears to be fewer pools and riffles within the Bayou Pierre River system, along with increased sedimentation and decreased water quality. This action is forcing the bayou darters further into the headwaters of the Bayou Pierre River with the steeper gradients and swifter water.

Anthropogenic changes initiated with historical sand and gravel extraction and accelerated with agricultural practices that extend along the bankside within the watershed produce geomorphic changes that continue to add tremendous amounts of sediment to the river system. In the lower reach of the Bayou Pierre River, significant portions of the bank, close to the Natchez Trace Parkway Bridge, collapse regularly. Recent floods in 2011 of 8 feet above flood stage added to the bank collapse and significant sedimentation of the river. One hundred foot (30 m) banks buckled and sent tons of sediment into the river. This process is not particular to this section of the river. Other areas further upstream go through these processes seasonally and have for years (Drennen 2011 pers. obsv). Minor attempts to correct or abate the problem have failed. Major planning of bank stabilization in the 1990's with the Corps of Engineers was not funded.

The impact of this rapid change may be detrimental to the long-term survival of the species (Ross 2001). Interestingly, the highest bayou darter populations are in areas of upstream erosion while they are persisting in the middle and lower reaches of the system (Slack *et al.* 1998). Slack *et al.* (2004) emphasized the importance of disjunctive riffle habitat and the downstream transport of larvae in relation to gene flow between riffle catchments and possibly weakening the population overall. How the changes in the Bayou Pierre River's geomorphology which includes less pools and riffles will affect the species different life stages is unknown.

- b. Overutilization for commercial, recreational, scientific, or educational purposes:** The bayou darter is not a commercially valuable species. However, this species had been actively sought by researchers since 1966. The overall impact of collecting on the population parameters of the bayou darter has not been investigated but does not seem to be a threat at this time. Collections are regulated by the State of Mississippi Department of Wildlife Fisheries and Parks.

Therefore, we find that overutilization for commercial, recreational, scientific, or educational purposes are not a threat to the bayou darter at this time.

- c. Disease or predation:** Diseases of the bayou darter are poorly known and we have no specific information indicating that disease occurs within bayou darter fish populations or poses a threat. Eggs, juvenile and adult bayou darters are preyed upon by some invertebrate species, parasites, and vertebrate species such as frogs, snakes, turtles, other fish, and piscivorous birds. However, we have no evidence of any specific declines in the bayou darter due to predation. In summary, diseases and predation of the bayou darter remain largely unstudied and are not considered a threat to the species.
- d. Inadequacy of existing regulatory mechanisms:** The bayou darter and its habitat are afforded some protection from surface water quality and habitat degradation under the Clean Water Act of 1977 ([33 U.S.C. 1251](#) et seq.) and the Mississippi Water Pollution Control Law (Code of Mississippi, sections 49-17 *et seq.* and regulations promulgated thereunder the Mississippi Department of Environmental Management (Ables *et al.* 1994). While these laws have resulted in some improvement in water quality and stream habitat for aquatic life, including the bayou darter, such as requiring landowners engaged in agricultural practices to have an erosion prevention component within their farm plan, they alone have not been fully adequate to protect this species due to inconsistent implementation, monitoring, and enforcement. Furthermore, habitat degradation is ongoing despite the protection afforded by these laws.

The State of Mississippi maintains water-use classifications through issuance of National Pollutant Discharge Elimination System (NPDES) permits to industries, municipalities, and others that set maximum limits on certain pollutants or pollutant parameters. For water bodies on the Clean Water Act's Section 303(d) List of Impaired Water Bodies, States are required under the Clean Water Act to establish a Total Maximum Daily Load (TMDL) for the pollutants of concern that will bring water quality into the applicable standard. Many of the water bodies that do not meet Clean Water Act standards are within the occupied range of the bayou darter (Mississippi 2008 Section 303(d) List of Impaired Water Bodies).

The State of Mississippi's surface water quality standards, adopted from the national standards set by the U.S. Environmental Protection Agency (USEPA), appear to be protective of the bayou darter as long as discharges are within permitted limits and are enforced according to the provisions of the Clean Water Act. These water quality requirements were established with the intent to protect all aquatic resources within the State of Mississippi and are presumed to be protective of the bayou darter. The Service is currently in consultation with the USEPA to evaluate the efficacy of criteria approved in

USEPA's water quality standards for endangered and threatened species and their critical habitats as described in the Memorandum of Agreement our agencies signed in 2001 ([66 FR 11201](#); February 22, 2001).

In summary, degradation of habitat for this species is ongoing despite the protections afforded by these existing laws. Therefore, based on the best scientific and commercial information available and the uncertainty of the level of protection the existing laws will provide, we consider the inadequacy of existing regulatory mechanisms to be a threat to bayou darter.

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

The current range of the bayou darter is restricted to localized sites within the Bayou Pierre River drainage. Subsequently, genetic diversity has likely declined due to fragmentation and separation of bayou darter populations. The long-term viability of a species is based on conservation of numerous local populations throughout its geographic range (Harris 1984). These features are essential for the species to recover and adapt to environmental change (Noss *et al.* 1994, Harris 1984). Interbreeding populations of bayou darters are becoming increasingly disjunctive. This disjunctive distribution makes bayou darter populations vulnerable to extirpation from catastrophic events, such as toxic spills, large in-stream-gravel mining projects, or changes in flow regime caused by extensive pumping for agriculture and drought.

D. Synthesis – Since the discovery of the species in 1966 the species has experienced significant curtailment of range and habitat and is currently known only in specific sites. Population data suggests the species may be responding spatially to the dramatic changes caused by almost 50 years of headcutting through the Bayou Pierre River system. However, population data does not suggest that slight increases in population numbers corresponds to improvement in the status of the bayou darter since listing under the Act in 1975. This phenomenon may be a shifting of the species to less impacted habitat above an ongoing habitat change and the re-colonization of habitat disturbed by the geomorphic change produced by the headcut. The latest inclusive population estimate of the Bayou Pierre River system was completed by Ross *et al.* (1989) with different river reach and tributary surveys and studies occurring sporadically since 1990.

Specifically, changes in geomorphology and deterioration of water quality has increased along with new urbanization, agriculture, silviculture and continued pollution threats within the Bayou Pierre River system. The species' limited distribution and small population size makes it vulnerable to random natural or

human induced events such as toxic spills, vandalism, and sedimentation events caused by maintenance of existing road and bridge structures, fence lines, stormwater management pipes and risers, effluent discharge from small municipalities and pipeline crossings. Along with historical sand and gravel extraction and bankside agriculture within the watershed, geomorphic changes continue to add tremendous amounts of sediment to the river system. Long-term spatial and temporal monitoring accurately assessing population trends, along with geomorphic changes within the habitat is needed. Based on the above analysis, the bayou darter continues to meet the definition of a threatened species under the Act.

III. RESULTS

A. Recommended Classification:

No change is needed

B. New Recovery Priority Number: 8: Previous Priority Number is 8C; however based on current information, there is no justification in our files to substantiate this designation of 8C, indicating a specific impending conflict.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Initiate consistent annual long-term monitoring of the species along with its habitat in the Bayou Pierre River and tributaries.

Initiate geomorphic analysis within the upper/headwater reach of the Bayou Pierre River. Determine significant problem areas within the upper reach and formalize plans to abate and reduce the impact.

Continue work to obtain protection for sites on privately owned lands through the Bayou Pierre River Enhancement Group. Incorporate all stakeholders in determining long-term and short term strategy for management of the watershed and lessening the impact of headcutting and prevention of future nick points.

Work with state, county and town governments in establishing best management and conservation practices to improve water quality and water quantity issues, through number 3 above.

Revise and or update recovery plan (1990) to include new stakeholders and priorities based on land use and geomorphic changes.

V. REFERENCES

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U.S. Fish and Wildlife Service. 1990. Bayou Darter Recovery Plan. Jackson, MS. 25 pp.

Personal communication:

Slack, T. 2007. Personal Communication. Daniel J. Drennen. Bayou darter habitat in Foster's Creek. Mississippi Museum of Natural Science, Ichthyologist, Jackson, MS.

Personal observation:

Drennen, Daniel. 2003-2011. Cursory visits to selective sites within the watershed over 9 years: photographs.

APPENDIX A: Summary of peer review for the 5-year review of bayou darter (*Etheostoma rubrum*)

A. Peer Review Method: The document was sent to three independent peer reviewers including: Dr. Todd Slack with the Mississippi Museum of Natural Science, Jackson, Mississippi; Dr. Martin T. O’Connell with the University of New Orleans, Louisiana; and Dr. Mark Hughes.

B. Peer Review Charge: The following cover letter was sent along with the draft 5 year review (excluding the signature page) to the peer-reviewers:

On September 8, 2006, the U.S. Fish and Wildlife Service published a notice in the Federal Register announcing a 5-year review of 25 federally listed species, including bayou darter (*Etheostoma rubrum*). The purpose of the 5-year review is to ensure that the classification of species as threatened or endangered is accurate and reflects the best available information.

You have provided data used to review the status of this species, and you have been identified as knowledgeable about this species. Therefore, in order to ensure that the best available information has been used to conduct this 5-year review, we now request your peer review of the attached document. Specifically we ask for comments on the validity of the data used, and identification of any additional new information on any of these species that has not been considered in this review. Please note that we are not seeking your opinion of the legal status of these species, but rather that the best available data and analyses were considered in reassessing their status.

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. Please give me a call if you have any questions (601-321-1127). Please feel free to respond by email or letter. Thank you for your assistance.

Sincerely,

Daniel J. Drennen
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U.S. Fish and Wildlife Service
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C. Summary of Peer Review Comments/Report – All peer reviewers supported analyses and information in the document. Editorial comments were provided by two peer reviewers.

D. Response to Peer Review – Only editorial comments were provided and these changes were made in the document. There was no disagreement expressed by any of the reviewers.