Appendix G

Results of Consultation Performed under Section 7 of the Endangered Species Act

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February 9, 2004

Mr. Jon M. Loney, Manager
NEPA Administration
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902

Re: FWS #04-0198

Dear Mr. Loney:

This document is the Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed Reservoir Operations Study (ROS) located in the Tennessee River Valley in Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia, and its effects on the federally threatened snail darter (*Percina tanasi*), pink mucket (*Lampsilis abrupta*), and green pitcher plant (*Sarracenia oreophila*) per section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Your October 24, 2003, request for formal consultation was received on October 24, 2003. The Tennessee Valley Authority (TVA) has made findings for 59 species (Table 1); "likely to adversely affect" the snail darter and "not likely to adversely affect" 58 species, including the pink mucket and green pitcher plant and three Federal candidate species.

FWS Log No: **Application No**:(Action Agency)

Date Started: October 24, 2003 **Ecosystem**: Lower Tennessee/Cumberland; Southern Appalachian

Applicant: N/A **Action Agency**: Tennessee Valley Authority

Project Title: Reservoir Operations Study

County: All counties in the Tennessee River drainage (Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, Virginia)

Table 1. Species and critical habitat evaluated for effects and those where "not likely to be adversely affected" determinations were made.

SPECIES	EVALUATED FOR DIRECT, INDIRECT, AND/OR CUMULATIVE EFFECTS	LIKELY TO ADVERSELY AFFECT	CRITICAL HABITAT DESIGNATED/AFFECTED
Gray bat	YES	NO	NO / NO
Indiana bat	YES	NO	YES / NO
Least tern	YES	NO	NO / NO
Whooping crane	YES	NO	YES / NO
Red-cockaded woodpecker	YES	NO	NO / NO
Wood stork	YES	NO	NO / NO
Bald eagle	YES	NO	NO / NO
Piping plover	YES	NO	YES / NO
Alabama cavefish	YES	NO	YES / NO
Snail darter	YES	YES	NO / NO
Pygmy madtom	YES	NO	NO /NO
Yellowfin madtom	YES	NO	YES / NO
Smoky madtom	YES	NO	YES / NO
Boulder darter	YES	NO	NO / NO
Bluemask darter	YES	NO	NO / NO
Duskytail darter	YES	NO	NO / NO
Slackwater darter	YES	NO	YES / NO
Slender chub	YES	NO	YES / NO

SPECIES	EVALUATED FOR DIRECT, INDIRECT, AND/OR CUMULATIVE EFFECTS	LIKELY TO ADVERSELY AFFECT	CRITICAL HABITAT DESIGNATED/AFFECTED
Spotfin chub	YES	NO	YES / NO
Cumberland bean pearlymussel	YES	NO	NO / NO
Purple bean	YES	NO	NO / NO
Pale lilliput	YES	NO	NO / NO
Cumberland monkeyface	YES	NO	NO / NO
Rough rabbitsfoot	YES	NO	NO* / NO
Fat pocketbook	YES	NO	NO / NO
Rough pigtoe	YES	NO	NO / NO
Cumberland pigtoe	YES	NO	NO / NO
Clubshell	YES	NO	NO / NO
Orangefoot pimpleback	YES	NO	NO / NO
White wartyback	YES	NO	NO / NO
Little-wing pearlymussel	YES	NO	NO / NO
Ring pink	YES	NO	NO / NO
Birdwing pearlymussel	YES	NO	NO / NO
Pink mucket	YES	NO	NO / NO
Cracking pearlymussel	YES	NO	NO / NO
Fine-rayed pigtoe	YES	NO	NO / NO
Shiny pigtoe	YES	NO	NO / NO

SPECIES	EVALUATED FOR DIRECT, INDIRECT, AND/OR CUMULATIVE EFFECTS	LIKELY TO ADVERSELY AFFECT	CRITICAL HABITAT DESIGNATED/AFFECTED
Tan riffleshell	YES	NO	NO / NO
Oyster mussel	YES	NO	NO* / NO
Cumberlandian combshell	YES	NO	NO* / NO
Dromedary pearlymussel	YES	NO	NO / NO
Fanshell	YES	NO	NO / NO
Appalachian elktoe	YES	NO	YES / NO
Armored snail	YES	NO	NO / NO
Noonday globe	YES	NO	NO / NO
Slender campeloma	YES	NO	NO / NO
Anthony's river snail	YES	NO	NO / NO
Tennessee yellow-eyed grass	YES	NO	NO / NO
Virginia spiraea	YES	NO	NO / NO
Mountain skullcap	YES	NO	NO / NO
Green pitcher plant	YES	NO	NO / NO
Ruth's golden aster	YES	NO	NO / NO
Small-whorled pogonia	YES	NO	NO / NO
Leafy prairie clover	YES	NO	NO / NO
Cumberland rosemary	YES	NO	NO / NO
Price's potato bean	YES	NO	NO / NO

*Critical habitat has been proposed, but has not been officially designated. Proposed designation is currently under review.

We concur with TVA's finding of "not likely to adversely affect" for 53 of the above-listed species and critical habitat indicated in Table 1. Those species will not be discussed further in this biological opinion. Upon review of the biological assessment, we concur with the "likely to adversely affect" finding for the snail darter; however, we do not concur with the "not likely to adversely affect" findings for the pink mucket (*Lampsilis abrupta*) and green pitcher plant (*Sarracenia oreophila*). Consequently, those three species will be addressed in this biological opinion. Three Federal candidate species: white fringeless orchid (*Platanthera integrilabia*), slabside pearly mussel (*Lexingtonia dolabelloides*), and the fluted kidneyshell (*Ptychobranchus subtentum*); were also evaluated. We concur that these three species will not be adversely affected by implementation of the preferred alternative. Furthermore, we appreciate that these species were included in the biological assessment, but they currently have no legal protection under the Act and they will not be considered further in this biological opinion.

Although construction of many of the facilities in the TVA water control system pre-dates the consultation requirements of the Act, current operations of those facilities (i.e., the Base Case) have had, and continue to have, adverse effects on a number of federally listed species. However, this biological opinion only addresses the effects to listed species that will occur as a result of implementation of the preferred alternative. Effects of operation and maintenance of the TVA water control system on federally listed species should be addressed in a separate consultation. A recommendation that TVA initiate consultation on operation and maintenance of its water control system was made by the Service in a letter dated December 8, 2003. A response to our letter was received via facsimile from Kathryn J. Jackson, TVA's Executive Vice President for River System Operations and Environment, on February 6, 2004, indicating a willingness to meet as soon as possible to discuss scope for such a consultation. A meeting will be held in the near future between Service and TVA representatives to determine the scope of the consultation.

This biological opinion is based on information provided in the October 24, 2003, project proposal and biological assessment, the June 2003 draft environmental impact statement, and other sources of information. A complete administrative record of this consultation is on file at the Tennessee Ecological Services Field Office, 446 Neal Street, Cookeville, Tennessee 38501; telephone, 931/528-6481.

Consultation History

October 30, 2001 - Wayne Poppe (TVA) met with Lee Barclay, Doug Winford, and Jim Widlak at the Cookeville Office. The purpose of the meeting was to inform Service personnel that TVA was initiating the Reservoir Operations Study, and that the timeline for completing the study, including environmental compliance, was going to be much shorter than that for the Tennessee/Cumberland drainage portion of the broader consultation on operations and maintenance on the Ohio River and its tributaries.

April 25, 2002 - The Endangered Species Working Group met for the first time. The group consisted of the following representatives from TVA and various Service field stations within the Tennessee River drainage:

TVA	Service
John Jenkinson	Steve Alexander
Peggy Shute	Rob Hurt
Bo Baxter	Alice Palmer
Bill Redmond	Mark Cantrell
Carolyn Wells	Bruce Porter
Hill Henry	Jim Widlak
Chuck Nicholson	

TVA presented information about the proposed ROS and how Endangered Species Act compliance would be approached. The group discussed section 7 issues.

July 10, 2002 - Endangered Species Working Group met to discuss the list of species that would be evaluated in the consultation and the approach that would be used to conduct the assessment.

December 9, 2002 - The Endangered Species Working Group met to discuss progress on the biological assessment.

June 25, 2003 - The Endangered Species Working Group met to discuss progress on the biological assessment.

August 7, 2003 - John Jenkinson and Peggy Shute met with Jim Widlak in Cookeville to discuss ways to facilitate the ROS consultation. The biological assessment would address 59 species, three of which are candidate species. Additionally, the scope of the proposed action would likely require lengthy discussion of the baseline condition if baseline conditions were included. It was agreed that the language used in the environmental setting section of the draft environmental impact statement could be used largely verbatim for the baseline section of the biological opinion.

October 20, 2003 - The Endangered Species Working Group met to discuss the draft biological assessment. Joining this meeting from TVA were David Nye, the project manager, Gary Hickman, and Robin Kirsch.

October 24, 2003 - TVA submitted the biological assessment to the Service, along with a request for initiation of formal consultation.

October 28, 2003 - The Service submitted a request to TVA, by letter, for further information.

November 7, 2003 - John Jenkinson, Peggy Shute, Chuck Bach, Morgan Goranflo, Gary Hickman, and Robin Kirsch met with Lee Barclay, Steve Alexander, Jim Widlak, Mark Cantrell (via telephone), and Rob Hurt (via telephone) in Cookeville to discuss the Service's request for more information concerning the formal consultation. TVA representatives agreed to provide further information.

November 12, 2003 - The Service sent a letter to TVA acknowledging receipt of the consultation package.

November 20, 2003 - TVA provided additional information in response to Service requests made on October 28, 2003, and during the meeting on November 7, 2003.

BIOLOGICAL OPINION

(*NOTE: Text contained in the "Description of Proposed Action" and "Baseline" sections of this biological opinion came largely from TVA's draft environmental impact statement and subsequent biological assessment*)

DESCRIPTION OF PROPOSED ACTION

In response to changes in public values since completion of the water control system, TVA has periodically evaluated its reservoir operations policy. Currently, TVA is conducting a comprehensive study of its reservoir operations policy-the Reservoir Operations Study-to determine whether changes in operations policy would produce greater overall public benefits. A wide range of policy alternatives for its water control system were analyzed and reviewed, and recommendations for appropriate changes in the reservoir operations policy may be made (**Note:** this biological opinion will, however, only address the preferred alternative). A decision by TVA to change the reservoir operations policy would affect the operation of TVA's water control system and adjust the balance of operating objectives, subject to meeting the purposes of navigation, flood control, and power production.

For the purposes of the ROS, individual water control facilities within the water control system were classified. Each TVA reservoir falls into one of four general categories that are closely related to its characteristics, primary function, and operation in the reservoir system: (1) mainstem storage, (2) mainstem run-of-river, (3) tributary storage, and (4) tributary run-of-river. Because the ecological and geographic characteristics of waterbodies were found to be important to describe the affected environment for the specific resource areas and evaluate potential impacts from changes in the existing reservoir operations policy, an additional waterbody classification was developed. The ROS waterbody classification identifies eight types of waterbodies, ranging from pooled mainstem reaches to warm tributary tailwaters. Each waterbody in the TVA system was defined as a "reach", extending from an upstream boundary to a downstream boundary, and was classified into one of the eight waterbody types. The eight categories reflect several important differences among the waterbodies, including geographic location (physiographic regions), whether the reaches were pooled or flowing, and thermal characteristics (warm, cool, or cold water).

The Tennessee Valley drainage waterbodies, with approximate length of each reach, were classified in each of the following categories:

Flowing Mainstem Reaches (11 Reaches)

1. Kentucky tailwater - 22.4 miles
2. Pickwick tailwater - 95.9 miles

3. Wilson tailwater	-	14.4 miles
4. Guntersville tailwater	-	38.3 miles
5. Nickajack tailwater	-	22.7 miles
6. Chickamauga tailwater	-	39.9 miles
7. Watts Bar tailwater	-	23.9 miles
8. Fort Loudoun tailwater	-	26.3 miles
9. Fort Loudoun [Inflow]	-	11.2 miles
10. Clinch River to Melton Hill Dam	-	8.6 miles
11. Cumberland R.: Barkley Dam tailwater	-	30.6 miles
Total miles		344.2 miles

Pooled Mainstem Reaches (12 Reaches)

1. Kentucky Reservoir to Duck River	-	88.4 miles
2. Pickwick Reservoir to Colbert	-	38.3 miles
3. Wilson Reservoir	-	15.5 miles
4. Wheeler Reservoir to Limestone Creek	-	35.8 miles
5. Guntersville Reservoir to Scottsboro	-	53.0 miles
6. Nickajack Reservoir to Raccoon Mountain	-	21.3 miles
7. Chickamauga Reservoir to Gillespie Bend	-	35.0 miles
8. Watts Bar Reservoir to Paint Rock Creek	-	46.1 miles
9. Fort Loudoun Reservoir to Peter Blow Bend	-	38.7 miles
10. Melton Hill Reservoir to Clinton (Route 61)	-	43.2 miles
11. Tellico Reservoir to Chilhowee Dam	-	33.2 miles
12. Barkley Reservoir to Cumberland City	-	73.4 miles
Total miles		521.9 miles

Blue Ridge-Type Tributary Reservoirs (12 Reaches)

1. Appalachia Reservoir	-	9.8 miles
2. Hiwassee Reservoir to 19/64 bridge	-	21.0 miles
3. Chatuge Reservoir	-	12.6 miles
4. Parksville Reservoir to Ocoee #2 Dam	-	12.3 miles
5. Ocoee #3 Reservoir	-	6.4 miles
6. Blue Ridge Reservoir	-	12.0 miles
7. Nottley Reservoir	-	17.5 miles
8. Chilhowee to Calderwood Powerhouse	-	8.8 miles

9. Calderwood Dam to Cheoah Dam	-	7.8 miles
10. Cheoah Dam to Fontana Dam	-	9.6 miles
11. Fontana Reservoir	-	28.8 miles
12. Watauga Reservoir	-	16.3 miles
Total miles		162.9 miles

Ridge and Valley-Type Tributary Reservoirs (6 Reaches)

1. Norris Reservoir	-	72.2 miles
2. Cherokee Reservoir to John Sevier	-	54.4 miles
3. Fort Patrick Henry Reservoir	-	10.4 miles
4. Boone Reservoir	-	17.4 miles
5. South Fork Holston Reservoir	-	24.8 miles
6. Douglas Reservoir	-	44.2 miles
Total miles		223.4 miles

Interior Plateau-Type Tributary Reservoirs (7 Reaches)

1. Normandy Reservoir	-	17.8 miles
2. Bear Creek Reservoir	-	15.9 miles
3. Upper Bear Reservoir	-	16.4 miles
4. Cedar Creek Reservoir	-	16.0 miles
5. Little Bear Creek Reservoir	-	11.1 miles
6. Tims Ford Reservoir	-	35.2 miles
7. Great Falls Reservoir	-	19.4 miles
Total miles		131.8 miles

Cool/Cold Tributary Tailwaters (6 Reaches)

1. Mission Dam to Chatuge Dam	-	14.9 miles
2. Norris Dam tailwater	-	13.5 miles
3. Calderwood powerhouse to dam	-	1.2 miles
4. South Fork Holston Dam tailwater	-	13.8 miles
5. Watauga River: Boone to Wilbur	-	18.2 miles
6. Wilbur Reservoir	-	2.7 miles
Total miles		64.3 miles

Cool-to-Warm Tributary Tailwaters (7 Reaches)

1.	Duck River:Shelbyville to Normandy	-	27.2 miles
2.	Elk River:Fayetteville to Tims Ford	-	43.5 miles
3.	Hiwassee River: Ocoee River to Powerhouse	-	18.4 miles
4.	Blue Ridge tailwater	-	17.4 miles
5.	Nottely River to Nottely Dam	-	14.6 miles
6.	Holston River Nance Ferry: Cherokee Dam	-	19.0 miles
7.	Fort Patrick Henry Dam tailwater	-	8.2 miles
	Total miles		148.3 miles

Warm Tributary Tailwaters (17 Reaches)

1.	Duck River to Columbia	-	123.5 miles
2.	Duck River: Columbia to Shelbyville	-	87.9 miles
3.	Bear Creek to Bear Creek Dam	-	60.4 miles
4.	Upper Bear tailwater	-	24.0 miles
5.	Cedar Creek to Little Bear Creek	-	14.9 miles
6.	Cedar Creek Reservoir tailwater	-	8.3 miles
7.	Little Bear Creek to dam	-	11.5 miles
8.	Elk River: to Fayetteville	-	73.8 miles
9.	Hiwassee River to Ocoee River mouth	-	15.9 miles
10.	Hiwassee River: Appalachia cut-off reach	-	13.2 miles
11.	Mission Dam tailwater	-	14.3 miles
12.	Ocoee River: mouth to Parksville Dam	-	11.9 miles
13.	Ocoee #2 Reservoir to Ocoee #3 Dam	-	5.0 miles
14.	Holston River to Nance Ferry	-	33.3 miles
15.	Holston River: John Sevier to North Fork	-	35.5 miles
16.	French Broad River to Douglas Dam	-	32.3 miles
17.	Caney Fork: Great Falls Dam tailwater	-	0.8 mile
	Total miles		566.5 miles

Within and adjacent to the designated waterbody types, the following habitat types were identified: (1) Big rivers; (2) Small rivers/Large creeks; (3) Small creeks; (4) Underground aquifers; (5) Riparian areas along streams/ponds; (6) Gravel bars or boulders in large creeks or rivers; (7) Non-forested seeps, Wetlands, or Meadows; (8) Forested seeps or wetlands; (9) Moist woodlands Xeric hardwood/Coniferous forest/Mountain woods; (10) Prairies, Fields,

Roadsides/Early successional woodlands; (11) Limestone, Sandstone, Granite outcrops/Cedar glades, Caves, Sinkholes, Rockhouses, Boulders, Bluffs, Cliff faces.

The following is a summary of the description of the preferred alternative presented in TVA's biological assessment. Under the preferred alternative, drawdown of tributary reservoirs would be restricted from June 1 through Labor Day and summer operating zones would be maintained through Labor Day at four mainstem facilities. Higher winter pool operating ranges would be established at 10 tributary reservoirs. Existing (i.e., Base Case) minimum flows and dissolved oxygen targets adopted under the Lake Improvement Program would continue to be met. Scheduled releases would be provided at five tributary facilities to increase tailwater recreational opportunities; recreational releases are presently not scheduled at these facilities. These releases will be subject to flood control operations and/or extreme drought conditions in the basin.

Elevations at 10 tributary reservoirs would be maintained as close as possible to the flood guides from June 1 through Labor Day subject to each individual facility meeting its own minimum flow requirements and a proportionate share of the system minimum flow requirements. When the volume of stored water is greater than the minimum operations guide curve, weekly average system minimum flow requirement at Chickamauga Dam would be increased each week from 14,000 cubic feet per second during the first week of June to 25,000 cubic feet per second during the last week of July. Beginning on August 1 and continuing through Labor Day, the weekly average flow would be 29,000 cubic feet per second. If the volume of stored water were less than the minimum operations guide curve, weekly average minimum flows at Chickamauga Dam between June 1 and July 31 would be 13,000 cubic feet per second; flows between August 1 and Labor Day would be 25,000 cubic feet per second. Continuous minimum flows would be provided in the Appalachia bypass reach from June 1 through November 30.

Winter flood guide levels under the preferred alternative would be raised at 10 tributary reservoirs based on flood risk analysis. One-half foot to maintain an 11-foot navigation channel would raise minimum winter elevation on Wheeler Reservoir. Steady water releases up to 25,000 cubic feet per second would be provided, as necessary, at Kentucky Dam to maintain tailwater elevation of 301 feet. Great Falls Reservoir would be filled earlier to reach full summer pool level by Memorial Day. The fill period at Fort Loudon, Watts Bar, and Chickamauga reservoirs would follow the existing fill schedule during the first week of April. Filling at these facilities would then be delayed to reach summer operating zone by mid-May.

During critical power system situations such as Power System Alerts or implementation of the Emergency Load Curtailment Plan, reservoir operations would temporarily deviate from preferred alternative operations to meet power system needs. In such situations, stored water would be used to preserve power system reliability.

Under the preferred alternative, TVA would preserve the primary reservoir operating objectives of flood control, navigation, and power generation. It will increase tailwater recreational opportunities, increase the minimum depth of the Tennessee River navigation channel at two locations, maintain power system reliability, maintain minimum tailwater flows and dissolved oxygen content. It would not increase annual average flood damages at any critical location within the Tennessee River Valley, and minimize adverse impacts on reservoir water quality.

Conservation Measures

The Tennessee Valley Authority has committed to maintain established minimum flows and minimum dissolved oxygen levels in tailwaters as part of the Reservoir Operations Study. Over the years, reservoir operations have been changed to reflect an adaptive response that has included substantial monitoring of environmental parameters, evaluation of ongoing environmental impacts, and systematic mitigation for large-scale impacts. An example is the Reservoir Release Improvement Program (RRIP). The RRIP was initiated to improve water quality and aquatic habitat in tributary tailwaters by providing minimum flows and increasing dissolved oxygen content. Under this program, TVA has restored levels of dissolved oxygen in over 300 miles downstream of 16 projects. Implementation of this program was completed in 1996, but ongoing operational activities could be used to mitigate any increases in problems with low dissolved oxygen in project releases. The Tennessee Valley Authority has implemented a variety of programs to improve conditions for aquatic resources.

Another TVA activity attempts to stabilize reservoir levels for a 2-week period when water temperatures reach 65°F at a depth of 5 feet. This fish spawning operation minimizes water level fluctuations during the peak spawning period to avoid more than a 1-foot-per-week change (either lowering or rising) in pool levels. Stabilizing reservoir levels aids fish spawning success. TVA conducts regular ecological monitoring of reservoirs and tailwater fauna.

The Vital Signs Monitoring Program rates environmental conditions in reservoirs using a fish and benthic Index of Biotic Integrity (IBI). TVA also monitors sport fish populations using the Sport Fish Index (SFI), which incorporates the status of population quantity and quality along with available angler catch information. Within a reservoir, SFI scores monitor positive or negative trends in population status, relative to fishing experience. Beyond the SFI monitoring program, TVA operates certain hydropower operations in a manner that provides important flow levels for spring spawning grounds of certain fishes. For example, below Watts Bar reservoir, prescribed spring flows are provided to enhance sauger spawning. These programs may benefit mussel resources in the Tennessee River, including federally listed species because fish play a vital role in the life cycles of mussels.

As part of the ROS, TVA will participate with personnel from the Nature Conservancy in monitoring the green pitcher plant population at Lake Chatuge. Monitoring will be done to determine the hydrology of the site and to determine what effects, if any, implementation of the preferred alternative is having on the plants and their habitat. If declines in numbers of green pitcher plants or degradation of the habitat attributable to implementation of the preferred alternative are observed, TVA will coordinate with the Service to develop means to halt or reverse such declines and or degradation of habitat.

The Service has described the action area to include the waters in the Tennessee River drainage that are part of the TVA water control system (i.e., the main stem of the Tennessee River and its tributaries) (Figure 1). Lands adjacent to and within one mile of those waters are also included for reasons that will be explained and discussed in the "EFFECTS OF THE ACTION" section of this consultation.

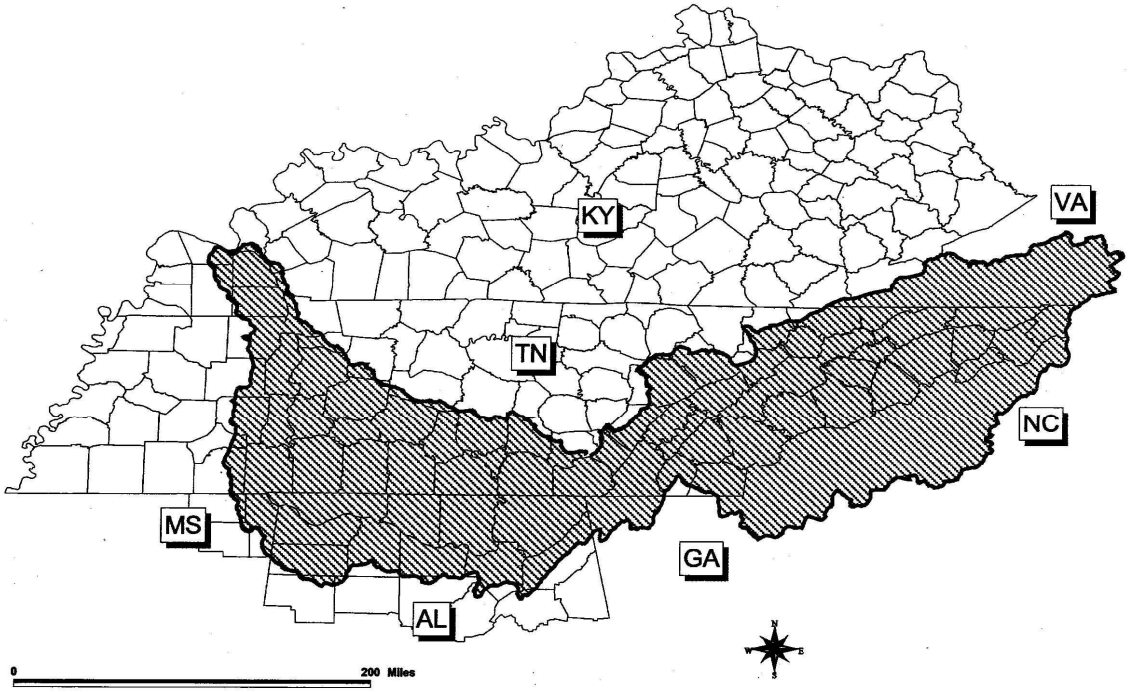
STATUS OF THE SPECIES/CRITICAL HABITAT

Snail darter

The snail darter, *Percina tanasi*, was officially listed on October 12, 1975. Because it was known to occur only in the Little Tennessee River in the vicinity of Tellico Dam, which was under construction, the original listing designated the snail darter as an endangered species. Critical habitat for the species was designated on April 1, 1976, to include the Little Tennessee River from River Mile 0.5 to River Mile 17. Subsequent to listing of the species, additional snail darter populations were discovered and, on July 5, 1984, the snail darter was re-designated as a threatened species. At the same time the critical habitat designation was eliminated because the reach of the Little Tennessee River that was designated as critical habitat was impounded when the Tellico Dam project was completed (Service 1983).

Prior to construction of impoundments in the Tennessee River drainage, the snail darter is thought to have occurred in the mainstem of the Tennessee River and the lower reaches of its major tributaries from Fort Loudon downriver to the confluence of the Paint Rock River in Alabama (Service 1983). Populations likely existed in the Tennessee River and in the lower reaches of the Hiwassee, Clinch, Little Tennessee, French Broad, and Holston Rivers (Service 1983). Surveys conducted by TVA biologists at 120 sites during 1974 and 1975 failed to reveal additional snail darter populations, however, snail darter populations were subsequently found in the Tennessee River and four large tributaries during surveys since 1980. Naturally occurring populations were discovered in the Tennessee River below Watts Bar Dam, Nickajack Dam, and

Figure 1. Reservoir Operations Study Action Area



Chickamauga Dam; Sewee Creek; South Chickamauga Creek (Tennessee and Georgia); Sequatchie River; and Paint Rock River (Alabama) (Service 1983). In 1975 and 1978, snail darters were transplanted from the Little Tennessee River into the lower Hiwassee River and lower Holston River, respectively. Currently, snail darters are relatively abundant in the lower French Broad River, Holston River, Hiwassee River, and Little River. Although the Service considers the status of the snail darter to be uncertain (Service 2003), recent status surveys indicate that the species appears to be increasing in distribution and population size (TVA 2003[a]).

In an effort to offset the loss of the Little Tennessee River population, snail darters were transplanted to several streams prior to completion of Tellico Dam. Populations were re-introduced in the Elk River (Tennessee), Holston River (Tennessee), Hiwassee River (Tennessee), and Nolichucky River (Tennessee); low numbers of snail darters have subsequently been found in the Nolichucky, and Elk, but populations may have become established in the Holston and French Broad Rivers as a result of the transplant into the Holston River.

The snail darter is described as a robust member of the subgenus *Imostoma*, growing to a maximum total length of 85 millimeters. Coloration above the lateral line is generally brown with occasional traces of green. Four prominent dark brown saddles cross the area behind the origin of the dorsal fin. Body color below the lateral line is lighter and is interspersed with dark blotches. The belly is usually white and the dorsal area of the head is dark brown. Cheeks are mottled brown with traces of yellow (Service 1983).

The snail darter inhabits shoal areas having relatively swift flow over mixed substrate of sand, gravel, cobble, and rock ledges. The species inhabits shallow water areas, but may also occur in areas with water depths of 12 to 20 feet (Service 1983). Snails comprise approximately 60 percent of the diet of the species, but caddisfly and black fly larvae are also consumed seasonally (Service 1983).

Approximately 25 percent of snail darter populations reach maturity at one year of age. Mature males migrate to spawning shoals from November through late January. Spawning occurs through mid-March. Eggs are deposited on gravel or cobble substrate and hatch within 20 days. Newly hatched larval snail darters drift with river currents to pool habitats, which serve as nursery areas. Juvenile darters may spend five to seven months in the nursery areas, after which they migrate upstream to shoal and riffle habitats where they spend the remainder of their lives (Service 1983). The action area encompasses the entire known range of the snail darter.

There is currently no designated critical habitat for the snail darter. A recovery plan for the species was approved on May 5, 1983. Recovery criteria are:

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 that can survive and reproduce independently of tributary rivers as evidenced by documented reproduction in Watts Bar Reservoir or some other Tennessee River reservoir.

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 criterion 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.

Alternative C

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.

Pink mucket

The pink mucket, *Lampsilis abrupta*, was listed as an endangered species on June 14, 1976. It is an Ohioan species with possibly the widest range known for a listed mussel. Historical records indicate that this species once occurred in large rivers in 12 states. Presently, known populations occur only in the Barren River, Big River, Black River, Clinch River, Cumberland River, Current River, Gasconade River, Green River, Kanawha River, Little Black River, Meramec River, Ohio River, Osage River, Paint Rock River, and Tennessee River (Service 1985, 1992; Parmalee and Bogan 1998). Of these extant populations, only a few have shown recent evidence of recruitment. Some taxonomists have recently postulated that the reproducing populations west of the Mississippi River are not *Lampsilis abrupta*, but rather are more closely related to another endangered species, the Higgins eye pearlymussel (*Lampsilis higginsi*). If this is true, then there are fewer known reproducing populations of *L. abrupta* than originally thought. Although it has a relatively wide distribution and is apparently more tolerant of reservoir-type habitat conditions than other listed mussel species, the pink mucket is reported to occur in low numbers where it occurs.

This species inhabits areas in large rivers with swift currents, depths of 0.5 to 8.0 meters (1.6 feet to 26.2 feet), and mixed sand/gravel/cobble substrate. Notwithstanding this, the pink mucket appears to have adapted to reservoir-type conditions in the upper reaches of some impoundments. Life history aspects of this species are presently unknown, although it is probably a long-term breeder, as are other *Lampsilis* species. The glochidia are undescribed and the fish host is unknown (Service 1985, 1992; Parmalee and Bogan 1998).

In the Tennessee River drainage, live pink muckets have been recently collected from below the following TVA facilities: Wilson Dam, Pickwick Landing Dam (from the dam to the headwaters of Kentucky Lake), Kentucky Dam, Guntersville Dam, Nickajack Dam, Chickamauga Dam, Fort Loudon Dam, and Watts Bar Dam. Individuals were also found recently in the Holston River below Cherokee Dam, French Broad River below Douglas Dam, in the Clinch River below Melton Hill Dam and in Claiborne County, and below Bear Creek Dam and Wheeler Dam in Alabama (TVA 2003[a]).

There is no designated critical habitat for this species. A recovery plan was approved for the pink mucket on January 24, 1985. This species will be considered recovered when:

1. Two additional viable populations are found in any two rivers other than the Tennessee River, Cumberland River, and Meramec River. Populations in those two rivers will be distributed such that a single catastrophic event would likely not result in elimination of the population. Survey data must show at least five viable populations with each having a minimum of two year classes between four and 10 years of age.

2. Additional mussel sanctuaries must be established or expanded in river systems containing known populations of the pink mucket.

3. An education program must be established for the public with major emphasis toward commercial mussel harvesters.

4. The species and its habitat are protected from present and foreseeable human-related and natural threats that might interfere with survival of any of the populations.

Green pitcher plant

The green pitcher plant, *Sarracenia oreophila*, was listed as an endangered species on September 21, 1979. It is currently restricted in range to areas of the Cumberland Plateau in Alabama; and Blue Ridge and Valley and Ridge areas in Georgia and North Carolina (Service 1994). Green pitcher plant populations historically existed in the Coastal Plain and Piedmont areas in Alabama and Georgia, and in the Cumberland Plateau in eastern Tennessee. Extant populations occur at an estimated 35 sites in northeastern Alabama, northeastern Georgia, and southwestern North Carolina; population sizes range from one to several thousand plants (Service 1994). No critical habitat was designated for this species.

The green pitcher plant occurs in various types of habitat. Some populations occur in moist upland sites and seepage bogs, while others exist in boggy, sandy streambanks. Soils are acidic and consist of sandy clays and loams in upland sites or nearly pure sand along streams. Suitable habitat, consisting of relatively open canopy, is maintained by the saturated acidic, or poor nutrient, soils and periodic moderate fire that maintains which prevents encroachment of competitive species. Flood events are thought to maintain or create streambank sites. Predominant plants associated with green pitcher plant include alder, mountain laurel, red maple, and rhododendron on streambank sites. Various oak and pine species, which provide sparse canopy, occur on upland sites (Service 1994). Sphagnum and cinnamon fern are typically associated with this species at all sites. The herbaceous layer is typically diverse, with a mixture of grasses, sedges, and forbs. The more diverse sites are those that are frequently burned.

Green pitcher plants reproduce by seed and by rhizomes. The plants are pollinated by bumblebees, but at some sites having low numbers of plants, pollinator success was found to be low (Service 1994). Weather, particularly rainfall is considered to be an important limiting factor in flowering and vegetative growth. Flower buds are formed in fall, gradually enlarging throughout winter; bud enlargement is dependent on temperature. The plants flower from late April through late May and is affected by elevation and local climatic conditions. Fruit maturation typically occurs by late August, and seeds are released in mid to late September through early spring (Service 1994). Seedlings require high soil moisture, open mineral soil, and high light intensity for first year growth.

Green pitcher plant populations have been lost, and continue to be threatened by loss of suitable habitat. Clearing and degradation of habitat are thought to be the primary threats. Populations are thought to have been lost due to inundation at Lake Weiss and Lake Chatuge. Road construction, coal mining, intensive grazing and trampling by livestock, fire suppression resulting in encroachment by competitive plant species, and use of fertilizers and pesticides have had adverse effects on other green pitcher plant populations. Over-collecting by commercial

dealers has resulted in complete elimination of many populations, and continues to be a major threat to the species (Service 1994).

A recovery plan was approved for the green pitcher plant on May 11, 1983; revised plans were approved on April 5, 1985 and on December 12, 1994. The species will be considered recovered when:

1. A minimum of 18 viable populations, representing the diversity of habitats and the geographic range of the species, are protected and managed as necessary to ensure their continued existence. Colonies should also include the wide spectrum of current genetic variation found in the species, which will be investigated as a recovery task. Of the 18 populations, at least three colonies should be located within each of the following four geographic areas: Coosa Valley, Lookout Mountain, East Sand Mountain, West Sand Mountain, and Lake Chatuge.

2. A population will be considered protected when it is legally protected from any present or foreseeable threats and is actively managed. A population will be considered viable if it is successfully sexually reproducing and the population's size is stable or increasing. A successfully sexually reproducing population is one which has consistent seed production followed by seedling establishment. Population viability should be confirmed through long-term monitoring (20 to 30 year period) before a final assessment of its eligibility for delisting is made.

A list of formal consultations completed for the species addressed in this biological opinion is attached (Appendix 1).

TVA evaluated a total of 59 species in its biological assessment for the Reservoir Operations Study. Three of those species: slabside pearlymussel, fluted kidneyshell, and white fringeless orchid: are Federal candidate species. They have no Federal protection and the consultation requirements of the Act do not apply to them. Consequently, those three species will not be addressed further in this biological opinion. All of the remaining 56 listed species are known to occur in the action area, however, implementation of the proposed alternative is not likely to result in changes that are likely to adversely affect 53 of those species (see Table 1) or their habitats. We will therefore not address those species further in this biological opinion. The snail darter, pink mucket, and green pitcher plant are likely to be adversely affected by implementation of the proposed action. Changes resulting from implementation of the preferred alternative (Blend 8) will alter water temperatures, water levels, and/or flows in some reservoirs and /or tailwater reaches that could potentially alter suitable habitat, affect reproduction, or have adverse effects on normal behavioral activities of populations of those three species in the

affected areas. Therefore, these three species will be addressed in subsequent sections of this biological opinion.

ENVIRONMENTAL BASELINE

The TVA is a multipurpose federal corporation responsible for managing a range of programs in the Tennessee River Valley for the use, conservation, and development of the water resources related to the Tennessee River. In carrying out this mission, TVA operates a system of dams and reservoirs with associated facilities-its water control system-to manage the storage and flow of water within the system. This system is used to manage the water resources of the Tennessee River for the purposes of navigation, flood control, power production, and a wide range of other public benefits.

The water control system provides the cooling water supply for TVA's fossil and nuclear power plants located adjacent to TVA reservoirs. Additionally, TVA owns and manages approximately 293,000 acres of land in the Tennessee River Valley, much of which is along the shorelines of the reservoirs. Policies have been established for the development of reservoir shorelines and adjacent TVA lands, and reservoir levels influence development and management of these lands and activities and river flows. Reservoir operations policy for the water control system - i.e., the dams, reservoirs, and regulated river segments-guides the day-to-day operation of the Tennessee River system.

The Tennessee River drainage covers approximately 41,000 square miles. This area includes 125 counties within much of Tennessee and parts of Alabama, Kentucky, Georgia, Mississippi, North Carolina, and Virginia. The larger TVA Power Service Area covers 80,000 square miles and includes 201 counties in the same seven states. The TVA watershed includes 42,000 miles of streams that drain to the Tennessee River, 480,000 acres of reservoirs, and 300,000 acres of TVA-managed land.

The Tennessee River drainage begins with headwaters in the mountains of western Virginia and North Carolina, eastern Tennessee, and northern Georgia. At Knoxville, Tennessee, the Holston and French Broad Rivers join to form the Tennessee River, which then flows southwest through the state, gaining water from three other large tributaries: the Little Tennessee River, Clinch River, and Hiwassee River. The Tennessee River eventually flows into Alabama, where it picks up another large tributary, the Elk River. At the northeast corner of Mississippi, the river turns north, re-enters Tennessee, picking up the Duck River, and continues flowing north to Paducah, Kentucky, where it enters the Ohio River at Ohio River Mile 932.

The total river elevation change from the maximum reservoir surface elevation at Watauga Dam (highest elevation on the system) to the minimum tailwater surface elevation at Kentucky Dam (lowest elevation on the system) is 1,675 feet in 828.6 river miles. The mainstem of the Tennessee River, has a fall of 515 feet in 579.9 river miles from the top of the Fort Loudoun Dam gates to the minimum tailwater elevation at Kentucky Dam. The mainstem fall is gradual except in the Muscle Shoals area of Alabama, where a drop of 100 feet is found in a stretch of less than 20 miles.

The eastern half of the Tennessee Valley includes the slopes of the Blue Ridge and Great Smoky Mountains, where an abundant growth of timber covers the ground. The western half of the Valley is less rugged, with substantial areas of flat or rolling land occurring in middle Tennessee and along the western edge. Reservoirs and the associated tailwaters of the Tennessee River Valley span six physiographic regions, including the Highland Rim, Coastal Plain, Cumberland Plateau, Blue Ridge, Central Basin, and Valley and Ridge. Thirty-nine percent of the TVA region is in the Highland Rim, and 40 percent in the Coastal Plain.

The eastern portion of the Tennessee River watershed is located in the Blue Ridge Physiographic Region (Unaka Mountains) and the Valley and Ridge Physiographic Region. The headwaters of the Tennessee River originate in the rugged Unaka Mountains in North Carolina and eastern Tennessee. This region has undergone multiple mountain-building events and is underlain by folded and faulted complexes of igneous, metamorphic or sedimentary rocks dating from the Precambrian and Paleozoic Eras. The soils of the Blue Ridge Physiographic Region consist of highly weatherable material. The depth of soil varies from 1 to 3 feet at higher elevations and from to 3 to 7 feet on the lower side slopes. The valleys contain a variety of soils and are generally productive. Soil depths of the Valley and Ridge Physiographic Region range from shallow over shales and sandstones to very deep over the dolomitic limestone. The upland soils are primarily highly leached, and strongly acidic with low fertility. Because of the variable landscape, soils properties vary over short distances, resulting in small patches of productive land intermixed with average land or large tracts of rough land.

The Tennessee River flows southwest from the Valley and Ridge Physiographic Region into the Cumberland Plateau Physiographic Region. This region consists of a high tableland that is underlain by nearly flat-lying sedimentary rocks of Paleozoic age. The Plateau is highly dissected by streams and rivers, forming valleys with moderate to high relief. Because limestone underlies portions of this region, karst (an irregular limestone region with sinks, underground streams, and caverns) landscapes and extensive cave systems have developed. The Cumberland Plateau is bounded on the west and east by escarpments. The terrain is gently rolling to hilly highland with deeply cut gorges.

From the Cumberland Plateau, the Tennessee River flows northwest through the Highland Rim Physiographic Region. This region consists of a highly dissected flat-lying tableland that is underlain by nearly flat-lying Paleozoic age limestone. Due to the presence of limestone, an extensive karst plain has developed, with numerous sinkholes, disappearing streams, and cave systems. The hill slope soils were formed from limestone and have clayey and cherty subsoils. The more level areas and hill caps have soils formed from thin loess (windblown material) and limestone residuum. The soils are highly leached and strongly acid with low fertility, except near the Kentucky/Tennessee border.

The Central Basin Physiographic Region is within the Highland Rim. The Central Basin is one of the smaller physiographic regions of the Tennessee Valley watershed and includes parts of the Duck River and Cumberland River drainages. The Basin is underlain by up-warped Paleozoic age limestone that has been eroded to form a basin surrounded by the Highland Rim. The inner portion of the Basin is relatively flat lying with low relief, and is bordered by large hills and ridges along its outer edge. Due to the weathering and erosion of the underlying limestone, karst topography is present in this region.

From the Highland Rim, the Tennessee River flows north through the Coastal Plain Physiographic Region. The portion of this region that lies within the Tennessee Valley is almost entirely west or southwest of the Tennessee River and includes the drainages of the Beech River and Bear Creek. The relief within this area is generally low; consequently, stream gradients are very low. Their valleys are broad and flat and filled with thick accumulations of alluvium. The rocks exposed in the Gulf Coastal Plain are all unconsolidated sediments, with Paleozoic rocks underlying the whole area at great depth. The soils of the Coastal Plain Physiographic Region are highly leached, low in fertility, and strongly acid. Control of erosion is of major concern, as evidenced by deep gullies that are common on some hillsides.

Aquatic resources occurring in the Tennessee Valley region are important from local, national, and global perspectives and add value to the lives of citizens of the Tennessee River basin. Tennessee has approximately 319 fish species, including native and introduced species, and 129 freshwater mussels. The Tennessee-Cumberland River eco-regions have the highest number of fish, mussels, crayfish, and endemic species in North America. This is the most diverse temperate freshwater ecosystem in the world.

Prior to construction of the TVA reservoir system, aquatic communities were structured by water quality and physical habitat condition, which were driven by physiographic region and climate. Stream flow was proportional to rainfall, and flow regime (pattern) followed the same trends as the annual rainfall pattern. Flow established physical habitat conditions (e.g., depth, velocity) within a stream and maintained stream shape and other habitat conditions (substrate). Relatively infrequent high-flow events (i.e., flows that only occur every 1 to 2 years) were responsible for

maintaining large-scale habitat patterns such as the number of riffles or pools. High flows clean substrate by flushing out fine sediments, which may suffocate fish eggs or mussels and fill in the spaces between rocks needed by aquatic insects. Because historical flow was proportional to rainfall, over short time intervals, such as days, flow was relatively predictable meaning that yesterday's flow was likely to be similar to today's flow and from hour to hour there was little change, except during storm events.

Floods were common during spring, and flows decreased throughout the year with the lowest flows typically occurring August through October, the warmest part of the year. Spring flooding was an important component in the life cycles of some fish species that use flooded overbank areas for spawning or nursery areas. The Tennessee River was shallow, with expansive areas of rocky or gravel shoals critical features contributing to the great diversity of aquatic life. Two of the purposes of TVA system dams and reservoirs were to provide year-round navigation on the river and control flooding. Achieving these objectives required modifying the river environment described above to which the pre-impoundment aquatic community was adapted. For example, most of the shoal habitat was eliminated by impoundments, and seasonal flow patterns were greatly modified by capturing high spring flows in upstream impoundments and increased late summer/fall flows with drawdown releases from those reservoirs.

The construction of the TVA reservoir system significantly altered both the water quality and physical environment of the Tennessee River, with little regard at the time for aquatic resources. Aquatic resources were generally not a consideration for many types of river projects then because flood control, navigation, and cheap hydroelectric power for economic stimulation were more highly valued.

The primary impact of the reservoir system was to convert free-flowing river habitat into reservoir pools. Virtually all of the mainstem Tennessee River was impounded to maintain navigation channel depth. The dams became obstacles to migratory species. Differences in goals and, consequently, operation of reservoirs became important factors in determining water quality and associated impacts on resident aquatic communities in tributary and mainstem reservoirs and downstream tailwaters. Low levels of dissolved oxygen in summer and fall virtually eliminated aquatic communities from the pool area in the lowest layer of the reservoir that is characterized by relatively cool water. Before the RRI Program, similar impacts occurred in downstream tailwaters because water was released from the lower layer of the upstream reservoir.

The large differences between summer and winter pool levels of some tributary reservoirs also created environmental hardships for aquatic resources in these reservoirs. Benthic organisms requiring re-colonization each summer cannot survive in bottom areas exposed to drying during winter. This exposure, in association with dissolved oxygen stratification impacts, severely

limits benthic communities in many tributary reservoirs. Aquatic communities in and downstream of mainstem reservoirs are also affected by poor water quality conditions, but impacts are less severe. Taking advantage of modified habitat conditions (i.e., reservoir pools and dam tailwaters), state agencies introduced numerous sport and some prey fishes, including rainbow trout, brown trout, lake trout, cutthroat trout, kokanee, striped bass, striped bass hybrids, muskellunge, northern pike, cisco, rainbow smelt, alewife, yellow perch, and walleye (northern strains). Not all introductions have led to self-sustaining populations; state agencies continue stocking many popular fishes. Stocking has in itself led to changes to aquatic communities or created new community types in areas they did not exist (e.g., trout in tailwater river reaches).

Completion of TVA's water control system resulted in the following impacts to the aquatic system: (1) Conversion of riverine habitat to reservoir pool habitat; (2) Loss of riverine habitat and associated species; (3) Conversion of floodplain to reservoir pool; (4) Loss of seasonal floodplain habitat and associated species; (5) Fragmentation of riverine sections; (6) Disruption of fish migrations; (7) Seasonal fluctuations of pool levels; seasonal drying of habitat reduces abundance and diversity of species; (8) Strong stratification (layering) of temperature for certain dam types; (9) Stress or mortality of organisms or sensitive life stages; (10) Seasonal dissolved oxygen depletion in temperature stratified water; (11) Ammonia release created by presence of dissolved oxygen-depleted water; (12) Disruption of stream transport of sediment; (13) Trapping of sediment; (14) Capture of toxic substances associated with substrate; (15) Toxic substances release created by presence of dissolved oxygen-depleted water; (16) Enrichment of nutrients (eutrophication) with consequent increases in productivity, plant and algae growth, and changes in habitat quality and associated species.

Status of the species within the action area

The action area encompasses the entire range of the snail darter. Populations of snail darters persist despite construction of the water control facilities on the mainstem of the Tennessee River and its large tributaries.

Snail darter populations have expanded since the species was listed. New populations have been found or reported in the Holston River, French Broad River, Hiwassee River, Tennessee River below Watts Bar Dam and Nickajack Dam, Paint Rock River, Sewee Creek, Sequatchie River, Ocoee River, and South Chickamauga Creek. These populations were either newly discovered natural populations or the successful result of transplant efforts. Efforts to establish self-sustaining populations by transplants failed to succeed in the Nolichucky River and the Elk River.

In the action area, the pink mucket is known to occur in the Tennessee River below Kentucky Dam, Pickwick Landing Dam, and Wilson Dam; in the French Broad River below Douglas Dam; and in the Holston River below Cherokee Dam. Smaller populations or scattered individuals may still persist below other dams on the mainstem of the Tennessee River and in the Clinch River above Knoxville. Historical records from within the action area indicate that the pink mucket occurred in the Flint River, Limestone Creek, and the Duck River.

Green pitcher plant populations currently exist within the action area only in Towns County, Georgia, and Clay County, North Carolina. The Nature Conservancy owns two sites on which this species occurs.

Factors affecting species environment within the action area

Stream and river reaches within the action area containing snail darter populations are being affected by a variety of activities. Dams block spawning migrations of fish, including snail darters; these structures may also be a barrier to newly hatched fry, which drift downstream to nursery habitats. Erosion of streambanks resulting from poor land use practices and water level fluctuations from hydropower releases has likely increased the sediment input into the streams. Sediment compacting the substrate can affect reproductive success by smothering eggs deposited in the gravel or on rocks. Runoff from agricultural areas may contain pesticides, fertilizers, and other agricultural chemicals that degrade water quality. Runoff from coal mining activities may be affecting the species in the Sequatchie River drainage as a result of sediment and acidic discharges. Dredging and construction of barge facilities could potentially have adverse effects to snail darter populations in the Tennessee River. Sand and gravel dredging could affect the species by removing or disturbing important spawning shoals.

Impoundment of the Tennessee River and its tributaries has likely had the most extensive adverse impacts on populations of the pink mucket. Construction of dams converted large reaches of free-flowing riverine habitat to lake-like conditions. Along with alteration of the physical habitat, this change also resulted in changes in the fish fauna. Fish species adapted to lake habitats replaced native riverine fishes that served as fish hosts for the mussels.

Many of the activities that affected snail darter populations have also adversely affected populations of the pink mucket. Streambank erosion, poor land use practices, dredging, municipal and industrial discharges, and development along the river have disturbed, altered, or destroyed habitat used by the pink mucket.

The greatest adverse effect to the green pitcher plant within the action area has resulted from loss of habitat resulting from clearing for agricultural, residential, industrial, and silvicultural purposes. Trampling by grazing cattle and use of herbicides has affected some populations. Suppression of natural fire has resulted in encroachment by competitive plant species. Alteration of natural hydrological conditions has also resulted in loss or significant reductions of some populations. In addition, the carnivorous nature of the green pitcher plant has made it attractive to plant enthusiasts. Collection of plants has resulted in complete loss or significant reduction of some populations.

EFFECTS OF THE ACTION

Factors to be considered

Implementation of the preferred alternative, throughout most of the action area, is not anticipated to result in significant changes in conditions from those occurring under current operations. The Tennessee Valley Authority is committed to maintaining minimum flows and dissolved oxygen levels established under the Reservoir Release Improvement Program and the Lake Improvement Program. If implementation of the preferred alternative results in changes in flows or dissolved oxygen in tailwater reaches below TVA dams included in the RRI program, appropriate actions will be taken to restore and maintain minimum flow and dissolved oxygen levels.

One anticipated change in conditions from current operations is a decrease in water temperatures in the Holston River below Cherokee Dam. During years of normal climatic conditions, temperatures are expected to decrease during the latter part of August and will be from one to six degrees (Celsius) lower than those under current operations and will extend an undetermined distance downriver.

Another change will occur as a result of maintaining summer pool levels in reservoirs later in the season during normal years. Under the preferred alternative, median reservoir pool elevations in Chatuge Lake will be approximately 1.5 feet higher than those under current operations from July through Labor Day; median elevations will be one-half foot lower than current conditions from April through June.

Analyses for effects of the action

Implementation of the preferred alternative may directly affect populations of the snail darter and pink mucket in the Holston River. The pink mucket is a long-term breeder; eggs are fertilized and larvae develop during spring and summer; females retain larvae for release the following spring. Decreases in water temperature during late summer could potentially effect the development of larval mussels or attachment of larval mussels to suitable fish hosts. Such a change could indirectly affect the mussels if changes in water temperature changed the activity or presence of the species' fish host.

The snail darter is a winter spawner. Eggs are laid in mid to late winter and the fry hatch during early spring. Lower water temperatures during late summer could possibly affect the species if such changes altered the feeding activity of reproductive individuals. Changes in water temperature may also affect gamete production, thus affecting spawning success and recruitment.

The green pitcher plant population at Chatuge Lake could potentially be affected by the anticipated change in summer pool level that will result from implementation of the preferred alternative. There appears to be some uncertainty about the hydrologic conditions of the site at which the plants exist. If lake levels drive the hydrology of the site, the site will be exposed to water levels 1.5 feet higher than presently occurs during the summer. What effect this might have on flowering, fruit formation, and seed dispersal are unknown at this time.

Species' response to a proposed action

Subsequent to inundation of the Little Tennessee River site, snail darters were stocked, or new populations were subsequently found in the Holston River; French Broad River; Sequatchie River; Tennessee River below Watts Bar Dam, Chickamauga Dam, and Nickajack Dam; Sewee Creek; Nolichucky River; Hiwassee River; Ocoee River; Elk River; and South Chickamauga Creek. Some of these populations appear to be reproducing and increasing in numbers while others have declined. Current estimates of population size are not available.

The snail darter has demonstrated a certain degree of resilience to changes in its habitat, evidently having adapted to current conditions within the action area. Construction of reservoirs has isolated some populations, but many of the extant populations continue to thrive.

Pink mucket populations currently exist in the action area below Kentucky Dam, Pickwick Landing Dam, Wilson Dam, Cherokee Dam, and Douglas Dam. Population estimates are not available, but individuals likely are scattered at low densities throughout the tailwaters below

those dams in areas containing suitable habitat. This species has low resilience to changes in its habitat. Although it has adapted to lake-like conditions (individuals have been found in the upper reaches of some reservoirs), construction of impoundments has destroyed miles of its riverine habitat. Additionally, coldwater releases from some dams has resulted in elimination some populations. Even if the action area was restored to pre-impoundment conditions, it is unlikely that the pink mucket would re-colonize those disturbed areas in the foreseeable future.

The green pitcher plant currently occurs in the action area only at sites around Lake Chatuge in southwestern North Carolina and northern Georgia. Population estimates range from one plant to more than 2,000 plants. This species is not resilient to changes in habitat. Disturbance, or lack thereof, generally results in declines in numbers or elimination of entire populations. Depending on the type and degree of habitat disturbance, the green pitcher plant may or may not recover in a restored habitat.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local and/or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation under section 7 of the Act.

The area in which the proposed action will be conducted is currently being affected by a variety of actions and activities. Major urban areas exist throughout the action area; those areas are likely affecting the species and habitats within the mainstem of the Tennessee River and its tributaries. Large recreational boats and barge traffic that move upriver and downriver through the action area likely have some effect on aquatic species and habitats; propeller wash creates waves that erode the riverbanks, resulting in sediment deposit on the river bottom. Runoff from adjacent agricultural fields may contain fertilizers and/or pesticides that can affect aquatic organisms. Residential, commercial, and industrial development around some of the reservoirs, particularly those located near major urban centers, have increased over time and is likely to continue; resulting in destruction or alteration of aquatic and terrestrial habitats. These effects have occurred over many years and are likely to continue.

CONCLUSION

After reviewing the current status of the snail darter, pink mucket, and green pitcher plant, the environmental baseline for the action area, the effects of the proposed ROS, and the cumulative

effects, it is the Service's biological opinion that implementation of the preferred alternative (Blend 8), as proposed, is not likely to jeopardize the continued existence of the snail darter, pink mucket, or green pitcher plant, and is not likely to destroy or adversely modify designated critical habitat. No critical habitat is currently designated for these species, therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations under section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. *Take* is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. *Harm* is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. *Harass* is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. *Incidental take* is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by TVA so that they become binding conditions of the Reservoir Operations Study for the exemption in section 7(o)(2) to apply. The Tennessee Valley Authority has a continuing duty to regulate the activity covered by this incidental take statement. If TVA fails to accept and implement the terms and conditions of the incidental take statement, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, TVA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(I)(3)]

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service expects incidental take of the snail darter and the pink mucket will be difficult to detect for the following reasons: (1) the snail darter is a small, secretive fish that typically occurs under rocks or other cover on the bottom of rivers or large streams. If a snail darter dies, it likely would remain under cover, be quickly swept downstream, or consumed by scavengers. Finding a dead individual would thus be highly unlikely; (2) in the event that a dead or impaired individual snail darter is found, attributing death or impairment to implementation of the preferred alternative would be extremely difficult; (3) the pink mucket spends its entire lifetime burrowed into the substrate in large rivers; when an individual dies, it likely remains in place, thus finding a dead individual would be unlikely unless the river was periodically monitored by divers; (4) attributing death of an individual pink mucket to operations under the preferred alternative would be difficult; (5) the pink mucket is rare; individuals are generally scattered randomly over the river bottom in areas containing suitable habitat; finding an individual, live or dead, typically requires intensive searching. However, the following level of incidental take of these species can be expected by loss, alteration, or degradation of their habitats resulting from implementation of the preferred alternative. Changes in water temperature below Cherokee Dam during the latter part of August could disrupt normal reproductive behavior and result in take of all or portions of the following season's year class. Cooler water could also result in take by affecting feeding and thus inhibiting the development of juveniles.

The snail darter currently occurs in the Hiwassee River. The population in that river appears to be stable and reproducing. Late summer temperatures in the Hiwassee River below Appalachia Dam are currently similar to those projected during late summer in the Holston River under the preferred alternative. Thus, it appears that the snail darter is tolerant of water temperatures that may occur (i.e., four to five degrees Celsius cooler than current temperatures) from implementation of the preferred alternative. Consequently, incidental take of snail darters is not anticipated unless more severe water temperature decreases occur.

Based on available records, the pink mucket currently occurs in the Holston River upriver to approximately River Mile 30. We assume that this is presently the upstream limit of the distribution of this species in the Holston River. Temperature tolerance of the pink mucket is not known, therefore it is assumed that there could be incidental take of the species resulting from decreases in water temperature. We assume that take would occur downriver from River Mile 30, and that all pink muckets in the lower thirty miles of the river would be susceptible to take.

Table 2. The incidental take estimated and critical habitat destroyed for the proposed project.

SPECIES	INDIVIDUALS	TAKE TYPE	CH DESTROYED
Snail darter	Cannot be Determined	Harm, Harass	N/A
Pink mucket	Cannot be Determined	Harm, Harass	N/A

Table 3. How the incidental take will be monitored if the specific number of individuals cannot be determined.

SPECIES	CRITICAL HABITAT	HABITAT	OTHER
Snail darter	N/A	Change (decrease) in water temperature downriver from HRM 30.0	
Pink mucket	N/A	Change (decrease) in water temperature downriver from HRM 30.0	

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of expected take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary to minimize impacts of incidental take of the snail darter and/or pink mucket:

1. Water temperature in the Holston River below Cherokee Dam will be monitored to ensure that temperature variations do not exceed those modeled for the ROS.

2. The snail darter population in the Holston River below Cherokee Dam will be monitored. Surrogate species will be selected for monitoring in place of the pink mucket due to its rarity in the Holston River.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Tennessee Valley Authority must comply with the following terms and conditions, which carry out the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Annually between August 15 and September 30, TVA personnel will collect water temperature data from the Holston River below Cherokee Dam. Temperature data will be collected at approximately River Mile 48.0, River Mile 30.0, River Mile 20.0, and River Mile 5.0. Instream data loggers will be placed at each site prior to August 15 to record temperature data over the entire 45-day period. Readings will be taken continuously to provide daily average temperature with variation. If water temperatures at any of the sites decrease by more than two degrees (Celsius) beyond those predicted by the model (e.g., if the model predicted that water temperature would be 18 degrees Celsius during late August at River Mile 30, and the actual temperature at that site is 16 degrees, or lower), the Cookeville Field Office will be contacted. Data will be provided to the Cookeville Field Office supervisor each year at the middle and at the end of this 45-day period. Water temperature monitoring will be conducted for a minimum of four years.

2. TVA personnel will monitor the snail darter population in the Holston River. If declines in numbers, recruitment, or general health of the snail darter population are observed and are attributable to the changes in water temperature beyond

those predicted by the model, the Cookeville Field Office will be notified immediately. Monitoring of the snail darter population will be conducted for a minimum of four years.

3. Because of its rarity in the lower Holston River, it would be difficult to monitor the pink mucket population specifically. Therefore, benthic invertebrates will be monitored as surrogates for the pink mucket. If declines in numbers, recruitment, or general health of the populations are observed and are attributable to changes in water temperature beyond those predicted by the model, the Cookeville Field Office will be notified immediately. Benthic invertebrate monitoring will be conducted for a minimum of four years.

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the Fish and Wildlife Service Law Enforcement Office at (Mr. Steve Middleton, Senior Resident Agent; 220 Great Circle Road, Nashville, TN 37228; telephone 615/736-5532). Additional notification must be made to the Fish and Wildlife Service Ecological Services Field Office in Cookeville, Tennessee. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death or injury.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. Loss of or declines in numbers of populations of temperature-sensitive invertebrates will be assumed to be comparable to loss of or declines in numbers (i.e., incidental take) of pink muckets. If, during the course of the action, populations of monitored invertebrates or snail darters decline by more than 25 percent, and the declines are attributable to changes in water temperature as a result of implementation of the preferred alternative, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Table 4. The incidental take reduced, based on the best available commercial and scientific information, as a result of the implementation of the RPMs.

SPECIES	INDIVIDUALS	
	Project Take	RPM Lowered**
Snail darter	None anticipated	N/A
Pink mucket	All individuals in the Holston River from HRM 30.0 to HRM 0.0	All individuals in the Holston River from HRM 30.0 to HRM 0.0

** The number that the project takes will be reduced as a result of implementation of the RPMs.

Table 5. The index to monitor the level of take and how much the RPMs reduced, based on the best available commercial and scientific information, that level of take.

SPECIES	HABITAT			OTHER	
	Amount Present on Project Site	Amount Project Destroyed or Impacted	Amount that RPM's Lowered the Level of Impact**	Amount Project Impacted	RPM Lowered**
Snail darter	Populations present in Holston, French Broad, Hiwassee, Tennessee rivers; Sewee Creek, South Chickamauga Creek	None anticipated	N/A	None anticipated	N/A
Pink mucket	Populations in the Tennessee R., Clinch R., Holston R., French Broad R., Nolichucky R.	30 river miles in the Holston River	Impact not lowered	Holston River below Cherokee Dam	Impact not lowered

** The amount of habitat or other measurement, used to monitor the level of take for this opinion and species that will be reduced as a result of implementation of the RPMs.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help carry out recovery plans, or to develop information.

We offer the following conservation recommendations for consideration:

1. The Tennessee Valley Authority should continue to maintain its existing database regarding the 59 species evaluated in the biological assessment. Changes in the species' status and distribution should be monitored and recorded. Data should be collected on the status and distribution of other rare, but currently unlisted, species in the Tennessee River drainage as well.

2. The Tennessee Valley Authority should continue to collect data regarding the populations of endangered and threatened species throughout the area under its jurisdiction. Periodic surveys should be conducted to maintain up-to-date information regarding the status of populations of those species. Data collection and surveys should be initiated for other species as they are added to the Service's list of endangered and threatened species.

3. The Tennessee Valley Authority should continue existing programs initiated for the protection of endangered and threatened species and their habitats throughout the area under its jurisdiction. The agency should adopt or maintain an adaptive management approach to management of the Tennessee River Valley system. This will allow for changes to be made as new species are listed or as new information becomes available concerning species already on the Service's list.

4. The Tennessee Valley Authority should begin outreach programs or continue existing outreach programs to educate the public about the importance of, and protection and recovery of, endangered and threatened species in the Tennessee River drainage. These programs should be presented or distributed to schools, civic groups, and local governments in the drainage.

5. The Tennessee Valley Authority should continue to work closely with personnel from the Service, state fish and wildlife agencies, and other conservation organizations to ensure that operation of the Tennessee River Valley system is conducted in a way that will protect terrestrial and aquatic species and their habitats in the Tennessee River drainage.

6. Nutrient enrichment has been identified as a potential problem in the river reach from Guntersville Dam downriver to Decatur, Alabama. TVA should initiate monitoring within that river reach to determine if eutrophication is adversely affecting federally listed mussel species. If this is identified as a problem, TVA should investigate means to reduce enrichment within this reach of the river.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the conservation recommendations carried out.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the consultation request. As written in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary TVA involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the TVA action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the TVA action is later modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease until reinitiation.

For this biological opinion the incidental take would be exceeded when the take exceeds more than 25 percent of the snail darter population or more than 25 percent of the surrogate invertebrates in the lower 30 miles of the Holston River, which is what has been exempted from the prohibitions of section 9 by this opinion. The Service appreciates the cooperation of TVA personnel during this consultation. We would like to continue working with you and your staff regarding the Reservoir Operations Study. For further coordination please contact Mr. Steve Alexander or Jim Widlak of this office at 931/528-6481, ext. 210 or 202, respectively.

Lee A. Barclay, Field Supervisor — 2/09/04 Date

LITERATURE CITED

Parmalee, P.W., and A.E. Bogan. 1998. The Freshwater Mussels of Tennessee. University of Tennessee Press, Knoxville.

Tennessee Valley Authority. 2003. Draft environmental impact statement for the reservoir operations study. Knoxville, Tennessee.

Tennessee Valley Authority. 2003(a). Reservoir operations study programmatic environmental impact statement, biological assessment. Knoxville, Tennessee.

U.S. Fish and Wildlife Service. 2003. Summary report to congress on the recovery program for threatened and endangered species, 1998 and 2000. Washington, D.C.

U.S. Fish and Wildlife Service. 1994. Recovery plan for the green pitcher plant (*Sarracenia oreophila*). Atlanta, Georgia.

U.S. Fish and Wildlife Service. 1992. Endangered and Threatened Species of the Southeast United States (The Red Book). Prepared by Ecological Services, Division of Endangered Species, Southeast Region. Government Printing Office, Washington, D.C. (two volumes).

U.S. Fish and Wildlife Service. 1985. Recovery plan for the pink mucket pearly mussel (*Lampsilis orbiculata*). Atlanta, Georgia.

U.S. Fish and Wildlife Service. 1983. Snail darter recovery plan. Atlanta, Georgia.

APPENDIX 1: Previous Biological Opinions Completed by Fish and Wildlife Service Biologists for the Endangered and Threatened Species Addressed in the Biological Opinion for the TVA Proposed Reservoir Operations Study.

SPECIES	YEAR	INCIDENTAL TAKE NUMBER
Pink mucket	1987	Take not anticipated
Pink mucket	1990	2 individuals
Pink mucket	1991	7 individuals
Pink mucket	1991	Not able to determine
Pink mucket	1992	Incidental take not anticipated with implementation of RPA
Pink mucket	1993	No take authorized
Pink mucket	1993	Not able to determine
Pink mucket	1994	Not able to determine
Pink mucket	1994	Not able to determine
Pink mucket	1994	Not able to determine
Snail darter	1995	One individual
Pink mucket	1996	Six individuals each species over and above 30 allowed for “rescue”
Pink mucket	1999	Not able to determine
Pink mucket	2000	Not able to determine
Pink mucket	2001	Two individuals
Snail darter	2002	No take anticipated
Pink mucket	2002	No take anticipated
Pink mucket	1994	One individual
Pink mucket	1998	One individual
Pink mucket	2000	17 individuals

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