

U.S. Fish and Wildlife Service

Recovery Plan

Vermilion Darter



RECOVERY PLAN
for the
Vermilion Darter (*Etheostoma chermocki*)

Prepared by

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and

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for

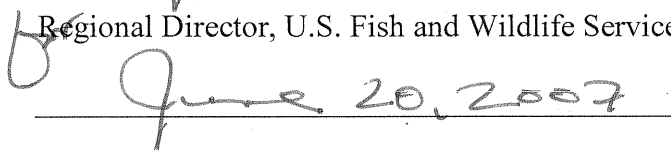
U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

Approved: _____


Cynthia K. Decker

Regional Director, U.S. Fish and Wildlife Service

Date: _____


June 20, 2007

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By approving this recovery plan, the Regional Director certifies that the data used in its development represent the best scientific and commercial information available at the time it was written. Copies of all documents reviewed in development of the plan are available in the administrative record located at the Jackson Field Office in Jackson, Mississippi.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Vermilion Darter, *Etheostoma chermocki*. Atlanta, Georgia. 38 pp.

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Cover photo: Turkey Creek, Alabama at Highway 79 intersection, by Daniel J. Drennen, USFWS.

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This plan is dedicated to Bob Reid, who worked persistently to protect the vermilion darter and the Turkey Creek watershed.

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EXECUTIVE SUMMARY

Current Status: The vermilion darter (*Etheostoma chermocki*) is federally listed as endangered. The darter is narrowly endemic, known from fragmented populations throughout only 11.6 kilometers (km) (7.2 miles (mi)) of the upper mainstem reaches of Turkey Creek and two of its tributaries in Jefferson County, Alabama. These populations of vermilion darters are sparse and isolated within certain areas of Turkey Creek, due to natural or manmade barriers, like a waterfall, road culverts, and impoundments. Surveys conducted from 2003 to 2006 have indicated that populations have declined gradually. The recovery priority number (48 FR 43098) for the vermilion darter is 2.

Habitat Requirements and Limiting Factors: Habitat for the vermilion darter is similar to that of other snubnose darters and entails small to medium-sized clear streams, with gravel riffles and moderate currents. This darter requires clean, clear, flowing water, and clean rocks, logs, or sand and gravel substrate for the attachment of eggs during spawning in the spring. This species is sometimes associated with emergent aquatic vegetation. The greatest threat to the vermilion darter is degradation of water quality and substrate components of its habitat due to sedimentation and other pollutants (both point and non-point sources).

Recovery Objective: Delisting. The overall recovery strategy for this fish and its habitat are to emphasize stewardship with all citizens, businesses and interest groups, living and working within the Turkey Creek system in order to maintain the health of the watershed and remove threats such as sedimentation and to promote use and enforcement of existing laws, regulations and policies to protect and/or enhance all fragmented vermilion darter populations and habitat, associated wetlands and water quality by reducing erosion and sedimentation in its small range.

Recovery Criteria: Delisting the vermilion darter will be considered when all of the below criteria are met:

- 1) Populations of vermilion darters and its habitat within its known range in Turkey Creek are shown to be protected from present and foreseeable threats to the point where listing is no longer required through implementation of activities including stewardship, outreach, best management practices, securing conservation easements or acquisitions, and ensuring adequate regulatory enforcement.
- 2) Stable or increasing population trends for at least 10 years throughout its known range are verified through monitoring and surveys.
- 3) Suitable flows and water quality in Turkey Creek supporting the vermilion darter are determined through recovery tasks and assured, through State or

local groundwater management plans, or water conservation plans.

- 4) An average monthly reading of 10 NTU (Nephelometric Turbidity Units), a unit used to measure sediment discharge, or 15 mg /L TSS (Total Suspended Solid) or less discharge into the Turkey Creek watershed within and upstream of the vermilion darters' range is being attained and documented as occurring for a minimum of 10 consecutive years. Information will be compiled from sampling water quality monthly throughout the year during base, low and high flows.
- 5) A captive vermilion darter population of 20 pairs (40 individuals) has been established and successfully propagated for augmentation.

Actions Needed:

1. Protect vermilion darter populations and habitat.
2. Ensure and support implementation of effective protective actions.
3. Determine habitat requirements and population information of the vermilion darter.
4. Determine the necessary husbandry techniques of the species, to produce them in captivity.
5. Identify, acquire and restore properties in the Turkey Creek watershed.
6. Promote partnerships and voluntary stewardship within the watershed.

Total Estimated Cost of Recovery:

Implementation of recovery tasks for which cost estimates can be made over an initial 3-year period of recovery effort totals \$736,000. The total cost of delisting the species over 10 years is estimated to be \$1,806,000.

DATE OF RECOVERY: Estimated date for delisting the species, if recovery criteria are met, is 2017.

	Action						
Year	1	2	3	4	5	6	Total
2007	45	40	64	94	75	10	328
2008	40	35	-	58	75	10	228
2009	35	30	-	55	50	10	180
2010	35	30	-	55	50	10	180
2011	35	30	-	55	50	10	180
2012	20	30	-	10	50	10	120
2013	20	30	-	10	50	10	120
2014	20	30	-	10	50	10	120
2015	20	30	-	10	50	10	120
2016	20	30	-	10	50	10	120
2017	20	30	-	10	50	10	120
Total	310	345	64	377	600	110	1806 (Dollars in thousands)

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I. INTRODUCTION

The vermilion darter (*Etheostoma chermocki* (Teleostei: Percidae)), formally described by Boschung *et al.* (1992), is a rare fish only known from Turkey Creek, which is within the Black Warrior River drainage of Alabama (Figure 1). The Black Warrior River is a part of the expansive Mobile River Basin system, which falls mostly within the state of Alabama but also reaches into Mississippi, Georgia, and Tennessee. In 2000, the Southeastern Fishes Council Technical Advisory Committee of the American Fisheries Society listed the vermilion darter as endangered (Warren *et al.*, 2000). Due to its rarity and vulnerability to threats, the vermilion darter was federally listed as endangered on November 28, 2001 (U.S. Fish and Wildlife Service, 2001). The fish is listed as a species of highest concern by the State of Alabama (Blanchard and Drennen, 2004). However, only federally listed fish designated as threatened or endangered are regulated.

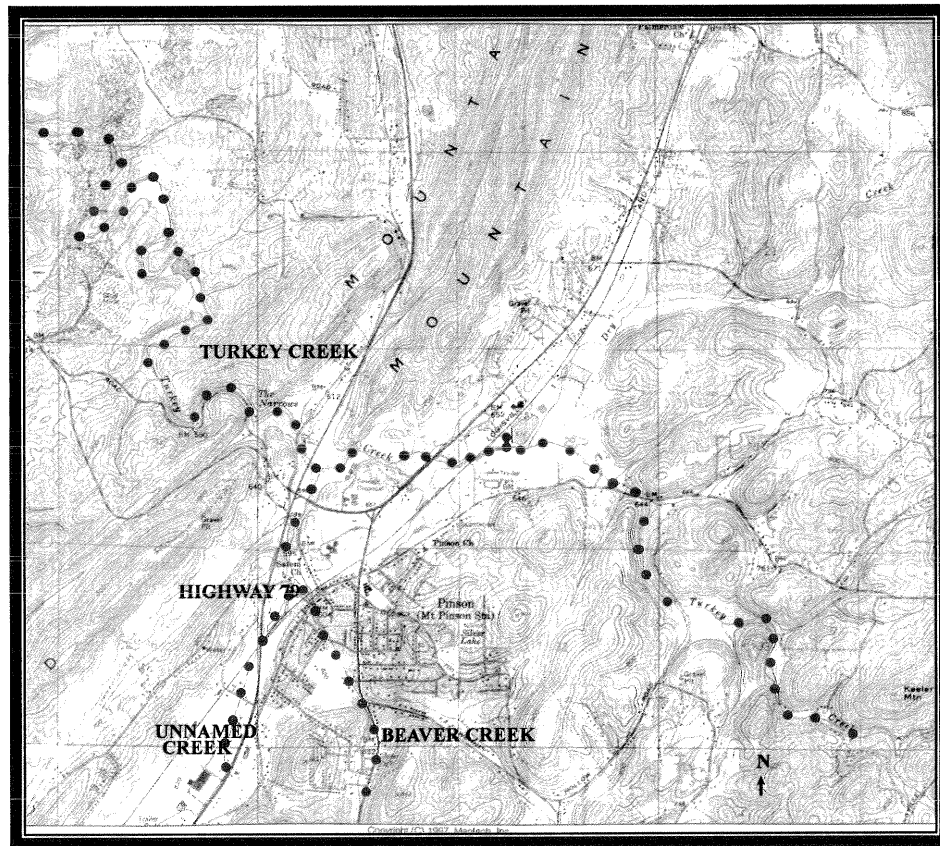


Figure 1. Range of the vermilion darter, *Etheostoma chermocki*, in Turkey Creek, Jefferson County, Alabama, (Maptech Terrain Navigator, Ed. 1.0, 2000, New Hampshire).

Description

The vermilion darter is a medium-sized darter reaching about 7.1 centimeters (2.8 inches) total length (length from tip of snout to longest portion of tail fin) (Boschung *et al.*, 1992; Suttkus and Bailey, 1993). The vermilion darter belongs to the subgenus *Ulocentra* (or “snubnose darters”), which includes fish that are slightly laterally compressed, have complete lateral lines, broadly connected gill membranes, a short head, and a small pronounced mouth. Like other members of the *Etheostoma duryi* species group, the vermilion darter lacks a premaxillary frenum (the upper jaw bridge of tissue that connects the upper lip and snout) and has vomerine teeth (teeth on the vomer bone, within the upper jaw) (Bailey and Etnier, 1988). The vermilion darter is distinguished by extensive vermilion (reddish-orange) pigmentation on the lower sides and especially on the belly (Figure 2). Males have a bright red spot on the membrane between the first spines of the spinous dorsal (upper) fin. During breeding, the males have red blotches along the side of the body just above the midline (Boschung *et al.*, 1992; Suttkus and Bailey, 1993). The female’s red spots are smaller.

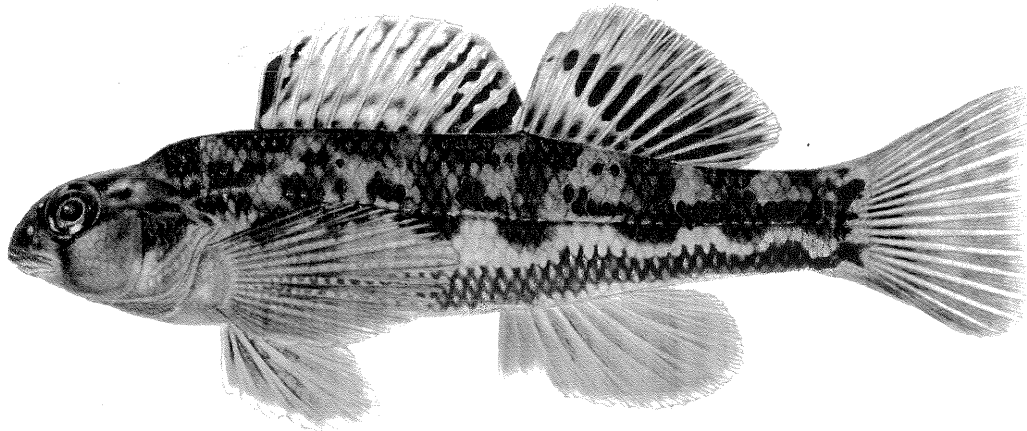


Figure 2. Male vermilion darter, *Etheostoma chermocki*
(Drawing by Joseph Tomelleri, used with permission)

Population Status and Distribution

The vermilion darter is found only in the Turkey Creek drainage, a tributary of the Locust Fork of the Black Warrior River, Jefferson County, Alabama. The current range of the vermilion darter is 11.6 kilometers (km) (7.2 miles (mi)) of the mainstem of Turkey Creek, the lowermost reaches (0.8 km (0.5 mi) total) of Dry and Beaver creeks, and within a spring run of an unnamed spring that drains into Beaver Creek along Alabama Highway 79 (Figure 1). Extensive surveys in similar habitats have failed to locate this species outside of its current drainage (Boschung *et al.*, 1992; Blanco *et al.*, 1995; Mettee *et al.*, 1996; Shepard *et al.*, 1998; Blanco and Mayden,

1999; Boschung and Mayden, 2004).

The historic population size of the vermilion darter within the Turkey Creek drainage is unknown. In the 1960s and 1970s, the vermilion darter was common at the Alabama highway 79 bridge site, which roughly bisects the fish's range, but by 1992, occurrences of the darter had become very rare at that site (Boschung *et al.*, 1992; K. Marion, University of Alabama in Birmingham, pers. comm. 2007). Currently, populations of vermilion darters are sparse and isolated within certain areas of Turkey Creek, due to natural or manmade barriers, like a waterfall, road culverts and impoundments. Dispersal beyond the current range is not likely (Blanco and Mayden, 1997) because of these barriers and the increasing decline of water quality by point-source pollution (pollution created from a single source) and nonpoint-source pollution (pollution created from larger processes and not from one concentrated point source, like excess sediment from a construction site washing into a stream after a rain). Relative abundance data by Blanco and Mayden (1999), during 1998 and 1999, indicated the population size of vermilion darters was between 1,847 and 3,238 individuals (256.5 to 449.7 individuals/creek mile) based on the number of vermilion darters caught within the Turkey Creek main stem and the tributaries of Dry and Beaver creeks. However, Stiles and Blanchard (2003), found only 0 to 16 individuals (0 to 2.2 individuals/creek mile) for a total of 107 individuals (14.9 individuals/creek mile), between March and August 2003 within the Turkey Creek main stem and the tributaries of Dry and Beaver creeks, which suggests a serious decline. Cursory surveys conducted sporadically from 2004-2006 indicate the overall sparseness and isolated nature of the vermilion darter along with a gradual population decline (Drennen pers obsv 1999 - 2007). A general guideline for the minimum number of individual vermilion darters needed to protect the population against risks of viability (Hallerman, 2003) is unknown.

Vermilion darters are found in Turkey Creek proper (3rd and 4th order stream) and tributaries (1st order streams) for about 11.6 km (7.2 mi). Powers and Mayden (in press) used the works of Page and Mayden (1981) to estimate the density of the abundant Cumberland snubnose darter (*Etheostoma atripinne*) in Tennessee at about 50,000 individuals per 1 km (0.62 mi) stretch of a 10 meter-wide (32.8 ft) stream of suitable habitat (for example, two collections of *E. atripinne* in the University of Alabama Ichthyological Collection (UAIC 3390.26 and UAIC 3392.17), containing 888 and 450 individuals, respectively, were collected in 50 meters (164 ft) of a 1st order stream). In view of that, extrapolating from the above information about *E. atripinne*, an equally healthy population of vermilion darters within its range in the Turkey Creek watershed would be approximately 705,000 individuals (50,000 individuals multiplied by 11.6 km (7.2 mi)). This is an overestimation given that *E. atripinne* is one of the most common snubnose darters, but demonstrates just how low in abundance the vermilion darter is relative to a common species.

Habitat

Vermilion darter habitat is similar to that of other snubnose darters found in small to medium-sized clear streams, with gravel riffles and moderate currents (Kuehne and Barbour, 1983; Etnier and Starnes, 1993). Boschung *et al.* (1992) described the stream habitat for vermilion darters as 3 to 20 m (10 to 65 feet (ft)) wide, 0.01 to more than 0.50 m (0.03 to more than 1.64 ft) in depth, with pools of moderate current alternating with riffles of moderately swift current, and low water turbidity. Blanco and Mayden (1999) found this species primarily in areas dominated by fine gravel with some coarse gravel or cobble. This species is absent in habitats with only a bedrock bottom, but has been found on bedrock with sand and gravel. Vermilion darters have been found in habitats with consistent water velocity, usually at the head of riffles and at the foot and downstream of the run habitat (stream zones with faster water) where the water becomes deeper and slower. They are usually absent from the riffle proper (shallow, fast-flowing water upstream of the run) and the run proper (deeper, fast-flowing water) and are found in the transition zone between a run/riffle (fast water) and pool (slow water) (Blanco and Mayden 1999). This species is generally not found in deeper pool habitats. Vermilion darters are sometimes associated with aquatic vegetation such as *Nasturtium officinale* (watercress), *Potamogeton* spp. (pondweed), *Ceratophyllum* spp. (coontail), and *Myriophyllum* spp. (milfoil) (Boschung *et al.*, 1992; Blanco and Mayden, 1997).

Life History and Ecology

The only documented spawning habitat for vermilion darters, at the confluence of Turkey Creek and the runoff from Tapawingo and Penny Springs, consists of a mixture of fine silt on small gravel interspersed with larger gravel, cobble, small boulders, aquatic vegetation, small sticks and limbs on the substrate and occasional filamentous algae (Stiles, pers. comm. 2007). Blanchard and Stiles (2005) found that vermilion darters preferred spawning substrate of large pebble and small cobble (35 to 68 mm; 1.40 to 2.72 inches in diameter). All rock surfaces must be clean for egg laying (Blanchard and Drennen, 2004).

No comprehensive life history studies have been undertaken for the vermilion darter. However, Khudamrongsawat *et al.* (2005) examined 136 individuals in museum collections and found that the standard length of vermilion darters was significantly correlated with body mass, gonad mass, and clutch size. The sex ratio (2:1) was in favor of females and length frequency distribution and enumeration of otolith annuli (growth rings) revealed four different age classes (0 to 3). Vermilion darters matured at the end of the first year of life. Gonadosomatic index (ovary weight/body weight, used to determine time of spawning) indicated reproduction occurred from March to June. Mean clutch size was 65 oocytes (egg cells) per female, and mean oocyte (bone structures in fish used to determine age) diameter was 1.14 mm (0.04 in).

It is believed that the vermilion darter's life history attributes are similar to other related snubnose darter species, which have life history information available, such as the bandfin and firebelly darters (*E. zonistrum* and *E. pyrrhogaster*, respectively) (Carney and Burr, 1989) and the Yazoo darter (*E. raneyi*; Johnston and Haag, 1996). These snubnose darters become reproductively mature at 1 year of age. Usually, a single egg is deposited and fertilized during spawning, which occurs from March to June at water temperatures of 11 to 20°C. No territoriality or migration has been observed. Spawning darters are promiscuous and there is no parental care provided for the eggs. Embryos typically hatch in 6 to 8 days at 20 to 25°C, with the larvae 3.4 to 4.6 mm (0.14 to 0.18 in.) total length. Males grow faster than females and the average size at sexual maturity is 34 mm (1.3 in.) for males and just over 30 mm (1.2 in.) for females. Porter *et al.* (2002) demonstrated a sister species relationship between the vermilion darter and the Warrior darter (*E. bellator*), from Gurley Creek, a tributary to the Locust Fork of the Black Warrior River in Alabama, just upstream from Turkey Creek. There is also little life history information for this species. However, Rakes and Shute (2005) raised Warrior darters (*E. bellator*), a closely related surrogate darter from Gurley Creek, and found that their eggs were 1.6 to 1.7 mm (0.064 to 0.068 in) in diameter, and incubation time was approximately 17 days with an average incubation temperature of 58 ° F. Larvae were approximately 5.5 to 6.0 mm (0.22 to 0.24 in) in total length at hatching, with very little pigment. They were drifting in the water column for 30 to 40 days.

Khudamrongsawat *et al.* (2005) found that vermilion darters were generalist benthic (bottom) insectivores consuming larval chironomids (midges), tipulids (crane flies) and hydropterygids (caddisflies). Microcrustaceans may be also consumed (Carney and Burr, 1989).

Therefore, based on the above mentioned work, we can make some basic assumptions concerning the vermilion darter's life history:

1. Clean pebble and cobble substrate are necessary for the attachment of eggs during spawning in the spring.
2. Because a large percentage of the population of snubnose darters consists of 0 to 1 year olds, one year of poor recruitment can severely deplete a population.
3. Because 90 percent of the population of snubnose darters consists of 0 to 2 year olds, two consecutive years of poor recruitment can devastate a population.

Threats and Population Limiting Factors

Restricted and localized in range, the vermilion darter is vulnerable and susceptible to sedimentation (excess sediments suspended or deposited in a stream), embeddedness (the degree to which fine sediments surround coarse substrates on the surface of a streambed), eutrophication (excessive nutrients present, such as nitrogen and phosphorus), and barriers or restrictions to stream flow caused by urbanization within watershed. Urbanization has contributed significantly to sedimentation within the Turkey Creek watershed. The Storm Water Management Authority, Inc. (SWMA) (2003) mapped 139 outfalls within Turkey Creek, of which about 90 are within the range of the vermilion darter. The approximately 91-square kilometer (35-square mile) Turkey Creek watershed drains 22,149 hectares (54,731 acres) of Jefferson County, the most populous county in the State of Alabama.

Sediment is the most abundant and severe pollutant produced in the Mobile River Basin (Alabama Department of Environmental Management, (ADEM), 1996; U.S. Fish and Wildlife Service, 2000) and in Turkey Creek (Blanco, 2001). Excessive sedimentation renders the habitat in Turkey Creek unsuitable for feeding and reproduction of vermilion darters. Sediment wears away and suffocates periphyton (organisms that live attached to objects underwater); disrupts aquatic insect communities, and negatively impacts fish growth, physiology, behavior, reproduction and survivability (Waters, 1995; Knight and Welch, 2001). Increases in sedimentation may increase embeddedness levels which decrease the space between substrate particles and limit the available area and cover for small fish, macroinvertebrates and periphyton (Sylte and Fischenich, 2003). Increased turbidity, suspended sediment concentrations, and bedload sediments have deleterious effects on fish (Kundell and Rasmussen, 1995). Nephelometric Turbidity Units and Total Suspended Solids (units used to measure sediment in water and abbreviated NTU and TSS respectively) greater than 10 NTU and 15 mg/ L can decrease primary production of sources for fish foods, decrease fish feeding activity and reduce fish species diversity (Henley *et al.* 2000). Sediment sources within the Turkey Creek watershed include activities that disturb the land surface, bankside or stream bottom. The amount and impact of sedimentation on the vermilion darter's habitat can be locally correlated with land use practices such as construction, urbanization, road maintenance, and soil type (D. Drennen, pers. observ. 2004). Use of all terrain vehicles within the stream may contribute to accelerated erosion and sediment disposition (Chin *et al.*, 2004), although their impact on the vermilion darter's habitat is unknown.

Nutrient loading is a major problem in Turkey Creek (Blanco, 2001). Water quality data for Turkey Creek taken in the late 1990's upstream of the Turkey Creek Waste Water Treatment Plant and along Turkey Creek Road showed high values for conductivity (Blanco and Mayden, 1999; Shepard *et al.*, 1998). High conductivity is an indicator of hardness, alkalinity and possibly eutrophication (Hackney *et al.*, 1992; Tennessee

Valley Authority (TVA), 1992). Domestic pollution (septic and gray water) and excessive use of fertilizers and pesticides result in a concentration of nutrients and toxic chemicals within Turkey Creek. High concentrations of these substances may indicate extensive urbanization impacts on the watershed. Nutrification promotes heavy algal growth that covers and eliminates clean rock or gravel habitats necessary for vermilion darter feeding and spawning (Shepard *et al.*, 1998; O'Neil and Shepard, 2001). Blanco *et al.* (1995) noted increased levels of filamentous algae in Dry Creek and above Turkey Creek Falls, within the range of the darter. Vermilion darter habitat along Turkey Creek Road was given a poor general index of biological integrity score (a numerical evaluation of the biological health of a stream) in 1997 because of domestic pollution (Shepard *et al.*, 1998).

There are six impoundments in Turkey and Dry creeks: Turkey Creek Lakes, Shadow Lake, Strip-mine Lake, Innsbrook Lake, Pearl Lake, and Horse Ranch Pond. These impoundments serve as dispersal barriers, affect water quality by reducing water flow, altering temperature and concentrating pollutants, and they may have contributed to the isolation and separation of the vermilion darter populations (Blanco and Mayden, 1999).

Over utilization has not been implicated in the decline of this species. Scientific collection permits are rarely issued and undergo strict scrutiny and justification before being issued for activities regarding the vermilion darter. Presently, disease and predation is unknown in the vermilion darter in the Turkey Creek watershed and does not seem to be a threat. Predation from other fish species may be a potential threat. Threats from stocked game fish within the Turkey Creek watershed and in impoundments within the headwaters could become problematic. Introduction of carp species may increase turbidity and decrease the quality and quantity of aquatic vegetation, especially around the confluence of Turkey Creek with the Tapawingo Spring run, the only known spawning site.

The current range of the vermilion darter is restricted to localized sites within the mainstem of Turkey Creek and the lowermost reaches of Dry Creek and Beaver Creek, within the Turkey Creek drainage. Subsequently, genetic diversity has likely declined due to fragmentation, separation, and destruction of vermilion darter populations. Potential genetic variation and diversity within a species are essential for recovery, adaptation to environmental change, and long-term viability (Hallerman, 2003). The long-term viability of a species is founded on conservation of numerous interbreeding local populations throughout the range of the species (Harris 1984). Interbreeding populations of vermilion darters are becoming increasingly separated.

The limited distribution of the vermilion darter makes populations vulnerable to extirpation (elimination) from catastrophic events such as an accidental toxic chemical spill, heavy pesticide or contaminant runoff, increased erosion and sedimentation, vandalism, or changes in flow regimes. A major highway (State

Highway 79) divides the watershed. Eastward (upstream), the watershed is experiencing rapid residential and business growth; while to the west (downstream), there are numerous commercial, residential, and reclaimed strip-mining sites.

Conservation Measures and Efforts

Potential impacts to the Turkey Creek watershed have been reduced by numerous conservation measures and efforts enacted by partners living or working in the watershed. Programs and manuals (Alabama Cooperative Extension Service (ACES), 1998; ADEM, 2000a) are continuously being developed or refined by State and private interests to improve and to encourage the application of Best Management Practices (BMPs) for construction, forestry and agriculture.

The watershed's citizens are also seeking to protect watershed quality through grass roots organizations. Community action groups such as the Society to Advance the Resources of Turkey Creek (START) and the Alabama Rivers Alliance, encourage proper stewardship of the watershed's aquatic resources. START was a major participant in protecting land along Turkey Creek Road from development. They have been vocal in environmental protection of the area and consistently clean and monitor the stream bank and flood plain for threats. Working with the Service, START has completed Partners for Fish and Wildlife projects to prevent erosion and to fortify stream banks.

The Jefferson County Lands Division and the Service have memorandums of understanding that mutually inform each other of construction projects and impacts on vermilion darters within the watershed. The County has actively pursued BMPs while maintaining roads, bridges, and water and sewer lines within the watershed.

The Black Warrior-Cahaba Rivers Land Trust has purchased fee title properties and easements within the watershed, thereby protecting water quality and reducing urbanization impacts. With the assistance of the Service, the Black Warrior-Cahaba Rivers Land Trust has removed harmful structures and other man-made objects from the Tapawingo Springs area. They continue to evaluate, purchase, manage and protect important land within the watershed.

Recovery Strategy

Problems impacting the Turkey Creek watershed and the vermilion darter's habitat are extensive, interrelated and are directly the result of urbanization. Urban and industrial waste management and water quality standards require considerable time and effort to resolve.

Current laws and regulations require future Federally funded projects that may cause impacts to the vermilion darter's habitat within the Turkey Creek watershed to be

assessed in regard to need, environmental impact, possible alternatives and costs. However, laws and regulations cannot guarantee that the least damaging project to the watershed will be chosen.

The strategy of this plan is similar to the strategy in The Mobile River Basin Aquatic Ecosystem Recovery Plan (U.S. Fish and Wildlife Service, 2000). Primarily, it is to emphasize stewardship responsibilities (Natural Resource Conservation Service (NRCS), 1998; ACES, 1998; ADEM, 2000a, 2000b) shared by all citizens living and working within the Turkey Creek system toward maintaining the health of the watershed. This will result in the conservation and management of the vermilion darter and its habitat. The Vermilion Darter Recovery Plan promotes the following guidelines:

1. Use and enforcement of existing laws, regulations and policies to protect and/or enhance vermilion darter populations and habitat, associated wetlands and water quality by reducing erosion and sedimentation. Promote BMPs and Streamside Management Practices for Alabama in regards to all construction and maintenance projects in the watershed (International Erosion Control Association (IECA), 2004; ADEM 2000a, 2000b, 1996; NRCS, 1998; TVA, 1992).
2. Encourage and recruit voluntary stewardship through joint initiatives and individual actions as the only practical means of minimizing adverse effects on private and public land use and activities within the watershed. Establish better communication and cooperation among landowners, government, businesses, forest managers, conservation groups and scientists concerning land management decisions, recommendations, conservation practices, projects and development within the watershed.
3. Voluntary soil and water stewardship practices implemented by landowners, businesses, conservation and watershed groups and the City of Pinson, Alabama can result in significant stewardship contributions to the conservation and management of the Turkey Creek watershed and the recovery of the vermilion darter. The floodplains and wetlands of the watershed should be left in forest or other natural cover types, especially in urban areas. Mechanisms must be provided for stakeholders to play a major decision-making role in the management of the watershed.
4. Educate landowners, governments, regulatory agencies, and the public, through existing programs of extension services, non-profit organizations, State and Federal agencies, or related programs, and encourage as needed that local authorities adopt ordinances and regulations that require the following conservation measures on:
 - a. The uniqueness of the fauna and flora of the Turkey Creek watershed;
 - b. The importance of biodiversity and appropriate stewardship

- measures that contribute to it;
- c. The importance of a healthy Turkey Creek watershed;
 - d. The importance of maintaining or increasing the extent of forest cover, especially cover over Turkey Creek and its tributaries;
 - e. The educational, technical, and financial assistance available for landowners and the tools available to them for resource conservation such as easements, cost-sharing or other similar programs;
 - f. Maintaining the natural hydrology of the Turkey Creek watershed to maximize stream and floodplain habitat;
 - g. Preventing future fragmentation of Turkey Creek and its tributaries by barriers like new dams, culverts, pipes and risers and other devices that reduce stream flow;
 - h. Maintaining and establishing habitat connectivity throughout the watershed; discouraging fragmentation of Turkey Creek and tributaries by urbanization or other human activities; and
 - i. Utilizing existing right of ways and easements for the location and construction of utility lines or pipes and roadways, rather than creating new ones.
5. Continue to promote research efforts on the vermilion darter and the Turkey Creek watershed.

II. RECOVERY

A. Recovery Objective and Criteria

The ultimate objective of this recovery plan is to improve the status of the vermilion darter to the point that protection under the Endangered Species Act is no longer required and the vermilion darter can be delisted. However, imperilment and extinction in the Mobile River Basin are a Basin-wide phenomena affecting all trophic levels, and are directly associated with human population density, habitat modification to meet human needs, and past and current land use activities (U.S. Fish and Wildlife Service, 2000). In particular, the Locust Fork of the Black Warrior River watershed where Turkey Creek is found, is experiencing an increased rate of urbanization and its subsequent associated infrastructure, all related to the watershed's proximity to the expanding Birmingham, Alabama metropolitan area.

The vermilion darter (*Etheostoma chermocki*) will be considered recovered and for removal from the list of endangered and threatened wildlife (delisted) when all of the below criteria are realized:

- 1) Populations of vermilion darters and its habitat within its known range in Turkey Creek are shown to be protected from present and foreseeable threats to the point where listing is no longer required through implementation of activities including stewardship, outreach, best management practices, securing conservation easements or acquisitions, and ensuring adequate regulatory enforcement.
- 2) Stable or increasing population trends for at least 10 years throughout its known range are verified through monitoring and surveys.
- 3) Suitable flows and water quality parameters in Turkey Creek supporting the vermilion darter are determined through recovery tasks and assured, through State or local groundwater management plans, or water conservation plans.
- 4) An average monthly reading of 10 NTU or 15 TSS (Nephelometric Turbidity Units or Total Suspended Solids measured as mg/L) units used to measure sediment discharge) or less discharge into the Turkey Creek watershed within and upstream of the vermilion darters' range is being attained and documented as occurring for a minimum of 10 consecutive years. Information will be compiled from sampling water quality monthly throughout the year during base, low and high flows.
- 5) A captive vermilion darter population of 20 pairs (40 individuals) has been established and successfully propagated for augmentation.

B. Listing/Recovery Factor Criteria

The following criteria (Factors A through E) apply to the delisting criteria identified above. These criteria are linked to specific recovery tasks and will serve to measure progress in removing threats to the species.

Factor A: The present or threatened destruction, modification or curtailment of a species habitat or range. In order to ensure the long-term recovery needs of the vermilion darter, and provide adequate assurance of population viability, threats to the vermilion darter's habitat or range must be reduced or removed (Recovery Criteria 1, 3, 4).

- 1) This can be achieved by the development of a habitat restoration plan that insists upon the usage and proper placement of Best Management Practices (BMPs) and Stream Side Management Zones (SMZs). (Tasks 1.2, 1.3, 1.4, 2.3, 5.0)
- 2) It can be achieved by the legal and voluntary enforcement of all water quality standards under the Clean Water Act along with a Section 303 (d) analysis of Turkey Creek to determine Total Maximum Daily Load for sediment. (Task 1.5, 2.2, 2.3, 6.0)
- 3) Water quality and quantity must be fully supporting a minimum designated use of fishing or fish and wildlife habitat (as reported by the states under Section 305(b) of the Clean Water Act) within all reaches of the Turkey Creek watershed. This can be achieved by maintaining an average monthly reading of 10 NTU or 15 mg/L TSS (Nephelometric Turbidity Units or Total Suspended Solids) or less erosion (sediment) discharge into the Turkey Creek watershed within and upstream of the vermilion darters range. (Task 1.3, 2.1, 2.4)

Factor B. Over utilization for commercial, recreational, scientific, or educational purposes. Over utilization has not been implicated in the decline of this species. Scientific collection permits are rarely issued and undergo strict scrutiny and justification (Task 2.2). Population numbers will be kept in check with monitoring (Task 2.2; Recovery Criteria 1, 2).

Factor C. Disease or predation. Presently, disease and predation is unknown for the vermilion darter in the Turkey Creek watershed and does not seem to be a threat. Predation from other fish species may be a potential threat. Threats from stocked game fish within the Turkey Creek watershed and in impoundments within the headwaters could become problematic. Introduction of carp species may increase turbidity and decrease the quality and quantity of aquatic vegetation, especially around the confluence of Turkey Creek with the Tapawingo Spring run, the only known spawning site (Task 1.1, 2.1; Recovery Criteria 1).

Factor D: The inadequacy of existing regulatory mechanisms. Adequate funding, from existing state, county and federal agencies, for enforcement activities is critical for protection of the vermilion darter and water quality impacting the vermilion darter's habitat through the Alabama Water Pollution Control Act, and the Alabama Environmental Management Act, and the Clean Water Act to maintain water quality standards in particular to the Category 30 NPS (Non-Point Source) pollutants (ADEM, 2000a) (Task 2.1; Recovery Criteria 1). Local county and state law enforcement agencies are critical in protecting the habitat of the vermilion darter from disturbances from all terrain vehicles (Task 2.1; Recovery Criteria 1).

Factor E: Other natural or manmade factors affecting its continued existence. Increasing and monitoring the population numbers and habitat along with the establishment of husbandry techniques and an ark population will reduce vulnerability to natural or manmade random catastrophic events. Genetic diversity and strategies for addressing potential problems should be addressed (Task 3.1, 3.2, 4.1-4.5, 5.0; Recovery Criteria 2, 6).

C. Narrative Outline

1.0 Protect vermilion darter populations and habitat.

1.1. Determine the magnitude of known and potential threats. Increase understanding of the nature and magnitude of the known threats to the vermilion darter and its habitat.

1.2. Develop and implement a habitat restoration plan. Develop a habitat restoration plan in coordination with biologists, county, municipalities, State, and Federal regulatory and management agencies and governments, watershed protection and environmental groups, landowners and businesses. The plan should comprehensively identify specific restoration parameters and threats to the water quality and habitat of the vermilion darter. Identify and rank in order of severity areas of erosion responsible for sedimentation of vermilion darter habitat in the Turkey Creek system. Areas that contribute to sedimentation include riparian zones to the top of ridges. A strategy for implementation of each parameter will be identified. Areas that need urgent protection are the 11.6 kilometers (km) (7.2 miles (mi)) of the main stem of Turkey Creek and the lowermost reaches (0.8 km (0.5 mi) total) of Dry and Beaver creeks and the unnamed spring run along Alabama Highway 79. However there are significant, critical areas within the watershed that need protection including the tops and ridges of all hills and mountains that drain into the watershed, especially those that drain upstream of and into the vermilion darters range.

1.3. Improve and enhance water quality and sedimentation reduction and to a monthly average of 10 NTUs and 15 mg/L TSS or less. The most significant factor adversely affecting the vermilion darter is degradation of its habitat by point and non-point source pollution. Therefore, the following measures should be immediately taken to improve the water quality: 1) a zero erosion discharge policy concerning construction and development in and upstream of the immediate area of the vermilion darters' range, 2) adequate stream setback zones for construction near Turkey Creek and tributaries based on the percent slope (the ratio of rise to run) of the topography (where 0% to 5% percent slope needs a minimum of a 30 feet stream setback zone, 6% to 20% needs 40 feet, 21% to 40% needs 50 feet and over 40% requires 60 feet, and 3) work to ensure effective erosion control, including proper installation and maintenance of erosion control structures such as silt fences, rolled erosion control products, soil stabilizers and other techniques from all land disturbance activities. Strive for a monthly turbidity average of 10 NTU's or 15 mg/L TSS or

less.

1.4 Implement actions to restore habitat. Once specific habitat and water quality restoration measures have been identified, each participant, agency or group should use the authorities and expertise available to contribute to habitat and water quality restoration.

1.5. Urge Environmental Protection Agency and the ADEM (Alabama Department of Environmental Management) to conduct a Section 303 (d) analysis of Turkey Creek to determine Total Maximum Daily Load for sediment.

2.0 Ensure and support implementation of effective protective actions.

2.1. Measure basic water quality parameters: Temperature, pH, oxygen, turbidity (in NTU's and mg/L for TSS), embeddedness of substrate, and other parameters should be measured seasonally. Other water quality considerations include testing for specific pollutants, both in water and sediment samples.

2.2. Assure adequate funding for enforcement activities: Begin a comprehensive monitoring program to assess urbanization projects within and upstream of the vermilion darters' range. Continue and establish "Memorandums of Agreement or Understanding" with Jefferson County, SWMA, ADEM, Alabama Department of Conservation and Natural Resources (ADCNR) and enforcement agencies, concerning monitoring, water quality and impacts of urbanization in the mentioned portions of the Turkey Creek watershed. Attempt to prevent the use of all terrain vehicles within the streambed of Turkey Creek and tributaries. Attempt to prevent carp and other destructive fish species from entering the vermilion darters habitat through neighboring impoundments, especially during flood events.

2.3. Encourage adequate stream management zones (SMZ). Establish protected zones, determined by Jefferson County, START, BWCR and others, along Turkey Creek upstream from the Turkey Creek Waste Water Treatment Plant and within specific tributaries of the creek.

2.4. Encourage enforcement of all water quality regulations under the Clean Water Act. The Mobile River Basin is the fifth most endangered water basin in the country because of low water quality standards (U.S. Fish and Wildlife Service, 2000). Address water quality in all project planning and strive to improve funding and enforcement of adequate controls.

3.0 Determine habitat requirements and population information for the various life stages of the vermilion darter.

3.1. Determine the population structure of the vermilion darter. Determine population viability, optimum numbers and spatial arrangement of population, including information about the species' movement, population dynamics including fecundity, age and size class, sex ratio and longevity through annual population estimations. Determine additional aspects of the population structure using genetic data, including mitochondrial DNA and microsatellite alleles. Sample vermilion darter populations within its range over 10 years.

3.2. Determine microhabitats for the different life stages of the vermilion darter. Perform laboratory studies on spawning habitat, embryo development, and habitat preferences for yolk-sac larvae, feeding larvae, and juveniles of vermilion darters or surrogates. Preserved larvae will be used as a reference collection for identifying any darter larvae captured in the Turkey Creek System. Perform field observations on spawning adults and habitat preference of larvae, juveniles and adults.

4.0 Determine the necessary husbandry techniques of the species or surrogate, to produce vermilion darters in captivity. Captive propagation is a necessary tool to maintain the survival of the species due to a natural or man made catastrophe in its range.

4.1. Determine if a surrogate species, such as *Etheostoma bellator* from Gurley Creek, should be used to establish proper laboratory protocol before adult vermilion darters are removed from Turkey Creek for laboratory spawning purposes.

4.2. Determine potential genetic constraints within the genetic pool of vermilion darters in Turkey Creek.

4.3. Determine potential sites for reintroduction and augmentation within tributaries of the historic and current range of the darter in the Turkey Creek drainage.

4.4 Require and assure substrate, water flow, quality, and other environmental requirements of the species are satisfactory and threats are abated before any stocking, reintroduction or augmentation of the species.

4.5 Maintain an ark population of vermilion darters in captivity to be used for augmentation purposes, if determined to be necessary.

5.0 Identify, acquire and restore properties in Turkey Creek Watershed. Acquire significant properties identified by the Black Warrior-Cahaba Rivers Land Trust, Jefferson County government and other public and private organizations for conservation, restoration, maintenance and management within the range of the vermilion darter. These include the mid and upper sections of Turkey Creek; the confluence of Turkey Creek and Dry Creek; upstream in Dry Creek; all of Beaver Creek including the areas above the Sunnysdale Road Bridge; the unnamed spring and drainage along Alabama highway 79 and where it drains into Beaver Creek; and all upland drainage areas identified as potential habitat. Funding for such purposes, through public or private grants, and other sources should be strongly encouraged and implemented. Land acquisitions or conservation easements essential for the recovery of the vermilion darter include but are not limited to the following land tracts described as land parcels from the Jefferson County Office of Land Development (USInfrastructure, Inc., 2000) along Turkey Creek proper and the mentioned tributaries.

6.0 Endorse, encourage and sponsor partnerships and voluntary stewardships. Formation of partnerships, support of existing partnerships, and promotion of voluntary stewardships will reduce land use conflicts and reduce the need for reliance on law enforcement and controls. Supplement efforts to educate and involve the public, schools, developers and businesses, about the need for and benefits of ecosystem management. Encourage that local authorities adopt ordinances or regulations to assist, maintain and augment the mentioned efforts.

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III. Implementation Schedule

The following implementation schedule outlines recovery tasks and their estimated costs. It is a guide for meeting the objective described in Part II of this plan. This schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsibility of agencies, and estimated costs. It should be noted that these are minimum estimates of the costs associated with recovery of the vermilion darter.

Priorities in column one of the following Implementation Schedule are assigned as follows:

1. An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.
2. An action that must be taken to prevent a significant decline in the species' population, habitat quality, or some other significant negative impact short of extinction.
3. All other actions necessary to provide for full recovery of the species.

Key to acronyms used in implementation schedule:

ADCNR- Alabama Department of Conservation and Natural Resources
ADEM- Alabama Department of Environmental Management
BWCR-Black Warrior-Cahaba Rivers Land Trust
EPA-Environmental Protection Agency
JEFFCO- Jefferson County Commission Office of Land Development
RES-Research
START- Society to Advance the Resources of Turkey Creek
SWMA- Storm Water Management Authority, Inc.
USFWS, ES-U.S. Fish and Wildlife Service, Ecological Services

Vermilion Darter Implementation Schedule

				RESPONSIBLE PARTY												COMMENTS												
				USFWS			OTHER																					
				REGION			DIVISION			FY 1			FY 2			FY 3			FY 4			FY 5						
PRIORITY NO.	TASK NO.	TASK DESCRIPTION	TASK DURATION	4	ES	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	COMMENTS
1	1.1	Determine the magnitude of known and potential threats.	Continuing	4	ES																							
1	1.2	Develop and implement a habitat restoration plan	1 year	4	ES																							
1	1.3	Improve and enhance water quality and reduce sedimentation to a monthly average of 10 NTUs or 15 mg/L TSS or less.	5 year	4	ES																							Dependent on NPDES permit and local ordinances
1	1.4.	Implement actions to restore habitat.	Continuing	4	ES																							
1	1.5	Urge the EPA and the ADEM to conduct a Section 303 (d) analysis of Turkey Creek to determine Total Maximum Daily Load for sediment.	Continuing	4	ES																							
1	2.1.	Monitor and measure basic water quality parameters	Continuing	4	ES																							
2	2.2.	Assure adequate funding for enforcement	Continuing	4	ES																							

2	2.3	Ensure adequate stream management zones (SMZ)	Continuing	4	ES		ADEM ADCNR BWCN JEFFCO RES START	5	5	5	5	5	
2	2.4	Ensure enforcement of all water quality regulations under the Clean Water Act	Continuing	4	ES		ADEM ADCNR BWCN JEFFCO RES START	10	10	10	10	10	Dependent on NPDES permit and local ordinances
2	3.1	Determine the population structure of the vermilion darter	1 year	4	ES		RES	27					
3	3.2	Determine microhabitats essential for the different life stages of the vermilion darter.	1 year	4	ES		RES	37					
3	4.1	Use the surrogate species to answer basic life history parameters.	1 year	4	ES		RES	27					
3	4.2	Determine genetic constraints within the limited genetic pool.	3 years	4	ES		RES	37	33	30	30	30	
3	4.3	Determine potential sites for reintroduction and/or augmentation.	3 years	4	ES		RES	10	10	10	10	10	
3	4.4	Require and assure substrate, water flow, quality, and other environmental requirements of the species are satisfactory and threats abated before any reintroduction and/or	Continuing	4	ES		RES	10	10	10	10	10	

3		augmentation.																	
	4.5	Establish an ark population of vermilion darters	3 years	4	ES		RES	10	5	5	5	5	5	5					
3	5	Identify and acquire properties in Turkey Creek Watershed	Continuing	4	ES		ADCNR BWCR JEFFCO	75	75	50	50	50	50	50					
3	6	Endorse, encourage and sponsor partnerships and voluntary stewardships:	Continuing	4	ES		START	10	10	10	10	10	10	10					

Part IV: Summary of Comments Received

Wildlaw:

Comment: “Draft recovery plan (DRP) appears to propose actions that truly address conditions that resulted in the perilous condition of the species. Since implementing plan is contingent on funding and implementation may not be complete as hoped, high goals with rigorous objectives should be set.”

A. Provide more site-specific information in the sections where you discuss the need to establish stream management zones.

Service Response: The target area is the Turkey Creek watershed. Discussions with partners such as Jefferson County, Black Warrior –Cahaba River Land Trust, START and others, along with adjacent landowners, are ongoing. Many areas of acquisition identified by USInfrastructure (2000) are being acquired as fee title or easement. The USFWS, SWMA and others provide technical assistance concerning the establishment of stream management zones within the Turkey Creek watershed and tributaries (Recovery Tasks 1.2, 1.3, 1.4, 2.3, and 5.0).

B. ...this document should give more details on proposed public or private processes (that) should be followed.

Service Response: The Service is in active communication with partners that have the ability to purchase property or easements within the watershed that will protect the habitat and the species such as the Black Warrior-Cahaba River Land Trust and the State of Alabama Department of Conservation and Natural Resources. Protection of the habitat via public or private processes is adequately addressed in Recovery Tasks 1.2 and 5.0.

C. ... recovery criterion #2, that allows the species to be delisted when stable or increasing population trends for at least 10 years are verified, is not adequate and should be revised.....clarify at what point stable or increasing population trends will be sufficient.

Service Response: The population is not currently considered stable. The vermilion darter will be considered recovered and for removal from the list when **all** five of the listed items under *Recovery Objective and Criteria* (II.A.) are accomplished: when the populations are shown to be protected from all present and foreseeable threats; the populations are shown to be stable and/or increasing; flows and water quality are adequate; an average monthly NTU reading of 10 or less and TSS of 15 mg/L sediment discharge is established over 10 years; and a captive vermilion darter population is established. As far as the clarification of a stable population, this will be determined by Tasks 3.0, 3.1, 3.2, 4.1, and 4.2.

D. Recovery criterion #3 does not meet the objective and measurable standard...

Service Response: At this time, we do not specifically know what adequate and suitable flows are needed to address this recovery criterion. However, we continue to work toward obtaining this information, through recovery tasks and the continuing efforts involving partners that are working to restore water quality and habitat of the species based on the most current available information, see Tasks 1.3, 2.1, 2.3, 2.4.

E. To truly evaluate the quality of the habitat...more information needs to be gathered than that suggested by criterion #4.

Service Response: Information will be compiled from sampling water quality monthly, throughout the year, during base, low and high flows. Water quality and quantity will meet the minimum designated use of fishing or fish and wildlife habitat (Section 305(b) of the Clean Water Act) within all reaches of the Turkey Creek watershed. NTU's (Nephelometric Turbidity Units) and TSS (Total Suspended Solids) measures will be implemented striving to maintain an average monthly reading of 10 NTU and 15 mg/L TSS discharge within and upstream of the vermilion darters range. Recovery II.A.4, Tasks 1.3, 2.1, 2.2, 2.3, 2.4, are considered continuing efforts.

F. ...there must be some measure of the embeddedness of the substrate.

Service Response: We concur; see Recovery Tasks 1.1, 1.3 and 2.1. The decrease rate of sedimentation will reflect a decreased rate of embeddedness.

G. Two of the threats listed as contributing to the jeopardy of this species are not addressed...the use of all terrain vehicles ...and...stocked game fish and carp.

Service Response: We concur and have corrected the plan. We have continuing discussions with Jefferson County Sheriffs Department, State of Alabama Division of Wildlife and Freshwater Fisheries Law Enforcement, ADCNR, and local landowners concerning the impact of riding all terrain vehicles within the stream bed of Turkey Creek and tributaries (Factor D: Tasks 2.1, 2.2; Recovery Criteria 1). Task 6 identifies the encouragement of individual and voluntary stewardship of the resources. Turkey Creek, within the range of the vermilion darter, is not stocked with game fish or carp. Presently this is only a latent threat, however, there is a potential of game fish and carp entering the vermilion darters habitat through neighboring impoundments, especially during flood events. The State of Alabama Division of Wildlife and Freshwater Fisheries and ADCNR regulate and monitor game fish stocking and exotic introductions. Water quality issues are addressed in Tasks 1.1, 2.1 and 2.2.

H. ...needs more details on use and enforcement of existing laws, regulations and policies...joint initiatives...voluntary measures...

Service Response: These actions are strongly encouraged in the Recovery Strategy

numbers 1, 2, 3, and 4; in Factor D (Task 2.1;Recovery Criteria 1) and in Factor A2 (Tasks 1.5, 2.2, 2.3, and 6.0).

- J. Encourage that local authorities adopt ordinances or regulations that require utilizing existing rights-of-way and easements rather than creating new ones.

Service Response: we concur; see Recovery Strategy 4 and Task 6.0.

- K. Who will carry out and maintain the steps to enhance water quality and reduce sedimentation...?

Service Response: These actions are encouraged and responsible parties identified in the Vermilion Darter Implementation Schedule (Tasks 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3 and 2.4).

Storm Water Management Authority:

Comment: “The Storm Water Management Authority (SWMA) hopes to continue to work with the USFWS to ensure that this and future recovery plans are as effective and defensible as possible.”

- A. Task 1.3 in Implementation Schedule...it is not within the scope of our permit to implement or enforce any water quality criteria within local water bodies to a specified quality or ensure enforcement of any water quality violation in the state of Alabama.

Service Response: We concur; SWMA is not listed as a responsible party in the Implementation Schedule under these specific recovery tasks (1.3, 2.2)

- B. SWMA has committed to more frequent monitoring of Turkey Creek to assist with the Vermilion Darter Recovery Plan.

Service Response: Commitment noted and SWMA listed as responsible party under task 2.1 of Implementation Schedule.

- C. Task 2.4 in Implementation Schedule...Ultimately, it is the responsibility of ADEM to ensure enforcement of any water quality violations within the State of Alabama.

Service Response: We concur; see Recovery Tasks 2.2, 2.3 and 2.4.

- D. ...SWMA understands we are only committing to those assignments outlined for SWMA as stated in the Implementation Schedule.

Service Response: We concur. SWMA has made significant contributions to the Recovery Plan and is a critical member of the Vermilion Darter Recovery Team.

E. The estimated date of recovery for delisting the species is 2015. SWMA is concerned that there is no measurable milestones or goals included with the plan that would indicate progress or regression along this ten year time span.

Service Response: It is hoped that the vermilion darter will be delisted if all the Recovery Criteria are met (includes all tasks) by 2015. Realistically, this is a general time frame used for funding estimation, and the time frame can be modified due to the success or failures of the Recovery Criteria. Recovery progress will be tracked and evaluated on an annual basis and during the course of 5-year reviews of the species.

F. Is this plan flexible enough to adjust if commitments of other agencies identified in the Implementation Schedule are not made to the tasks as proposed?

Service Response: Recovery Plans are flexible guidance documents, which do not obligate parties outside the service to undertake certain tasks (see Disclaimer). Overall, recovery of species is a dynamic process requiring adaptive management to account for the best available science. As new information or science is gained for a species, a change may be necessary in the extent of a recovery action or in criteria needed to be met for recognizing recovery of the species or it may negate a recovery criteria or action.

State of Alabama, Department of Conservation and Natural Resources, Wildlife and Freshwater Fisheries Division:

Comment: The description, population status, habitat, life history and ecology sections are informative and well written...threats and population limiting factors section is useful in determining what environmental factors are most critical regarding the impacts to the vermilion darter...recovery strategy section details efforts to use existing laws, encourage voluntary stewardship, and educate landowners on using BMP's to limit impacts to the watershed.

A. ... development of a habitat restoration plan is critical to the darter's survival considering the expanding threats in Jefferson County.

Service Response: We concur: see Recovery Task 1.2.

B. ... proper procedures or techniques need to be developed so that the vermilion darter can be spawned in captivity to assure possible reintroduction and /or augmentation within the current range and maintain an ark population at some future culture facility.

Service Response: We concur: see Recovery Tasks 4.0- 4.5.

C. Improvement and restoration of water quality in Turkey Creek should be given high priority...governmental organizations need to be involved in protection effort...regulatory efforts may be required to protect critical habitat...Education measures ...can provide information to the public regarding threats...Purchasing property along the watershed should be another priority...routine surveys should be performed regularly to monitor vermilion darter populations ...identify new threats , population trends and year class strength...

Service Response: We concur: these items are identified in the recovery tasks along with their responsible parties within the Implementation Schedule, Section III.

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