Snail Darter
(*Percina tanasi*)

Five-Year Review:
Summary and Evaluation

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

March 2013

FIVE-YEAR REVIEW

Snail Darter (*Percina tanasi*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: In conducting this 5-year review, we relied on the best available scientific information pertaining to historic and current distribution, life history, and habitat of this species. Our sources include the final rule listing the species under the Endangered Species Act (Act); the Recovery Plan; peer reviewed scientific publications; unpublished field observations by the U.S. Fish and Wildlife Service (Service), Tennessee Valley Authority (TVA) and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. A *Federal Register* (FR) notice announcing the review and requesting information was published on July 28, 2006 (71 FR 42871-42872). No comments were received during the 60-day public comment period. No part of this review was contracted to an outside party. This review was completed by the Services' Lead Recovery Biologist in the Tennessee Ecological Services Field Office, Cookeville, Tennessee. See Appendix A for a summary of peer review.

B. Reviewers

Lead Region – Southeast Region: Nikki Lamp, 404/679-7118

Lead Field Office – Cookeville, TN, Ecological Services: Todd Shaw, 931/525-4985

C. Background

1. FR Notice citation announcing initiation of this review: July 28, 2006: 71 FR 42871-42872

2. Species status: Stable

3. Recovery achieved: 1 (1 = 0-25%)

4. Listing history:
Original Listing
FR Notice: October 9, 1975; 40(197):47505-47506
Date Listed: November 10, 1975
Entity Listed: Species
Classification: Endangered

5. Associated Rulemakings
On July 5, 1984, a final rule (49 FR 27510-27514) was published reclassifying the snail darter from endangered to threatened. That rule also rescinded the designated critical habitat in the Little Tennessee River, Loudon County, Tennessee.

6. Review history
Recovery Data Call: 2000-2012, 1998, 1996, 1994, 1992, and 1990

Final Recovery Plan: May 5, 1983

7. Species' recovery priority number at start of review (48 FR 43098):
11 (moderate degree of threat and low recovery potential); threats persist (development, water quality degradation, etc.) reducing the likelihood of recovery.

8. Recovery plan or outline
Name of Plan: Snail Darter Recovery Plan
Date Issued: May 5, 1983
Dates of Previous Revisions: April 4, 1979; December 5, 1979; December 17, 1982

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. The most current version of the recovery plan (Service 1983) pre-dates downlisting of the species to threatened status, which occurred on July 5, 1984 (49 FR 27510-27514). Criteria included in the recovery plan are those needed for delisting. No criteria for downlisting are included in the recovery plan, as the Snail Darter Recovery Team believed the species could be reclassified to threatened status at the time the plan was written.

2. Adequacy of recovery criteria.

Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No. The recovery plan and criteria do not consider the existence and dynamics of the population inhabiting the French Broad and Holston rivers, considered one of the largest extant populations. This population, discovered in the Little River in 1983, and French Broad River in 1988, is believed to have resulted from TVA's 1978-1979 transplant into the Holston River (Scott 2006).

Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threats)? No. Threats to the Holston, French Broad, Little River, and Fort Loudoun Reservoir populations, not discussed in the snail darter recovery plan, include operations at Douglas and Cherokee dams (TVA 2003; TVA 2005).

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. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

The species shall be considered recovered when one of the alternatives (A, B, or C) listed below is met and no present or foreseeable threats exist which could cause the species to become in danger of extinction throughout a significant portion of its range.

Alternative A: Suitable habitat areas of the Tennessee River within the area from the backwaters of Wheeler Reservoir upstream to the headwaters of Watts Bar Reservoir are inhabited by snail darter populations which can survive and reproduce independently of tributary rivers as evidenced by documented reproduction in Watts Bar Reservoir or some other Tennessee River reservoir.

After the species was listed in 1975, individuals were observed or collected in the mainstem Tennessee River, including in Watts Bar Reservoir (Loudon County, Tennessee), Chickamauga Reservoir (Hamilton, Meigs, and Rhea counties, Tennessee), Nickajack Reservoir (Hamilton County, Tennessee), and Guntersville Reservoir (Marion County, Tennessee); all snail darters collected from these reservoirs were found in areas that exhibited flow (to date, no surveys have been conducted in areas of Tennessee River reservoirs lacking flow). These discoveries along with discoveries of additional populations in four Tennessee River tributaries and successful establishment of snail darters in the Hiwassee River resulted

in reclassification of the species to threatened status and removal of the critical habitat designation (Service 1984). The critical habitat designation was removed because the area was flooded by the Tellico Reservoir and no longer provided suitable habitat for snail darters. The Service also determined that designation of additional critical habitat was not prudent due to increased vulnerability to illegal take resulting from the notoriety of the species.

Between 1973 and 1982, snail darters were collected on several occasions by SCUBA divers and small otter trawls at six localities in the mainstem of the Tennessee River between the upstream reaches of Wheeler Reservoir upstream into Watts Bar Reservoir. Collections and observations of the species have been primarily from Guntersville Reservoir, in the vicinity of the confluence of the Tennessee River and Sequatchie River, and from the headwaters of Watts Bar Reservoir. However, the viability of the species in those areas has not been assessed to date, as the reservoirs in the mainstem Tennessee River have not been well surveyed for small, benthic, non-game fishes. Therefore, whether this criterion has been met has not been documented. The operation of several of TVA's dams (Douglas, Cherokee, Fort Loudoun, Watts Bar, Chickamauga, Nickajack, and Guntersville) potentially threaten the ability of snail darters to exist in mainstem reservoirs, although the operation guidelines that resulted from TVA's 2005 Reservoir Operations Study likely resulted in improved aquatic habitat and water quality. Whether or not snail darter populations would be isolated genetically by the existence of the dams is unknown.

Regardless of the current distribution and viability of the snail darter, threats to its recovery and existence remain throughout its range. These threats are discussed in more detail below under the five factor analysis (refer to C. Updated Information and Current Species Status, 2. Five factor analysis).

Alternative B: More Tennessee River tributary populations of the species are discovered and existing populations are not lost. The number of additional populations needed to meet this criteria would vary depending on the status of the new populations, but two populations similar to the Sewee Creek, South Chickamauga Creek, or Sequatchie River populations or one comparable to the Hiwassee River population would denote recovery.

Snail darters were transplanted from the Little Tennessee River into the Hiwassee River (1975-1976), Holston River (1978-1979), Nolichucky River (1975), and Elk River (1980) (Service 1983). The species was reclassified from endangered to threatened status after the Hiwassee River transplants succeeded and additional populations were discovered in the Tennessee River and in four tributaries to the Tennessee River, including

Sewee Creek, Meigs County, Tennessee; South Chickamauga Creek, Hamilton County, Tennessee, and Catoosa County, Georgia; Sequatchie River, Marion County, Tennessee; and Paint Rock River, Jackson and Madison Counties, Alabama (Service 1983).

When the species was reclassified in 1984, the success of the Holston River transplant was unclear. Although individuals have been periodically observed or collected at various localities on the Holston River (Table 1), it is likely that cool water releases from Cherokee Dam do not provide favorable conditions for an expanding snail darter population there (TVA 2003). However, snail darters observed in the Little River and in the French Broad River, beginning in 1983 and1993, respectively, are likely offspring from the Holston River transplants (Etnier and Starnes 1993; Scott 2006; refer to Table 1). In both rivers, snail darters have been observed at multiple locations (Tennessee Department of Environment and Conservation [TDEC] 2012; TVA 2012). Scott (2006) believes that snail darter larvae could drift from the French Broad River to the mouth of the Little River in less than three days.

The status of existing tributary populations was most recently assessed by Ashton and Layzer (2007), and no new snail darter populations were discovered in Tennessee River tributary streams or rivers. TVA (2008) observed one snail darter in Citico Creek in 2007. Citico Creek is not a direct tributary to the Tennessee River, but rather a tributary to the Little Tennessee River in Monroe County, Tennessee. The Little Tennessee River was impounded by Tellico Dam and is the system where the snail darter was first discovered in 1973. This origin of the individual discovered in Citico Creek in 2007 remains unclear. This discovery could suggest the possibility of an unknown, but extant, snail darter population. However, the fish may have also been a stray from a surviving population in the Tellico Reservoir impoundment of the Little Tennessee River, or possibly a result of larval drift from the Holston, French Broad, or Little (Fort Loudoun Reservoir) river population(s) (Table 1). Because no evident new populations of snail darters have been discovered in Tennessee River tributaries, this criterion has not been met.

<u>Alternative C</u>: Through maintenance of existing populations and/or by expansion of these populations, there exist viable populations of snail darters in five separate streams such as Sewee Creek, Hiwassee River, South Chickamauga Creek, Sequatchie River, and Paint Rock River.*

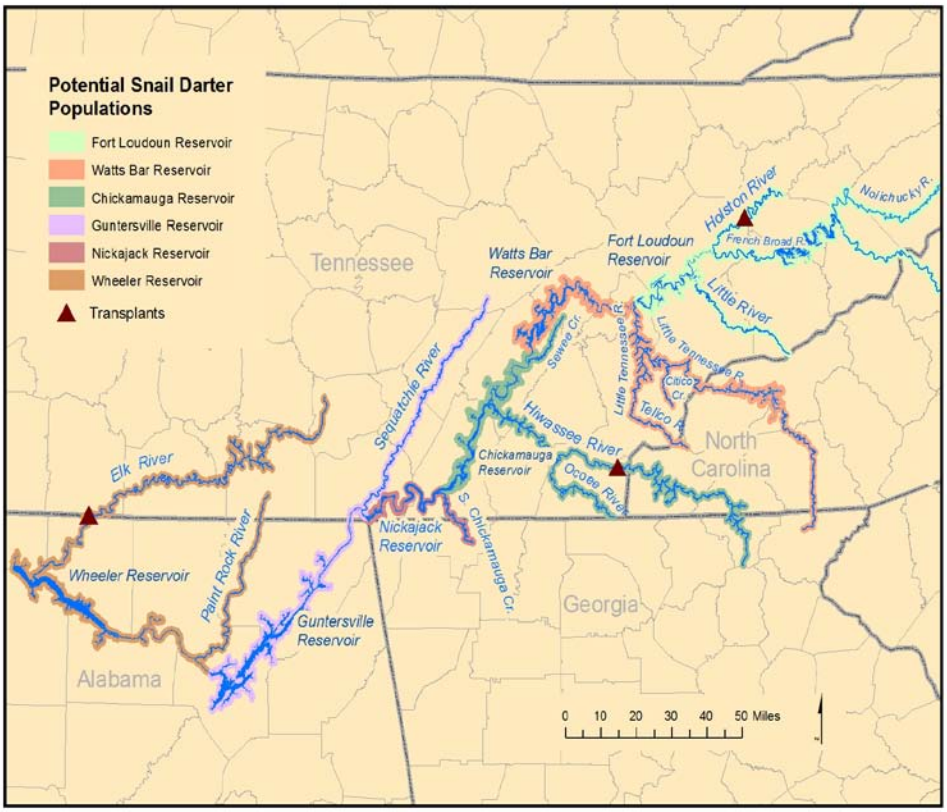
**Viable populations – Population monitoring over a ten-year period (biannual sampling) indicates that a snail darter is reproducing (at least two year classes present each year sampled) and that the population is either stable or expanding. For some populations, existing data may be used to meet this requirement.*

Snail darters have been periodically observed in ten tributaries entering the upper reaches of the Tennessee River, including the Holston River, French Broad River, Little River, Citico Creek, Hiwassee River, Ocoee River, Sewee Creek, South Chickamauga Creek, Sequatchie River, and Paint Rock River (refer to Table 1 and Figure 1 below) (Ashton and Layzer

Table 1. Record of known snail darter observations through 2011. Data sources include Geological Survey of Alabama (GSA) 2010; TDEC 2012; TVA 2008; TVA 2012.

Locality	Distribution	Frequency of Observation
Holston River (Knox County, Tennessee)	three localities over 9.4 river miles	1978/79 (533 transplanted); observed: 1980, 1981, 1989, 1991, 2000, 2003, 2004, 2005, 2007
French Broad River (Knox and Sevier counties, Tennessee)	four localities over 21.8 river miles	Observed in annual surveys: 1997-2007
Little River (Blount County, Tennessee)	five localities over 22 river miles	1983, 1987, 2000, 2001, 2005
Watts Bar Reservoir (Loudon and Knox counties, Tennessee)	three localities over 9.3 river miles	1976, 1980, 1982
Citico Creek (Monroe County, Tennessee)	one locality, 2.3 stream miles above impoundment at Tellico Reservoir	2007
Chickamauga Reservoir (Hamilton, Meigs and Rhea counties, Tennessee)	one locality	1976
Big Sewee Creek (Meigs County, Tennessee)	three localities over 2 stream miles	1981, 2005
Hiwassee River (Polk County, Tennessee, and very likely, Bradley and McMinn counties, Tennessee)	nine localities over 16 river miles	1975/76 (710 transplanted); observed: 1976, 1980, 1981, 1991, 1992, 1993, 1994, 1995, 2001, 2002, 2003, 2004, 2005, 2006, 2007
Ocoee River (Polk County, Tennessee)	two localities, 5.8 and 2.5 river miles above mouth	1993, 2011
Nickajack Reservoir (Hamilton County, Tennessee)	one locality	1981
South Chickamauga Creek (Hamilton County, Tennessee, and Catoosa County, Georgia)	seven localities over 14.3 stream miles	1980, 1982, 1983, 1995, 2005
Guntersville Reservoir (Hamilton County, Tennessee)	one locality	1981
Sequatchie River (Marion County, Tennessee)	five localities over 10 river miles	1981, 1988, 1989, 1990, 1996
Paint Rock River (Jackson, Madison and Marshall counties, Alabama)	five localities over 11.1 river miles	1981, 1983, 2002, 2007, 2010

Figure 1. Potential snail darter populations (currently known distributions of these populations have been included in Table 1 above).



2007; TVA 2008). The largest extant populations of snail darters occur in the French Broad and Hiwassee rivers. Consistent presence of the species in surveys, presence of more than one age class (3 or 4), and presence of young-of-year (YOY) individuals indicate that the French Broad River population is viable.

Hatching snail darters swim up into the current, and as a result the larvae drift downstream (Scott 2006). Scott (2006) estimated that larvae could be transported by current for 15-20 days after hatching (based on Starnes' [1977] description of laboratory behavior of captively-reared snail darter eggs), which could transport larvae many miles downstream of spawning sites (depending upon dam releases and current velocity). When their yolk-sac has been absorbed, the larvae likely settle to the stream bottom to grow into benthic juvenile and adult snail darters.

The species is apparently somewhat tolerant of reservoir conditions, as indicated by its current distribution (refer to Table 1). Scott (2006) speculated that larval drift results in juvenile snail darters drifting downstream into reservoirs and that these individuals become attracted to current as they mature and begin an upstream migration; they eventually

reach upstream spawning areas in the streams where they originated, or potentially other streams where current, habitat conditions and water quality are appropriate. Newly hatched snail darter larvae drift with river currents considerable distances downstream to pool habitats, which serve as nursery areas (Service 1983; Etnier and Starnes 1993).

Given this life history strategy, it is possible that populations of snail darters persist in relatively riverine areas of mainstem reservoirs and larger mainstem tributaries with juveniles potentially dispersing from these populations to occupy and breed in tributary reaches. TVA Index of Biological Integrity (IBI) surveys have demonstrated that individuals are frequently observed in tributaries, although not on a consistent basis (TVA 2008). In this scenario, individuals in the French Broad, Holston and Little rivers, and Fort Loudoun Reservoir may represent the most upstream migrants in this population; Watts Bar Reservoir, Tellico Reservoir, and Citico Creek represent the next downstream population; Chickamauga Reservoir, Sewee Creek, and the Hiwassee and Ocoee rivers represent the next downstream population; Nickajack Reservoir and South Chickamauga Creek represent the next downstream population; individuals in Guntersville Reservoir and the Sequatchie River represent the next most downstream population; and individuals in the Paint Rock River and upper portion of Wheeler Reservoir represent the most downstream population (refer to Table 1 and Figure 1). This hypothesis has not been confirmed, but the persistence of snail darter observations in tributaries, lack of consistently robust numbers of individuals observed and a reproductive strategy that includes larval drift, lends support to this hypothesis.

The number of snail darters collected or observed in the Little and Sequatchie rivers, and Sewee and South Chickamauga creeks have always been few. Collection or observation of YOY, indicating successful recruitment, has been documented in Sewee and South Chickamauga creeks. However, comprehensive sampling has not taken place to document YOY snail darter presence in the other streams. Distribution in the Sequatchie River and Sewee and South Chickamauga creeks appears highly variable. Only a few snail darters have ever been collected from the Little and Ocoee rivers, but the species has been observed relatively regularly by TVA in the Paint Rock River (Ashton and Layzer 2007). One individual was observed in Citico Creek in 2007 (TVA 2008).

Snail darters present in the French Broad River, Holston River and Little River probably represent one population, which is likely the most stable population (TVA 2008). Surveys conducted in 2005 found that the French Broad River had far higher numbers of snail darters (113 collected by electrofishing, 210 observed via snorkeling) than all other occurrence areas. The Hiwassee River was a distant second (24 collected by electrofishing and 18 observed via snorkeling) (Ashton and Layzer 2007). Snorkel surveys conducted in 2006 found a total of 125 adult and 359 YOY within

85 transects on the French Broad River and a total of 231 adult and 38 YOY snail darters within 76 transects on the Hiwassee River (Ashton and Layzer 2007). Therefore, since only two viable populations are currently known to exist, this criterion has only been partially met.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

A 2005 study (Ashton and Layzer 2007) to determine the status of all known snail darter populations found snail darters continuing to occupy seven of nine tributaries of the upper Tennessee River in Alabama, Georgia and Tennessee, where snail darters were previously collected. The nine tributaries in the study area included the French Broad River, Hiwassee River, Holston River, Little River, Ocoee River, Paint Rock River, Sequatchie River, Big Sewee Creek and South Chickamauga Creek. The two tributaries where snail darters were not collected during the 2005 study included the Paint Rock River and Ocoee River.

However, recent surveys (GSA 2010; TDEC 2012; TVA 2012) indicate the species still occurs, at least periodically, in both of these streams. In 2010, 20 snail darters were collected from the Paint Rock River in Jackson County, Alabama, (GSA 2010). Nine snail darters were observed in the lower Ocoee River in 2011 (TDEC 2012; TVA 2012). This discovery may be an indication that snail darters occur in higher numbers in the Ocoee River than had been previously assumed, or the species may be colonizing the system due to the water quality improvements in the upper watershed. Based on the species composition and diversity of the fish community in the Ocoee River, gleaned from TVA's ongoing IBI surveys, it appears that the Ocoee River aquatic community is recovering from upstream siltation caused by reclamation activities and industrial pollutants related to copper mining in the Ocoee River headwaters. A more concerted effort, directed solely at locating snail darters in the Ocoee River, would be needed to confirm or refute their persistence and geographic range in the drainage.

During a 2007 fish survey in Citico Creek, a tributary to the Little Tennessee River, biologists from the TVA and Tennessee Technological University collected one snail darter (TVA 2008).

This is the first known occurrence of the species in the Little Tennessee River drainage since the late 1970s.

Ashton and Layzer (2007) indicated that the most robust populations of the snail darter exist in the French Broad River and Hiwassee River. In the French Broad River, five age classes (I – IV and YOY) of snail darters were present. The abundance of the species in the French Broad River has substantially increased since its discovery (from five individuals collected in 1988 to a total of 484 individuals collected in 2006). The Hiwassee River was the only other tributary where more than two age classes of snail darters were collected in the 2005-2006 surveys. The authors concluded that reproducing populations of the species exist in both of those rivers.

Additional evidence of multiple age-classes persisting in the French Broad River were provided by Scott (2006), who reported the lengths of 42 snail darters collected during 1997 in the vicinity of Campbell Island. Fifteen YOY darters (hatched in early 1997) ranged in total length from 36 to 43 mm (1.4 to 1.7 inches); fourteen Age I fish (hatched in 1996) ranged in total length from approximately 67 to 75 mm (2.6 to 3.0 inches); nine Age II fish ranged from 76 to 83 mm (3.0 to 3.3 inches); individual fish which ranged in length from 84 to 90 mm (3.3 to 3.5 inches) were likely in their fourth year of life.

Five or fewer snail darters were observed or collected from each of the remaining streams (Holston River, Little River, Sequatchie River, Big Sewee Creek and South Chickamauga Creek) where the species was found during the 2005 study. All individuals collected in these streams included older individuals in two age classes. It has not been determined if these systems support reproducing populations (Ashton and Layzer 2007).

The 2005 study found snail darter distributions had changed in nine tributary streams in comparison to the distributions previously reported by various surveyors. Table 2 below illustrates the distributional changes and current status of populations noted by Ashton and Layzer (2007) in their 2005 study.

Table 2. Stream reaches where Ashton and Layzer (2007) surveyed for and found snail darters, and stream reaches where other surveyors have reported presence of snail darters (Eager 1982; Service 1983; Scott et al. 1996; Scott 2006; TVA Natural Heritage Database 2006; A.K. Wales, pers. comm. 2007).

Stream	River Miles (RM) Sampled (2005)	River Miles (RM) Occupied (2005)	River Miles (RM) Known Occurrences Based on Previous Sampling
French Broad River	8 – 29.8	8 – 15.2	8 – 29.8
Hiwassee River	33 – 45.2	33 – 44.4	29 – 38
Holston River	5 – 25.5	5 – 14.6	5 – 14.4
Little River	8.4 – 21.9	9 – 20.5	8 – 20.2
Ocoee River	2.9 – 5.9	*	5.9
Paint Rock River	15.9 – 25	*	15.9 – 24.6
Sequatchie River	8 – 17	17	7.1 – 17
Big Sewee Creek	3.5 – 5.7	4.2	3.2 – 5.7
South Chickamauga Creek	8.2 – 19.3	13.2 – 16	5.9 – 19.3

*Snail darters were not observed by Ashton and Layzer (2007) in the Ocoee and Paint Rock rivers during their 2005 study. However, snail darters were collected in the Ocoee River in 2011 (TDEC 2012; TVA 2012) and in the Paint Rock River in 2010 (GSA 2010).

Snail darters were transplanted into the Hiwassee River, Holston River, Nolichucky River and Elk River from the mid-1970s to 1980. The species has been collected from the Hiwassee River and the Holston River since those transplants occurred. Snail darters have not been found in the Nolichucky River or Elk River post-transplant.

It is widely accepted that the French Broad River snail darter population, first discovered in 1988, originated from larval drift of spawning snail darters in the Holston River following the 1978-79 transplants into the Holston River. Snail darter larvae would have drifted at least 14.7 miles down the Holston River and into the backwaters of Fort Loudoun Reservoir in order to reach the mouth of the French Broad (assuming they were spawned at the Monday Island transplant site in the Holston River). Also, snail darters found at various localities in the Little River (TDEC 2012; TVA 2012) are thought to have originated in either the lower French Broad River or Holston River, which would have required larvae to drift a distance of approximately 24 to 31.7 miles (Scott 2006). While snail darters have been observed in the Holston River, they do not appear to persist there, which may be due to cold water releases from Cherokee Dam creating less favorable conditions to sustain the species in the Holston River than in the warmer French Broad River.

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

To date, no studies have been conducted on snail darter populations to determine the level of gene flow among various populations or the amount of potential inbreeding within populations. Because snail darter records indicate that most individuals collected from Tennessee River tributaries tend to occur near their confluences with the mainstem Tennessee River, it is possible that these individuals represent the upstream extent of mainstem Tennessee River population(s), rather than distinct tributary-specific populations. An investigation of genetic structure could be useful in determining (1) whether fishes found in tributaries likely originated from mainstem populations or possess distinct genetic characteristics, and (2) whether reservoirs on the Tennessee River fragment the mainstem population into separate populations and thereby disrupt gene flow.

c. Taxonomic classification or changes in nomenclature:

There have been no changes to the species' taxonomic classification or nomenclature since its original listing in 1975.

d. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range):

With the exception of Citico Creek, no new occurrences of the snail darter have been discovered since the recovery plan was written. The discovery of one individual in Citico Creek in 2007 is significant because Citico Creek is a tributary to the Little Tennessee River, where the species was first discovered, and which was later impounded by Tellico Dam. Its presence could signify that a Little Tennessee River population has persisted in that watershed following construction and operation of Tellico Dam and Tellico Reservoir. Another possible explanation for the darter's presence in Citico Creek is the existence of a channel around Fort Loudoun Dam and Lock on the mainstem Tennessee River, which could allow snail darters to pass from Watts Bar Reservoir (where they have been collected in the past) downstream into Tellico Reservoir and traverse the reservoir to access Citico Creek (refer to map on page 10).

All other snail darter collections have occurred within stream reaches previously identified in the recovery plan. Thus, other than the Citico Creek discovery, the known distribution of the species within

its historic range (as indicated in the recovery plan) remains unchanged.

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Snail darters are currently known to occur, at least periodically in the lower reaches of ten tributaries and the riverine portions of five mainstem reservoirs over approximately 400 miles of the impounded upper Tennessee River.

It is known that the snail darter inhabits larger creeks, where it frequents sand and gravel shoals, and deeper portions of rivers and reservoirs where current is present (Etnier and Starnes 1993). What is not known is to what extent snail darters might utilize impounded areas in mainstem Tennessee River reservoirs. The last survey conducted for snail darters on the mainstem was in 1984. At the time the recovery plan was finalized (1983), it was thought that the species did not occupy impounded mainstem reaches. Additional surveys would be required to determine if snail darters occupy impounded mainstem reaches.

Some tributaries downstream of robust tributary populations (e.g., Little River downstream of the French Broad River) may have become populated as a result of larval drift and subsequent upstream dispersal of juveniles and adults from those larger, potential source populations with the mainstem serving as the conduit to transport larvae between the two tributaries. Also, because individuals in mainstem tributaries typically occur near their confluences with the mainstem Tennessee River, it is possible that snail darters in the lower reaches of mainstem tributaries may actually be Tennessee River populations that have migrated into those areas. The greatest concentrations of snail darters in Tennessee River tributaries are found within flowing river segments, upstream of impoundments; snail darters appear to prefer the farthest downstream shoals with suitable habitat, not far upstream of impoundments (Scott 2006).

Scott (2006) monitored snail darters in the French Broad River below Douglas Dam to assess whether construction and operation of new hydropower units at that dam affected the species or its habitat. He characterized elements of the species' habitat and ecological associations as part of the monitoring effort. He reported higher numbers of snail darters in areas containing gravel/rubble run and riffle habitat; numbers were lower in areas with dense aquatic vegetation.

Biological surveys of riverine habitats in the mainstem Tennessee River reservoirs are warranted to determine snail darter utilization of impounded habitat and to assess the current status of the few populations encountered in the late 1970s and early 1980s. In addition, genetics studies would provide valuable information regarding the origin (i.e., potential interactions between mainstem and tributary populations) of individuals collected.

In 1991, the TVA began implementing its Reservoir Release Improvement Program (RRIP). This program was designed to improve habitat conditions below TVA's dams by providing minimum flows and oxygenating releases from dams where flow and/or low dissolved oxygen were determined to be negatively impacting the aquatic habitat. Subsequent sampling by TVA biologists has revealed that the RRIP has enhanced habitat conditions and aquatic communities in tributary tailwater reaches. The snail darter has likely benefitted from the RRIP in the French Broad, Holston, Hiwassee and Ocoee rivers due to the presence of dams and diversion flumes upstream of snail darter populations. In addition, snail darters in mainstem reservoir areas benefitted from implementation of TVA's 2005 Reservoir Operations System.

2. Five factor analysis (threats, conservation measures, and regulatory mechanisms)

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

Poor habitat and water quality likely limit the abundance and distribution of snail darters in certain drainages. Many sites sampled for snail darters by Ashton and Layzer (2007) had limited riparian vegetation and aquatic macrophytes or silt covering the substrate and were unoccupied by snail darters.

Operation of towboats on the mainstem Tennessee River likely affects the snail darter. Towboats, positioning barges at off-loading docks and traversing the historic river channel, contribute to streambank erosion and increase turbidity in the water column and sediment deposition on substrate. These disturbances may compel snail darters to relocate to less suitable habitat or restrict the respiration of larvae or juveniles in the near vicinity.

The reach of the Holston River where snail darters have been observed and the related French Broad population are affected by cool water releases from Cherokee Dam as a result of thermal shock to snail darters during their spawning season. Hydro-peaking

releases from both Cherokee and Douglas dams also make it difficult for snail darters to maintain their positions in the river due to rapidly fluctuating water levels, and they are carried downstream. Although much of the French Broad River in Tennessee flows through agricultural (cropland or pasture) lands, the lower reaches of the river flow through urban areas in the vicinities of Sevierville, Tennessee and Knoxville, Tennessee. Lands adjacent to the river are undergoing, or will likely undergo, development for single-family residences, subdivisions, golf courses, and other commercial facilities. Runoff associated with such development could adversely affect the snail darter and its habitat. Ashton and Layzer (2007) found little silt and abundant macrophyte-free gravel substrate at sites where the greatest numbers of snail darters were collected in the French Broad River. Cold water releases from the Appalachian Powerhouse also negatively affect the transplanted snail darter population on the Hiwassee River (TVA 2005).

Ashton and Layzer (2007) found that most of the Little River was affected by siltation and lacked a contiguous riparian buffer. They noted that sites where snail darters did occur on the Little River had few macrophytes, little silt and a predominantly intact riparian zone.

The lower 17 miles of South Chickamauga Creek (i.e., the entire reach in Tennessee) flows through the City of Chattanooga. Development and associated runoff continue to affect stream water quality, riparian and instream habitat, and the snail darter. Municipal and industrial discharges into the stream may also be affecting stream water quality, and the snail darter and its habitat. Ashton and Layzer (2007) indicated that much of South Chickamauga Creek was heavily silted and lacked a riparian zone at the time of their snail darter survey; all snail darters the authors collected occurred within a 2.8-mile reach, containing little silt and a well-established riparian zone.

The Sequatchie River primarily flows through rural lands. Agricultural activities may be affecting the snail darter and its habitat as a result of sedimentation, runoff containing pesticides and fertilizers, and livestock impacting the river. Coal mining in the drainage has also impacted the river and will likely continue to have negative effects on aquatic habitats and species that utilize them (Ashton and Layzer 2007).

The snail darter population in the Holston River is likely being affected by development activities along the river in the vicinity of Knoxville. Also, potential upstream expansion of the population is likely inhibited by cold water releases from Cherokee Dam.

The snail darter population in Sewee Creek has been affected primarily by sedimentation and runoff associated with agricultural activities. Effects of those activities are likely to continue.

The Hiwassee River population is the result of the 1975-1976 transplant effort and is apparently reproducing and stable. Despite some infrequent accidental industrial spills into the Hiwassee River, the snail darter has persisted in the river. An April 2007 fish consumption advisory was issued for largemouth bass (*Micropterus salmoides*) in 2007 as a result of mercury levels (0.26 ppm, weighted average) being detected in fish tissues from river mile 7.4 –18.9 of the Hiwassee River; the highest levels were detected in the vicinity of Interstate 75 (Denton 2007). The Olin Corporation's (Olin) chlor-alkali facility, located in Bradley County, Tennessee, is the largest mercury-based factory remaining in the United States. The facility accidently spilled 50 pounds of mercury into the lower Hiwassee River over a three-day period in September 2011, as a result of excessive rainfall (approximately 13 inches) overflowing the plant's treatment lagoons (Sohn 2011). Olin plans to phase out the use of mercury in its chlor-alkali manufacturing process at this facility by the end of 2012. Several spills of sulfuric acid have also occurred on the Hiwassee River which required releases from Appalachia Dam to dilute and flush the chemical from the area (Service 1991). Spills in the lower reaches of this system could potentially affect drifting snail darter larvae or juveniles migrating upstream. Similar to the French Broad River, Ashton and Layzer (2007) found little silt and abundant macrophyte-free gravel substrate at sites where the greatest numbers of snail darters were collected in the Hiwassee River.

Aquatic fauna in the Ocoee River has been impacted by mining activities in the Copperhill area; generally high sediment levels and pH levels as low as 1.2 have been reported in the Ocoee River (Service 1991).

b. Over-utilization for commercial, recreational, scientific, or educational purposes:

No new information is available. The final rule reclassifying the snail darter from endangered to threatened indicated that because of the notoriety received by the species, it would be vulnerable to collection. However, no such activities have been reported to date.

c. Disease or predation:

No new information is available. The final rule reclassifying the species indicates that disease and predation were not factors that threatened the snail darter.

d. Inadequacy of existing regulatory mechanisms:

The snail darter and its habitats are afforded limited protection from water quality degradation under the Clean Water Act of 1977 (33 U.S.C. 1251 et seq.) and the Tennessee Water quality Control Act of 1977. These laws focus on point-source discharges, and many water quality problems are the result of non-point source discharges. Therefore, these laws and corresponding regulations have been inadequate to halt population declines and degradation of habitat for the snail darter.

In addition to the Federal listing, the snail darter is listed as threatened by the State of Tennessee. Under the Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974 (Tennessee Code Annotated §§70-8-101-112), "… it is unlawful for any person to take, attempt to take, possess, transport, export, process, sell or offer for sale or ship nongame wildlife, or for any common or contract carrier knowingly to transport or receive for shipment nongame wildlife." Further, regulations included in the Tennessee Wildlife Resources Commission Proclamation 00-15 Endangered or Threatened Species state the following: "except as provided for in Tennessee Code Annotated, Section 70-8-106 (d) and (e), it shall be unlawful for any person to take, harass, or destroy wildlife listed as threatened or endangered or otherwise to violate terms of Section 70-8-105 (c) or to destroy knowingly the habitat of such species without due consideration of alternatives for the welfare of the species listed in (1) of this proclamation, or (2) the United States list of Endangered fauna." Potential collectors of this species would be required to have a state collection permit.

e. Other natural or manmade factors affecting the species' continued existence:

No new information is available. The final rule reclassifying the snail darter indicated that there are no other factors known to be threatening the species' continued existence.

D. Synthesis – The snail darter is thought to have historically occurred in the upper Tennessee River basin in Alabama, Georgia and Tennessee (Etnier 1976). The recovery plan (USFWS 1983) indicates that the species may have inhabited the

mainstem of the Tennessee River and the lower reaches of its major tributaries from present-day Guntersville Reservoir upstream to Knoxville, Tennessee. Snail darters may have been historically distributed as far downstream in the mainstem as Wheeler Reservoir due to their presence in the Paint Rock River, a tributary to Wheeler Reservoir, or have more recently originated in the Paint Rock River as a result of the Elk River (another Wheeler Reservoir tributary) snail darter transplant.

The Hiwassee River and French Broad River snail darter populations appear to be reproducing and stable. Six populations (Little River, Sequatchie River, Sewee Creek, Holston River, South Chickamauga Creek, and Paint Rock River) may be reproducing, but they are apparently small, with variable distribution.

Threats to the snail darter are primarily the result of activities that adversely impact the species' habitat (Factor A). Sedimentation from various sources such as increased streambank erosion from barge traffic on the mainstem, agricultural activities, and development on tributaries to the mainstem pose potential threats to the species. Pollution from urban areas and non-point sources also threatens the snail darter by degrading water quality. All snail darter populations are subjected to such threats.

None of the alternative recovery criteria for the snail darter have been met and the threat of habitat destruction and modification persists. Therefore, the species continues to meet the definition of a threatened species, and no change in status is recommended.

III. RESULTS

A. Recommended Classification:

_____ Yes, downlist to Threatened
_____ Yes, uplist to Endangered
_____ Yes, delist
_____**X**_____ No, no change is needed

B. New Recovery Priority Number:

No change recommended at this time. However, if future surveys of the Tennessee River were to find that viable snail darter populations exist in the mainstem and are the source of fish observed in mainstem tributaries and Tennessee River subwatershed tributaries, the recovery potential could potentially increase, resulting in a lower recovery priority number.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Determine the distribution and status of the snail darter in the mainstem Tennessee River from Wheeler Reservoir to Watts Bar Reservoir (currently identified as Task 2 in the recovery plan). A concerted effort focusing on the distribution and status of the snail darter in the mainstem has never been carried out. This effort should include revisiting mainstem reservoir sites where snail darters were collected in the past (Watts Bar, Chickamauga, Nickajack, and Guntersville reservoirs), in addition to surveying a number of new sites where conditions are relatively riverine.

- Determine the distribution and population size of snail darters in the Little River, Sequatchie River, Ocoee River, Little Tennessee River, and Paint Rock River by conducting quantitative surveys of these systems. Prioritize surveying the Little Tennessee River and its tributaries to further verify the presence of the species in this system based upon the 2007 discovery of one individual in Citico Creek.

- Conduct genetics studies to determine (1) whether fishes found in tributaries likely originated from mainstem populations or possess distinct genetic characteristics, and (2) whether reservoirs on the Tennessee River fragment the mainstem population into separate populations and thereby disrupt gene flow.

- Evaluate suitable snail darter habitat in Sewee Creek and South Chickamauga Creek. This would include identifying limiting factors and potential threats to reestablishment of reproducing populations and initiating actions to restore habitat in those streams.

- Upon better determining what constitutes snail darter populations (following genetic studies and analysis), recruitment levels within each population and available habitat, evaluate the need to initiate propagation or translocation of snail darters to augment existing populations in the Hiwassee River, French Broad River, and Holston River populations and to establish more stable populations in the Sequatchie River, the Little River, the Paint Rock River and, possibly, the Little Tennessee River.

- Continue to monitor the snail darter and its habitat throughout its current range.

- Continue to implement all recovery tasks identified in the recovery plan.

V. REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF THE SNAIL DARTER (*Percina tanasi*)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist
___X___ No change is needed

Appropriate Listing/Reclassification Priority Number _____N/A_____

Review Conducted By Todd Shaw, Tennessee Ecological Services Field Office

FIELD OFFICE APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approve Mary C Jennings Date 1-10-2013

REGIONAL OFFICE APPROVAL

for Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 3/18/13

APPENDIX A

Summary of peer review for the 5-year review of the Snail darter (*Percina tanasi*)

A. Peer Review Method:

E-mails were sent to J.R. Shute, Patrick Rakes, Charles F. Saylor and Dr. James B. Layzer on October 2, 2012, and to Dr. Colin Shea on November 16, 2012, requesting their assistance in providing a peer review of the draft Snail Darter 5-year Review.

B. Peer Review Charge:

The following instructions and other information were included in the October 2, 2012, and November 16, 2012, e-mail sent to peer reviewers:

The U.S. Fish and Wildlife Service (Service) is conducting a 5-year review of the appropriateness of the current listing of the snail darter (*Percina tanasi*) as a threatened species under provisions of the Endangered Species Act of 1973, as amended (Act). On July 28, 2006, we published a notice in the Federal Register announcing our intent to conduct this review on this species for which our office has the lead responsibility under section 4(c)(2)(A) of the Act. At that time, we requested any new information on the snail darter since the time of its listing in 1975. In order to support the Service's interest in making its decision based on the best available science, portions of the draft review need to be subjected to an appropriate level of peer review. Due to your expertise regarding this species, we request that you peer review the attached portion of the document. We must receive your review comments within 30 days of the date of this email (October 2, 2012) in order to consider them in our final review document.

The goals of peer review during this process are (1) to ensure that the best available biological data, scientifically accurate analyses of those data, and the reviews of recognized experts are used in the decision-making process; and (2) to indicate to the public, to other agencies, to conservation organizations, and to personnel within the Service that the best available data and scientific analyses were used in the decision-making process.

The following materials are enclosed for use during your review:

Peer Review in Endangered Species Act Activities - This July 1, 1994, *Federal Register* notice established a peer review process for all listing and recovery actions taken under the authorities of the Endangered Species Act.

The Biological Portion of the Draft 5-Year Review – This is the draft material that we hope you will review.

The Literature Cited section of the Draft 5-Year Review - The list is enclosed.

We appreciate your assistance in ensuring that this review is based on the best available science. If you have any questions or if we can provide additional information, please contact Todd Shaw by telephone at 931/525-4985, or via email at ross_shaw@fws.gov.

C. Summary of Peer Review Comments:

Dr. Shea, Mr. Rakes, and Mr. Saylor all responded to our peer review request.

Dr. Shea did not have any substantive comments and stated that the document seemed well thought-out.

Mr. Rakes agreed with our recommendations for future genetic analyses and comparisons of putative populations. He also suggested that the mainstem Tennessee River and riverine reaches of reservoirs would be great candidates for the new "Missouri" trawl sampling technique recently used for slender chub surveys to determine whether populations of adult snail darters occupy those habitats undetected.

Mr. Saylor shared several comments including: 1) new records from the Flint River at Owens crossroads represent a range extension further down river; 2) there is a need to determine what role mainstem Tennessee River habitat plays in the life history of snail darters; and 3) double-check some details on collections, mostly who was in attendance.

D. Response to Peer Review:

We agreed with all peer reviewer comments and have incorporated their suggested edits in the final 5-year review where appropriate.