Watercress Darter
(Etheostoma nuchale)

5-Year Review:
Summary and Evaluation

Photo by Dr. Mike Howell, Samford University, Birmingham

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

5-YEAR REVIEW
Watercress Darter (*Etheostoma nuchale*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: In completing this 5-year review, we relied on the best available information pertaining to historic and current distributions, life history, and habitats of this species. Our sources include the final rule listing this species under the Endangered Species Act; the Recovery Plan; peer reviewed scientific publications; unpublished field observations by Service, State and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. A *Federal Register* notice announcing the review and requesting information was published on June 14, 2005 (70 FR 34492), and a 60 day comment period was opened. Comments were evaluated and incorporated where appropriate into this final document (see Appendix A). No part of this review was contracted to an outside party. This review was completed by the Service's lead Recovery biologist in the Jackson Ecological Services Field Office, Mississippi.

B. Reviewers

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

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

Cooperating Field Office – Daphne, AL, Ecological Services: Jeff Powell, 251-441-5858

C. Background

1. **FR Notice citation announcing initiation of this review:** June 14, 2005: 70 FR 34492

2. **Species status:** Declining (2009 Recovery Data Call)
   Status is based on the decline in population numbers and habitat condition at a primary population in 2008.

3. **Recovery achieved:** (1 = 0-25% recovery objectives achieved)
   Recovery achieved is based on lack of permanent protection of populations from present and foreseeable threats and lack of long-term monitoring data demonstrating stable populations.

4. **Listing history**
   Original Listing
   FR notice: 35 FR 16047
   Date listed: October 13, 1970
   Entity listed: Species
   Classification: Endangered

5. **Review History**:
   A previous 5-year review for this species was noticed on November 6, l991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors, threats, etc. as they pertained to the individual species. The notices summarily listed these species and stated that no changes in the designation of these species were warranted at that time. In particular, no changes were proposed for the status of the species in this review. A similar 5-year review was completed in 1985 and no changes were proposed for the status of the watercress darter.

   Recovery Data Call: 2009, 2008, 2007, 2006, 2005, 2004, 2003, 2002, 2001, and 2000
   Recovery Plan: 1993

6. **Species' Recovery Priority Number at start of review (48 FR 43098): 8**
   Degree of Threat: Moderate
   Recovery Potential: High
   Taxonomy: Species

7. **Recovery Plan:**
   Name of plan: Watercress Darter (*Etheostoma nuchale*) Recovery Plan
   Date issued: March 29, 1993
   Dates of previous plans: First Revision March 27, 1984; Original Approved June 25, 1980

II. REVIEW ANALYSIS

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

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

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

B. Recovery 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 and 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?** The invasive Northern crayfish (*Orconectes virilis*) has been observed to feed on living watercress darters at Roebuck Spring. However, the recovery criterion of ensuring populations are viable will address this recent threat.

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**.

<u>The criteria for reclassification of the watercress darter from endangered status to threatened are:</u>

1) Long-term protection of the three known naturally occurring populations (i.e., those found in Glenn, Thomas (Watercress Darter National Wildlife Refuge (WDNWR)), and Roebuck Springs, Jefferson County, Alabama.

At the time of the latest revision of the watercress darter recovery plan, the watercress darter was known to naturally occur in only the three spring systems listed above. In 2003, a fourth population was located in Seven Springs. These springs are all within the Valley and Ridge Physiographic Province which are all part of the Black Warrior River system in Jefferson County, Alabama (Boschung and Mayden 2004). Glenn, Thomas, and Seven Springs are tributaries to Valley Creek, a tributary to the Black Warrior River, while Roebuck Springs is a tributary to Village Creek, which joins the Locust Fork River, a tributary to the Black Warrior River. The Locust Fork River and Valley Creek both join the Black Warrior River to the west. Since the species is found in two distinct tributaries to the Black Warrior River, at some point within the species history, watercress darters may have been distributed more widely (Duncan *et al*. in review).

Glenn Spring is a privately owned 2-acre tract of land located in Bessemer, Alabama. It is the type locality for the species. Enhancement of the spring pool by the landowner and the Service in 1970 of a small rock dam decreased the spring run flow and increased the water level and habitat in the spring pool. Since then, little management and protection has occurred for the species at this site, besides the landowners' routine, downed tree removal, mowing and brush control away from the waters' edge. Once considered rural and isolated from the impacts of city-development, Glenn Springs and the recharge area is currently degrading due to impacts from stormwater runoff off 4th Avenue and adjacent housing construction (Drennen pers. ob. May 2009). Widening and maintaining 4th Avenue and the construction of a stormwater system in 2001, within 50 feet of the spring,

altered the course of the spring run and water level in the spring pool (Drennen pers. ob. April 2001). Construction on the hilltop above the springhead continues, in addition to increased road and maintenance activities along the west boundary of the Glenn property. Attempts since 2001 by the Freshwater Land Trust, to purchase the property, although unsuccessful, are ongoing.

Therefore, urbanization and stormwater runoff threaten the springhead, spring run, and recharge area. The criterion for long-term protection of Glenn Springs has not been met.

Thomas Spring in the Watercress Darter National Wildlife Refuge (WDNWR) is also located in Bessemer, Alabama. Total size of the refuge is about 23 acres consisting of two ponds from impounding the spring run, mixed forested buffer, a home site, and yard. Main roads are to the west and south of the spring and private lands are to the east and north. In 1977, the landowner of Thomas Spring (pre WDNWR) introduced grass carp (*Ctenopharyngodon idella*) to the spring to remove aquatic vegetation. This was to the detriment of the watercress darter due to the consumption by the carp of the vegetation needed by the darter. In 1980, after the establishment of the WDNWR, the carp were removed. Currently, the spring pool supports various species of aquatic vegetation, although shading from hardwood trees may be limiting some beneficial aquatic species such as *Nasturtium* sp. and *Fontanali*s sp. (Drennen pers. ob. May 2009). Entrance and usage on WDNWR are regulated and the grounds are protected and monitored. Urbanization, construction, and stormwater runoff, outside of WDNWR, threaten this spring and recharge area. Construction on the west side, just opposite WDNWR, was observed to be producing a large amount of sediment into Hall's Creek and at the same time sediment laden water was noted in the road drainage ditches next to the west boundary of Thomas Spring (WDNWR) and within 20 feet of the spring pool (Drennen pers. ob. May 2006). Increased sediment increases turbidity, which reduces sunlight and concurrently photosynthesis and productivity within the spring pool (Waters 1995). Along with sediment, stormwater runoff may carry pollutants such a hydrocarbons, fertilizers, and pesticides. Non-point source sedimentation and stormwater runoff into the refuge and the spring pools does occur after severe rain events (Drennen pers. ob. May 2009).

Even though the WDNWR and private land to the east are well protected, maintained and monitored; the recharge area, spring head, and spring run are threatened by adjacent urbanization, construction, road maintenance, and stormwater events. Thus, the criterion for long term protection of this site has not been met.

Roebuck Spring is located on the Vacca Campus of the State of Alabama – Department of Youth Services (DYS) and on Hawkins Municipal Park, in Birmingham (Roebuck), Alabama. The spring basin comprises approximately 1.28 acres of impounded waters whose source is the headwaters of Roebuck Springs. The springhead, spring pool, and spring run are within 200 feet east and south of Roebuck Boulevard and Roebuck Parkway. The school facility grounds are to the north with Roebuck Springs Golf Course and Hawkins Municipal Park grounds to the west and east. There are many parking lots

and small driveways and connecting streets within the area. Interstate 59 and Highway 11 are less than 0.25 miles to the south.

In the 1970s, construction of Interstate 59, just south of the spring pool, destroyed two spring heads of the Roebuck Springs system (Drennen 2004). The extent of the negative impacts caused by the destruction to the spring's hydrology is unknown. Additionally, Magic Screwdriver Cave, located in a residential area less than 0.5 miles south of Roebuck Springs, is interconnected hydrologically with the Roebuck Springs system (Hearn 1993). Since 1983, the condition of the groundwater within the cave has appeared to decline as indicated by the increased odor of septic water within the cave (Spencer, Alabama Department of Environmental Management, pers. comm. May 2008).

The DYS staff actively protects the water quality of the Roebuck Spring pool from sedimentation by establishing buffer zones and limiting the use of herbicides and entry into the area. DYS also restricts the entrance to the springhead and spring run by the public and vehicles. Historically, the spring pool has had high levels of *E. coli* bacteria (U.S. Department of the Interior 1979) and polycyclic aromatic hydrocarbons levels were high and suspected to be potentially harmful to the watercress darter (U.S. Fish and Wildlife Service 1991). No follow up testing has occurred and to date it is not known if these pollutants are still a problem. Traffic is dynamic along all roadways mentioned and is conducive to vehicle accidents and toxic spills.

Water level fluctuations at the Hawkins Municipal Park site (tennis courts) have occurred historically due to beaver activity and major rain events, which have resulted in elevated pool levels within the basin. According to Birmingham Park and Recreation officials, in the past, high water events at Roebuck Spring Basin, have flooded nearby tennis courts, and resulted in costly maintenance activities to repair damages (Moss 2008).

In September of 2008, a dam at the base of the Roebuck Spring pool was removed by the City of Birmingham in order to control what they perceived as excessive water levels at the tennis courts. Subsequent to the removal of the dam, the water level within the spring basin dropped approximately 1 meter and about 57% of the aquatic habitat for the watercress darter was drained (Buntin and Johnson 2008, Moss 2008, Duncan *et al*. 2008, Drennen pers. ob. September 24, 2008, Fluker 2009). The remaining water within the spring basin was limited to a small channel flowing through the basin and a small pool area located near the breached section of the dam. The dam's removal resulted in the death of an estimated 11,760 watercress darter individuals (Duncan *et al*. 2008, Moss 2008). Additionally, dead and decaying aquatic vegetation, snails, and crayfish were present along the spring run, among exposed rocks near the springhead and along both shorelines within the spring basin. Ninety-eight live watercress darters were sampled in the reduced spring run (Duncan *et al*. 2008, Moss 2008). Efforts to reduce the damage to the spring pool, spring run, watercress darters and watercress darter habitat began immediately (Drennen pers. ob. September 26, 2008).

Even though Roebuck Spring pool now appears to be stable, concern exists about continued protection of the spring pool from stormwater and other runoff. In addition,

the elimination of an estimated 57% of the watercress darter population within the spring pool and the lack of one-half of the genetic component of the species presents genetic risks and corresponding population problems (Buntin and Johnson 2008, Hallerman 2003). Thus, the criterion for long-term protection of this site has not been met.

Tapawingo Spring, also known as Penny Spring, in Northeast Jefferson County, Pinson, Alabama, is within the range of the watercress darter, but is not a natural historical site for the species. Watercress darters from Roebuck Spring were introduced into three similar springs in an attempt to expand the species' range in 1988 (Howell 1988, U.S. Fish and Wildlife Service 1993).

Tapawingo Spring was the only introduction site of the three where the species thrived. Tapawingo Spring is now owned and managed by the Freshwater Land Trust. The Service assisted the Freshwater Land Trust in the removal of buildings, a concrete swimming pool, and planting vegetation for erosion control within the spring basin.

Even though the springhead and parts of the spring run are protected, they still receive stormwater runoff due to urbanization, and maintenance of gas, water, communication, roadside and bridge maintenance activities. The trailer park to the east, along with possible developments to the north, threatens the long-term health of the spring recharge. Vandalism and the illegal use of all terrain vehicles are common within the spring run as is washing vehicles within the run at the confluence with Turkey Creek, rock removal and dumping (Drennen pers. ob. 2002-2009). The long-term protection is not assured for this area. Although this is not a site for naturally occurring watercress darters, it contains a robust population of the species that were introduced from Roebuck Spring (Howell 1988, U.S. Fish and Wildlife Service 1993). Waifs of watercress darters have been collected in Turkey Creek downstream from the confluence of Tapawingo Springs run with Turkey Creek (Kujahda pers. com. July 2009).

2) Long term protection of at least one additional population within the historical range:

In 2003, **Seven Springs**, a new site for the watercress darter, was discovered on the property of Faith Apostolic Church in Birmingham (Powderly), Alabama. Seven Springs has a spring pool and run and supports a small population of watercress darters. Faith Apostolic Church is located within 100 feet of the spring, Cleburn Avenue is within 20 feet south of the spring, and Arrington Elementary School is located 1000 feet northeast.

The watercress darter has survived even though industry and urbanization have affected much of the original spring recharge geomorphology and vegetation since the mid 1800s (Drennen 2004). A continuous flow of clean spring water that flushes point and non-point pollutants out of the spring pool and run, has apparently attributed to this species' survival in this spring (Gilbert 1994). The spring water also provides a constant cool temperature for watercress darter spawning and aquatic plant growth.

A new development of over 100 high density homes is proposed for construction in 2010 within 100 feet of the spring run (Drennen, 2007-2009 communications with property

owner). Attempts to purchase the property by the Freshwater Land Trust failed in 2006 (B. Rushing pers.com. 2006). Currently, the project is on hold due to economic conditions; however, infrastructure and some roads have been installed (Drennen pers. ob. 2007-2009).

The recharge area of the spring, spring run and spring head are threatened by stormwater discharge and sedimentation from urbanization, construction, and maintenance of roads, road gutters, and pipelines. Currently, there are several other ongoing developments within the same general area. Additionally, the Seven Springs site is a very high traffic area and has potential for catastrophic events such as toxic spills, car accidents, dumping, vandalism or collection. Nearby industry and road maintenance also pose threats.

Many positive initiatives have been made with the landowner of Seven Springs. Faith Apostolic Church has been a viable partner in preservation and conservation of the spring system on their property. In conjunction with the Freshwater Land Trust, Alabama Power, and the Service, protective measures such as implementation of best management practices have been made within the spring system.

However, even though significant gains have been made in the conservation of the Seven Spring site proper, very little can be said for conservation of the recharge area. All are still threatened by point and non-point source runoff, particularly related to urbanization and maintenance activities of roads and ditches and easements. Thus, the criterion for long term protection of this site has not been met.

3) Five years of data indicating that a minimum of four populations are viable.

Population surveys from the Glenn Spring, Thomas Spring, Roebuck Spring and Tapawingo Spring occurred from 1991 to1995. Results were based on different collection techniques and parameters (Moss and Haffner 1991, Moss 1992, Moss 1995), making comparisons difficult to assess and not reflecting adequately the viability of the populations. Presence/absence data has been sporadically taken from 1996 to 2006 (Stiles unpubl. data). Even though watercress darters were found at each site during this 5-year period, no consistent survey or estimate of the minimum viable population size was determined.

At Roebuck Spring, collection information by the State of Alabama after the dam removal in September of 2008, along with estimates of the number of watercress darters killed by the incident, indicates that the darter kill covered a 2,940 square meter section of Roebuck Spring Basin. Three hundred dead watercress darters were counted in a 75 square meter section of Roebuck Spring Basin. This number was extrapolated to obtain an estimate of the total number of darters killed as 11,760 (Moss 2008).

Additionally, the City of Birmingham, in accordance with a Service request, initiated watercress darter surveys in the spring pool and spring run to understand more about the impacts of the tragedy. The spring pool and spring run were noted to have robust watercress darter populations that consisted of numerous juveniles (<25 mm) and sub-

adults and adults (>25 mm). There were no overt health problems. Gravid and apparently reproductively active females were observed. Some females appeared to have recently spawned (Gilbert *in. litt*. 2009). However, information collected between September 22, 2008, and April 22, 2009, indicated a lower catch per unit effort of 10.7 to 90.0 individuals for all size classes. April data did not indicate an increase in small standard length size suggesting that very little spawning had occurred in Roebuck Spring (Bernard Kuhajda, University of Alabama, pers. comm., May 5, 2009)

Since 2006, only cursory capture data to determine presence and absence of watercress darters within the Seven Springs site has occurred (Drennen pers. ob. 2003-2006). However, capture data at Seven Springs in March of 2007 included 385 watercress darters of which about 38% were females, 35% males and 27.5% were juveniles (Duncan *et al*. in review).

Even though populations of watercress darters in Seven Springs and Tapawingo Springs appear to be thriving, there is not enough information to determine the degree of viability of these populations and those in Glenn and Thomas Springs. Along with the death of more than 50% of the viable population in Roebuck Spring pool, the criterion for five years of data indicating that a minimum of four populations are viable, has not been met.

The criteria for delisting the watercress darter from threatened status are:

1) Five years of data documenting the existence of six viable populations, each in separate discrete recharge areas.

2) Long-term protection of the discrete recharge area for each viable population.

The criteria as described above for reclassifying and delisting the watercress darter have not been met. We are continuing to work with partners to implement recovery actions in order to improve the watercress darter's status.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g. increasing, decreasing, and stable), demographic features, or demographic trends:

Kuhajda (2007) collected and released 274 specimens of watercress darters within the five spring systems in the fall of 2007 and found a wide discrepancy of individual population numbers collected, and catch per seining effort, at the different spring sites. The collections ranged from three individuals at Glenn Spring system to 112 specimens at Roebuck Spring. There was also a wide variation in size class numbers. No small size class individuals were collected in Glenn Spring and only one was collected in Thomas Spring (WDNWR). Seven Springs had 15 individuals of the small

size classes. However, Roebuck Spring and Tapawingo Spring sites had the largest number of small size class of individuals of 69 and 56 respectively. Small size classes indicate recruitment and a productive spawning year. Similarly, Fluker *et al* (2008) collected the highest number of smaller size classes and individuals from the Roebuck Spring site (pre-dam removal) and the Tapawingo site.

Kuhajda (2007) collected the fewest watercress darters from Glenn Spring. At the time of collection, the system had been negatively impacted by drought, with reduced flow and limited habitat in the springhead and spring run. However, at the same time, Kuhajda (2007) found individuals within an unnamed tributary to Halls Creek that drains the Glenn Spring run. This may indicate that this tributary is periodically used during low flow and when other conditions favor the watercress darter to temporarily migrate out of the spring run.

Since the removal of the dam at Roebuck Spring (September 2008) and the death of an estimated 11,760 watercress darter individuals (Duncan *et al*. 2008, Moss 2008), there have been significant concerns about the overall impact of this tragedy on the population dynamics of the species (Fluker and Kuhajda 2009, Duncan *et al*. 2008, Moss 2008). April 2009 data did not indicate an increase in small standard length size of watercress darters sampled, suggesting that very little spawning had occurred in Spring (Kuhajda, University of Alabama, pers. comm., May 5, 2009) and indicating a possible decline in population numbers during the non-spawning season. There may also be a significant loss of the new spawning age class in the Spring of 2010.

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

Natural populations of watercress darters from the Thomas Spring (WDNWR) site, within the Valley Creek drainage, and the Roebuck Spring site, within the Village Creek drainage, are divergent from one another specifically at the 11th gene loci and overall differing in allele frequency and composition. Because of this, these two populations are separate and different according to the Hardy-Weinberg equilibrium formula (Mayden *et al*. 2005), suggesting that the two populations are not from the same evolutionary significant unit. Therefore, in planning for future watercress darter population augmentations or introduction programs, stocks of watercress darters from the Valley Creek and Village Creek drainages, should not be mixed (Mayden *et al*. 2005).

The Tapawingo Spring population of watercress darters was derived from the 1988 transplant of specimens from Roebuck Spring. It is likely that these two populations are not genetically or morphologically divergent, although

questions regarding the founder effect are yet to be addressed (Fluker *et al.* 2008).

The loss of approximate one-half of the genetic component, based on the 11,760 watercress darter individuals lost at Roebuck Spring (Fluker and Kuhajda 2009, Duncan *et al*. 2008) may present genetic risks and corresponding population problems (Hallerman 2003) in the spring pool.

c. Taxonomic classification or changes in nomenclature:

Based on microsatellite analysis, Fluker, *et al*. (2008) proposed treating the different populations of watercress darters as three genetically distinct units: 1) Glenn Spring/Thomas Spring (WDNWR); 2) Seven Spring; and 3) Roebuck Spring/Tapawingo Spring. Fluker et al. (2009) also suggests that any future propagation/tranlocation efforts should take into account these units. However, these genetic differences are not thought to be at the level to warrant a change in the species' taxonomic status.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range:

As described in II.B.3, a new site for the watercress darter, Seven Springs, was discovered in 2003. Located on private property owned by Faith Apostolic Church, Seven Springs supports a small watercress darter population. A Memorandum of Understanding was signed in 2005 between Faith Apostolic Church and the Freshwater Land Trust to protect the springhead and spring run (Black Warrior – Cahaba Rivers Land Trust 2005 (now Freshwater Land Trust)). This area is considered as part of the Jefferson County Greenways Project (USInfrastructure 2002) but currently has not been adopted as part of the program. Located next to the church, a major road and elementary school in Birmingham, the spring is threatened by construction of a new high-density housing development (see II 3B1 of this document), stormwater runoff, dumping, pollution, vandalism and sedimentation. No changes in the extent of the watercress darter's range occurrences have occurred besides the discovery of the species at the Seven Springs site in 2003. However, the micro-distribution of the species changed drastically in the Roebuck Spring pool when up to 57% of the habitat was drained (Buntin and Johnson 2008), due to the dam removal, and the species was forced to concentrate in the remaining channels and small pools. By June 2009 (Drennen pers. ob. 2009), the habitats appeared to be rebounding due to the placement of the new water control structure and the increased water level of the pool.

e. Habitat or ecosystem conditions:

The watercress darter lives within the appropriate habitat of approximately 6.2 acres of spring pools and 7900 feet of spring run in the five spring locations (calculated from Maptech 2002). Within Roebuck Spring, the watercress darter occurs in approximately 1.28 acres of spring pool and 3000 feet of spring run; in Tapawingo Spring, the watercress darter occurs in approximately 2 acres of spring pools and 600 feet of spring run; in Glenn Spring, the watercress darter occurs in approximately 0.1 acre of spring pool and 1800 feet of both the spring run and parts of Halls Creek; in Thomas Spring (WDNWR), the watercress darter occurs in approximately 2 acres of spring pools and 1000 feet of spring run; and in Seven Springs, the watercress darter occurs in approximately 0.1 acre of spring pool and 1500 feet of spring run (calculated from Maptech 2002).

However, the habitat and the spring ecosystem conditions of the watercress darter continue to decrease in all five spring sites (see II.B 3-1 of this document), particularly within the recharge areas necessary for the springs' groundwater and outflow (Drennen pers. ob. May 2009). Changes in quality and quantity of groundwater from the recharge area in all the spring sites are associated with the lack of, or poor use of, best management practices for urbanization, stormwater management, and sedimentation on adjoining non-protected lands that drain the immediate recharge areas (see II.B 3-1 of this document).

Immediately after the dam removal at the Roebuck Spring site, the water level within the spring basin dropped approximately 1 meter and up to 57% of the aquatic habitat for the watercress darter was drained (Buntin and Johnson 2008, Moss 2008, Duncan *et al*. 2008, Drennen pers. ob. September 24, 2008, Fluker 2009). The remaining water flow was confined to a small channel flowing through the basin and a small pool area located near the breached section of the dam. Currently, vegetation destroyed by the dam removal in September 2008 appears to be responding to the replacement of the water control structure and increasing water depth. (Drennen pers. ob. March 2009; June 2009).

Duncan *et al*. (2008) noticed increased watercress darter activity in vegetative areas of the Seven Springs spring run where sunlight penetrated and spotlighted areas of the spring run. Increased shading by trees of the spring runs and the spring pool-bank side, and decreased water flow in Thomas Spring (WDNWR) and Seven Spring due to droughts in 2008 and 2007, likely contribute to the loss or reduction of certain aquatic plant species such as watercress (*Nasturtium* sp.) and subsequent decrease in watercress darter activity. Increased shading appears to also be occurring in Glenn Spring and Seven Springs (Drennen pers. ob. May 2008, May 2009).

2. Five-Factor Analysis

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

Protection of the specific habitat attributes associated with these five springs is essential for the recovery of the species. Specifically, maintaining adequate surface and subsurface water quality, water quantity and flow, protection of the habitat substrate and vegetation, along with protection of the immediate recharge areas, are essential for the species to recover. The long-term recovery of the species is founded on conservation of all populations by conserving the springhead, spring run, and recharge areas. Even though the five spring heads and most of the spring runs are protected by the use of best management practices such as vegetative buffer zones; neighboring properties are highly urbanized with little protection of the immediate recharge area of the Valley and Ridge aquifer system upon which all these spring systems depend.

The watercress darter is vulnerable to non-point source pollution, urbanization, and changes in groundwater and surface water flow due to its localized distribution in five spring sites within two stream drainages. Since watercress darters are associated with spring ecosystems, spring water quality, and quantity are essential for producing a flushing and cleansing effect of the spring pools and spring runs. Destruction or alteration of this water would significantly threaten and reduce the species' ecology including spatial and temporal movements. Spring water may be impacted by site specific spring head disturbances rather than overall spring drainage disturbances (Drennen 2004). Within the five watercress darter spring sites, all aquifer recharge areas are vulnerable to contamination from the land surface (Kopaska-Merkel *et al*. 2005). Spigner (1975) suggested that recharge to the Hartselle aquifer was reduced by paving of recharge areas near Irondale in Jefferson County so it is reasonable to believe that the Valley and Ridge aquifer is also impacted by the same process.

Non-point source pollution from land surface runoff can originate from virtually any land use activity and may be correlated with impervious surfaces and storm water runoff. Pollutants may include sediments, fertilizers, herbicides, pesticides, animal wastes, septic tank and gray water leakage, and petroleum products. These pollutants tend to increase concentrations of nutrients and toxins in the water and alter the chemistry of subsurface and surface waters such that the habitat and food sources for species like the watercress darter are negatively impacted. Construction and road maintenance activities associated with urban development typically involve earth-moving activities that increase sediment loads into nearby aquatic systems through storm water runoff during and after precipitation events. Excessive sediment and increased turbidity can make the habitat of watercress darters and associated benthic fish species unsuitable for feeding and reproduction by covering and eliminating available food sources and nest sites. Sediment has been shown to wear away and/or suffocate periphyton

(organisms that live attached to objects underwater and provide likely food items for species such as the watercress darter), disrupt aquatic insect communities, and negatively impact fish growth, physiology, behavior, reproduction and survivability (Waters 1995, Knight and Welch 2001). Sediment is the most abundant pollutant in the Mobile River Basin (Alabama Department of Environmental Management 1996).

The diminutive range of the watercress darter is within the industrial areas of the city of Birmingham. Because of the watercress darter's limited range, the threat from surface and subsurface water quality and quantity degradation is potentially the greatest impact facing the species. Surface water contamination and increased water temperatures may be preventing the species from occupying potential habitats at the spring runs confluences with parts of Village, Turkey, Valley, Nabors, and Hall's creeks.

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

In general, small species of fish such as the watercress darter are not utilized for either sport or bait purposes and are unknown to the public. Therefore, take of these species by the public has not been a problem. Scientific collecting and take by private and institutional collectors are not threats, and scientific collecting is controlled by the State of Alabama through the issuance of collection permits. The potential for the species to be collected by aquarist is possible, especially in the Glenn Spring, Thomas Spring (WDNWR) and Tapawingo Spring areas due to the isolation of the spring sites from the public eye. However, within the Roebuck Spring and Seven Springs sites, human activity within the spring sites is noticeable.

c. Disease or predation:

Predation undoubtedly occurs within all spring sites of the watercress darter. There is no evidence to suggest that disease or natural predators threaten the species in the Seven Springs, Glenn Spring, Tapawingo Spring or Thomas (WDNWR) sites. Stiles (pers. com. September 2007) collected large mouth bass (*Micropterus salmoides*) and sunfish (*Lepomis sp*.) from Thomas Spring (WDNWR). Gut analysis did not show the presence of any fish species.

However, in the Roebuck Spring site, unlike watercress darter mortality, crayfish mortality directly resulting from the dam removal in September 2008 was minimal. Immediately after the dam removal, the remaining wetlands of the Roebuck Spring pool and parts of the spring run, because of the lack of habitat and cover, supported high densities of the exotic Northern Crayfish, *Orconectes virilis* (Duncan *et al*. 2008). Duncan *et al*. (2008) witnessed crayfish attempting predation on watercress darters 10 days after the dam removal. Duncan *et al* (2008) sampled crayfish and watercress darters on September 22, 2008, and found an approximate 1:1 ratio of crayfish to watercress darters. This suggested that the watercress darters might be rapidly

decreasing due to the concentration of both crayfish and watercress darters within the remaining habitat. Carroll *et al*. (2009) believed that the Northern crayfish could exacerbate the recovery of the watercress darter within the spring pool and have a significant impact on the species in the spring run. An effort to remove this crayfish species has been initiated in an effort to reestablish the watercress darter population and restore ecological stability (Carroll *et al*. 2009).

To the extent that disease or predation of watercress darters by crayfish occurs, it becomes a more important consideration as the total population decreases in number.

d. Inadequacy of existing regulatory mechanisms:
The watercress darter and its habitats are afforded some protection from water quality and habitat degradation under the Clean Water Act of 1977 (33 U.S.C. 1251 et seq.) and the Alabama Water Pollution Control Act, as amended, 1975 (Code of Alabama, §§ 22-22-1 to 22-22-14). Because of inconsistency in implementation of Clean Water Act regulations and other best management practices, which are voluntary for some activities and mandatory for others, existing regulatory mechanisms in Alabama are still inadequate. If enforced and followed, these regulations would help reduce sediment loading in springs, streams and other aquatic habitats.

The watercress darter is also protected by the State of Alabama (220-2-.92). They are protected against take, capture, and possession unless a party has an appropriate scientific collection permit or written permit from the State.

There are currently no requirements within the scope of other environmental laws within Alabama to specifically consider the watercress darter or ensure that a project will not jeopardize its continued existence. The effectiveness of existing environmental laws and regulations protecting fish species in headwater streams, springs and seepages is not known because of inconsistencies in enforcement.

e. Other natural or manmade factors affecting its continued existence:
The species is vulnerable to catastrophic events such as chemical spills or modification of the spring basin due to the accessibility of the spring sites.

The loss of approximately one-half of the genetic component, based on the 11,760 watercress darter individuals lost at Roebuck Spring (Fluker and Kuhajda 2009, Duncan *et al*. 2008) may present genetic risks and corresponding population problems (Hallerman 2003) in the spring pool.

Genetic diversity of the watercress darter populations has likely declined due to isolation over time of the populations in the Valley and Village Creek drainages within the Black Warrior River system. The long-term viability of a

species is founded on conservation of numerous local populations throughout its geographic range (Harris 1984). The populations from the two stream drainages (Valley and Village Creeks) are genetically distinct and individuals from the two drainages (or any of the spring sites) should not be mixed when considering future watercress darter population enhancement efforts (Mayden *et al*. 2005, Fluker *et al*. 2008).

D. Synthesis

Since the listing of the species in 1970, there has been progress made in recovery efforts for the watercress darter. Improvements included the formation of the Watercress Darter National Wildlife Refuge (1980), the establishment of an additional watercress darter population at Tapawingo Spring (1988), and the discovery of a new population of watercress darters at Seven Springs (2003). However, the removal of the dam at Roebuck Spring in September of 2008, destroyed about 57% of the watercress darter population at this site, increased mortality of the species by predation, reduced reproduction potential for the Spring of 2009, and in general reduced the long-term viability of this genetically unique population. The Roebuck Spring population was the most robust population of the five spring sites. When considered in conjunction with the continued deterioration of water quality, both surface and subsurface waters, the watercress darters limited distributions and small populations render the species vulnerable to random natural or human induced events such as droughts, spills and especially spring basin modifications. Therefore, the watercress darter continues to meet the definition of an endangered species under the Act.

III. RESULTS

A. Recommended Classification:

No change is needed.

B. New Recovery Priority Number- 2

Recovery Priority Number changed from 8 to 2 to reflect “high” degree of threat, as opposed to “Moderate” degree of threat**.** A high degree of threat is appropriate in light of recent detrimental actions taken at the previously most robust population and ongoing uncertainty of obtaining long-term protection for the entire spring systems, specifically the recharge areas.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Continue implementing recovery actions from the Watercress Darter Recovery Plan (U.S. Fish and Wildlife Service 1993).

- Incorporate additional recovery actions prepared and discussed in 2006 by stakeholders (Drennen, memo 2006) into the recovery actions detailed by the Watercress Darter Recovery Plan.

- Continue working with all stakeholders including government entities, landowners, non-governmental organizations, and the City of Pinson and Bessemer in protecting all of the spring sites, in particular with regard to storm water runoff and non-point source pollution.

- Continue efforts with the DYS and the City of Birmingham to manage the Roebuck Spring system including the spring pool and run.

- Continue working with Faith Apostolic Church in managing and protecting Seven Springs.

- Continue to support and assist the Watercress Darter National Wildlife Refuge (Thomas Springs) in management of this system.

- Continue contact and offering technical advice to the new landowner of Glenn Spring.

- Continue to work with the Freshwater Land Trust in conservation and management of the Tapawingo Spring system.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of
WATERCRESS DARTER

Current Classification: Endangered
Recommendation resulting from the 5-Year Review

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist**
_X_ **No change is needed**

Review Conducted By: Daniel Drennen

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 8-26-09

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

for Approve _____ Date 8/28/09

Appendix A: Summary of peer review for the 5-year review of watercress darter (*Etheostoma nuchale*)

A. Peer Review Method:

In conducting this 5-year review, we have relied on available information pertaining to historic and current distributions, life histories, and habitats of the watercress darter. We specifically solicited information from knowledgeable individuals, agencies, academia, and conservation organizations. We sent the 5-year review notice via email to 21 different state and Federal agencies, individuals in academia and non-government conservation organizations.

B. Peer Review Charge:

Copy of the cover letter:

"Colleagues,

On June 14, 2005, 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 the watercress darter. The purpose of the 5-year review is to summarize new information for the species, ensure that the classification of species as threatened or endangered is accurate and reflects the best available information, and to identify actions required to conserve the species.

You have been identified as knowledgeable about the watercress darter. 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. The format is standardized, and we are seeking comments on the accuracy of the data used, identification of any additional new information that has not been considered in this review. Also note that this review will not be published, but will become a part of the watercress darter administrative record.

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, 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 or if you need copies of the references cited (601-321-1127). Also feel free to respond by email (daniel_drennen@fws.gov) or letter, whichever is most convenient. Thank you for your assistance."

C. Summary of Peer Review Comments/Report –

Scientific Peer Reviewers
Bernard Kuhajda
Collections Manager
Department of Biological Sciences

Box 870345
University of Alabama
Tuscaloosa, AL 35487-0345

Dr. Robert Stiles
Samford University (retired)
2221 Great Rock Road
Vestavia Hills, Alabama 35216

Comments received were generally editorial in nature.

D. Response to Peer Review
Editorial comments were evaluated and incorporated as appropriate.