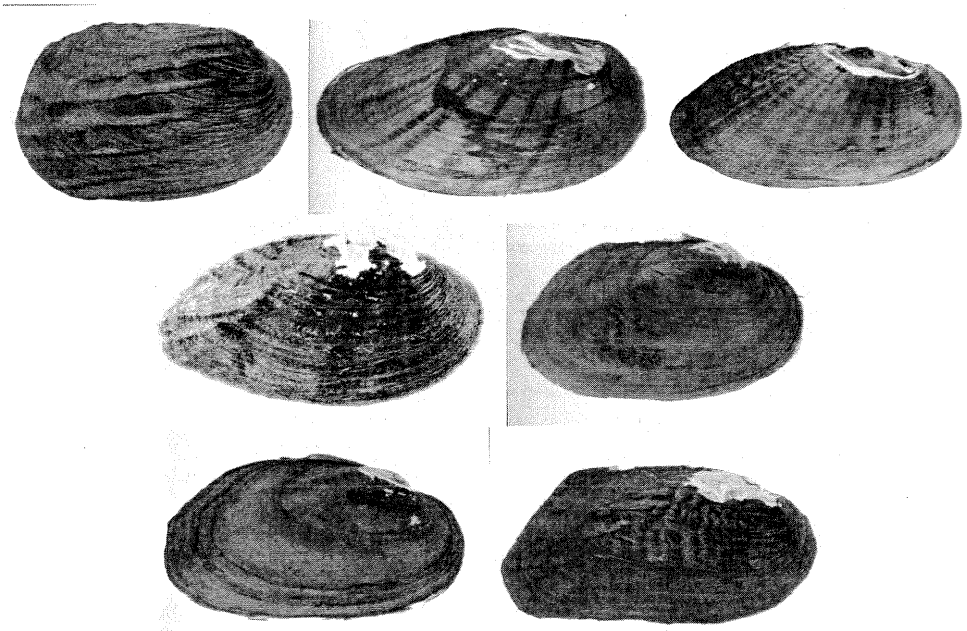
Fat Threeridge (*Amblema neislerii*)
Shinyrayed Pocketbook (*Lampsilis subangulata*)
Gulf Moccasinshell (*Medionidus penicillatus*)
Ochlockonee Moccasinshell (*Medionidus simpsonianus*)
Oval Pigtoe (*Pleurobema pyriforme*)
Chipola Slabshell (*Elliptio chipolaensis*)
Purple Bankclimber (*Elliptoideus sloatianus*)

5-Year Review:
Summary and Evaluation



Photos by Richard T. Bryant

U.S. Fish and Wildlife Service
Southeast Region
Panama City Field Office
Panama City, Florida

5-YEAR REVIEW
Fat Threeridge/*Amblema neislerii*
Shinyrayed Pocketbook/*Lampsilis subangulata*
Gulf Moccasinshell/*Medionidus penicillatus*
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Purple Bankclimber/*Elliptoideus sloatianus*

I. GENERAL INFORMATION

A. Methodology used to complete the review

The Service's Panama City Field Office completed this review. Information sources include: the Recovery Plan for the endangered fat threeridge, shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee moccasinshell, oval pigtoe, and threatened Chipola slabshell and purple bankclimber (Service 2003); peer-reviewed scientific publications; unpublished reports; ongoing field survey results and information from qualified Service and State biologists; the final rule listing the seven species (63 FR 12664); and recently proposed critical habitat (71 FR 32746). All literature and documents used for this review are on file at the Panama City Field Office. All recommendations resulting from this review are the result of thoroughly reviewing all available information on these seven species. The notice of this review was published on September 27, 2006, with a 60 day public comment period. Comments were received from peer reviewers on this document (refer to Appendix A).

B. Reviewers

Southeast Region – Kelly Bibb, 404-679-7132

Panama City Field Office – Karen Herrington (lead), 850-769-0552 x250, Jerry Ziewitz, 850-769-0552 x223

Cooperating Field Offices – Daphne Ecological Services Field Office, Jeff Powell, 251-441-5181; Georgia Ecological Services Field Office, Alice Lawrence, 706-613-9493; Warm Springs National Fish Technology Center, Bill Bouthillier, 706-655-3382

C. Background

1. FR Notice citation announcing initiation of this review: 71 FR 56545 (September 27, 2006)

2. Species status: Recovery Data Call 2006
Fat threeridge: Declining. Significant drought-induced mortality occurred in 2006.

Shinyrayed pocketbook: Improving. Recent surveys indicated range extensions.
Gulf moccasinshell: Unknown. No recent information available.
Ochlockonee moccasinshell: Improving. This was a typographic error and should be "Unknown" because no recent survey information was available.
Oval pigtoe: Declining. Populations declined in abundance.
Chipola slabshell: Unknown. No recent information available.
Purple bankclimber: Stable. Populations persisted over the year.

3. **Recovery achieved:** Recovery Data Call 2006
Fat threeridge: 1*
Shinyrayed pocketbook: 1
Gulf moccasinshell: 1
Ochlockonee moccasinshell: 1
Oval pigtoe: 1
Chipola slabshell: 1
Purple bankclimber: 1
(*1 = 0-25% recovery objectives achieved)

4. **Listing history**
Original Listing
FR notice: 63 FR 12664
Date listed: March 16, 1998
Entity listed: Species
Classification:
Fat threeridge: Endangered
Shinyrayed pocketbook: Endangered
Gulf moccasinshell: Endangered
Ochlockonee moccasinshell: Endangered
Oval pigtoe: Endangered
Chipola slabshell: Threatened
Purple bankclimber: Threatened

5. **Associated rulemakings**
The Service recently proposed critical habitat for all seven species on June 6, 2006 (71 FR 32746).

6. **Review History**
Final Recovery Plan, 2003
Recovery Data Calls: 2000, 2001, 2002, 2003, 2004, 2005, and 2006

7. **Species' Recovery Priority Number at start of review (48 FR 43098):**
Fat threeridge: 5 (5 is a species with a high degree of threat and a low recovery potential)

Shinyrayed pocketbook: 5
Gulf moccasinshell: 5
Ochlockonee moccasinshell: 5
Oval pigtoe: 5
Chipola slabshell: 11 (11 is a species with a moderate degree of threat and a low recovery potential)
Purple bankclimber: 11

8. **Recovery Plan or Outline**
Name of plan: Recovery Plan for Endangered Fat Threeridge (*Amblema neislerii*), Shinyrayed Pocketbook (*Lampsilis subangulata*), Gulf Moccasinshell (*Medionidus penicillatus*), Ochlockonee Moccasinshell (*Medionidus simpsonianus*), and Oval Pigtoe (*Pleurobema pyriforme*); and Threatened Chipola Slabshell (*Elliptio chipolaensis*), and Purple Bankclimber (*Elliptoideus sloatianus*).
Date issued: September 19, 2003

II. REVIEW ANALYSIS

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

Not applicable. These seven species are invertebrates and therefore not covered by the DPS policy.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes.

2. **Adequacy of recovery criteria.**

   a. **Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?** Yes.

   b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?** Yes.

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.**

   Recovery criteria address both demographic measures ("Subpopulation Criteria") and threats to the species ("Listing/Recovery Factor Criteria"). We classified criteria for threats to the species by the five listing factors with the exception of

Factor C (Disease or predation). We did not develop criteria for Factor C because there are little data indicating that disease or predation are limiting factors.

For subpopulation criteria, we loosely defined subpopulations/sites as stream reaches that would typically yield multiple live specimens with approximately 4-6 person hours sampling effort generally separated by reaches of unsuitable habitat. We defined a viable subpopulation as some number of mussels in a particular stream reach that contains: 1) multiple age classes; 2) gravid females during the appropriate season; 3) newly recruited juveniles; and 4) sufficient genetic variability to evolve in response to natural habitat changes without further human intervention.

Subpopulation criteria[1]:

1) Reclassification to threatened status will be considered for the fat threeridge, shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee moccasinshell, and oval pigtoe when each species: 1) has shown an increase in its current range to reflect occupation of at least 50 percent of its historic range; 2) has at least three viable subpopulations in each of the watersheds that currently support the species (Table 1); and 3) has at least ten viable subpopulations in the large river basins within the historic range of the species for at least 3 generations. Table 1 describes the status of these species as reported in the recovery plan, and range extensions are delineated as described in the critical habitat (71 FR 32746).

Table 1. Status of all seven listed species as reported in the 2003 Recovery Plan. We considered collections made pre-1990 as historical and collections post-1990 as current. RM is river mile.

Species, Sub-Basin, State	Historical Extent of Occurrence (RM)	Current Extent of Occurrence (RM)	Number of Extant Sub-Populations
fat threeridge			
upper Flint River, GA	46	0	0
middle Flint River, GA	31	0	0
lower Flint River, GA	103	0	0
Apalachicola River, FL	93	93	~14
Chipola River, FL	35	35	~3
Total	308	128	17

[1] The range of these seven species is divided into river systems and sub-basins within the Apalachicola, Chattahoochee, and Flint (ACF Basin), and the Ochlockonee, and Suwannee rivers. The sub-basins are defined as follows: 1) Econfina Creek; 2) upper Chattahoochee River from headwaters to West Point Dam; 3) middle Chattahoochee River from West Point Dam to W.F. George Dam; 4) lower Chattahoochee River from W.F. George Dam to Jim Woodruff Lock and Dam; 4) upper Flint River, including the headwaters downstream to Warwick Dam which forms Lake Blackshear; 5) middle Flint River from Warwick Dam at Lake Blackshear to the dam at Albany that forms Lake Chehaw, including the Muckafoonee (Muckalee-Kinchafoonee) Creek system; 6) lower Flint River, from the dam at Albany downstream to Jim Woodruff Lock and Dam; 7) Apalachicola River; 8) Chipola River; 9) upper Ochlockonee River above Talquin Reservoir; 10) lower Ochlockonee River below Talquin Reservoir; 11) Suwannee River main channel and tributaries excluding the Santa Fe watershed; and 12) Santa Fe River.

shinyrayed pocketbook			
upper Chattahoochee River, GA	119	0	0
middle Chattahoochee River, AL and GA	169	23	~2
lower Chattahoochee River, AL and GA	58	9	~2
upper Flint River, GA	241	51	~4
middle Flint River, GA	146	110	~11
lower Flint River, GA	259	133	~11
Apalachicola River, FL	4	0	0
Chipola River, FL	137	71	~7
upper Ochlockonee River, GA and FL	127	91	~8
Total	1260	488	45
Gulf moccasinshell			
Econfina Creek, FL	25	25	~2
upper Chattahoochee River, GA	102	0	0
middle Chattahoochee River, AL and GA	176	0	0
lower Chattahoochee River, AL and GA	84	9	~2
upper Flint River, GA	261	35	~3
middle Flint River, GA	127	49	~8
lower Flint River, GA	207	42	~4
Apalachicola River, FL	27	0	0
Chipola River, FL	137	81	~5
Total	1146	241	24
Ochlockonee moccasinshell			
upper Ochlockonee River, GA and FL	94	34	~1
Lower Ochlockonee River, FL	16	0	0
Total	110	34	1
Oval pigtoe			
Econfina Creek, FL	25	25	~2
middle Chattahoochee River, AL and GA	156	0	0
lower Chattahoochee River, AL and GA	84	9	~1
upper Flint River, GA	319	88	~6
middle Flint River, GA	186	102	~11
lower Flint River, GA	261	62	~8
Apalachicola River, FL	27	0	0
Chipola River, FL	162	93	~9
upper Ochlockonee River, GA and FL	88	32	~4
Santa Fe River, FL	102	16	~2
Suwannee River, FL	35	0	0
Total	1445	427	43
Chipola slabshell			
lower Chattahoochee River, AL and GA	6	0	0
Chipola River, FL	107	83	~6
Total	113	83	6
purple bankclimber			
middle Chattahoochee River, AL and GA	93	2	~1
lower Chattahoochee River, AL and GA	75	0	0
upper Flint River, GA	167	105	~2
middle Flint River, GA	33	25	~6
lower Flint River, GA	119	87	~8
Apalachicola River, FL	86	86	~10

Chipola River, FL	50	50	~2
upper Ochlockonee River, GA and FL	67	51	~3
lower Ochlockonee River, FL	47	47	~2
Total	737	453	34

Fat threeridge:

Recovery criteria require an increase of 26 RM in the Flint River basin to achieve occupation in 50 percent of its historical range. An increase from 0 to 3 subpopulations in the Flint River basin is necessary to support the range increase and to establish a minimum of 3 subpopulations per watershed.

Biologists recently re-discovered the fat threeridge in the Flint River. During the summer of 2006, they found seven live adults in the main channel near Georgia State Highway 37 (C. Stringfellow, unpubl. Data 2006; USFWS, unpubl data 2006). Biologists from the GDNR and USFWS revisited the site in May 2007 and found an additional three specimens (Wisniewski 2006b). These collections possibly represent one additional subpopulation; however, all fat threeridge collected at this location were relatively large (i.e., older) adults. Therefore, the viability of this subpopulation is unknown. In addition, we cannot assess the extent of a range increase because they have only been collected from one location. Additional surveys are necessary to document presence at other locations in the Flint River.

Reclassification criteria have not been met because we have only documented one potential subpopulation of the three required in the Flint River and the extent and viability of this subpopulation is unknown. In addition, the generation time for the fat threeridge has not been determined; thus, it is unknown whether ten viable subpopulations have persisted in the ACF for three generations. We are currently working on age structure of the fat threeridge, and we hope this information will lead to an understanding of generation time for this species (see section C.1.b for more information).

Shinyrayed pocketbook:

Recovery criteria require an increase of 142 RM to achieve occupation in 50 percent of its historical range. An increase of four subpopulations is necessary to meet the minimum number of subpopulations per watershed and large basin: two within the Upper Ochlockonee River and one each in the Middle and Lower Chattahoochee River.

We have not documented any new subpopulations in the Ochlockonee River or the Middle Chattahoochee River since the completion of the recovery plan. However, two new subpopulations have been located in the lower Chattahoochee River in Early County, GA: one in Sawhatchee Creek at Dowry Road and the other in Sheffield Mill Creek at Sowhatchee Road (C. Stringfellow, unpubl data

2003; USFWS unpubl data 2003). These subpopulations represent a range increase of 15 RM.

In addition to these required subpopulations, we have also documented several range extensions totaling 157 miles (USFWS unpubl data 2003-2006; C. Stringfellow, unpubl data 2006; M. Gangloff, unpubl data 2006). Seven new subpopulations resulting in range increases were documented in the Flint River drainage: Patsiliga Creek, Chokee Creek, Muckalee Creek, Jones Creek, Iveys Mill Creek, Aycocks Creek, and North Branch Swift Creek (USFWS unpubl data 2006; GDNR unpubl data 2005). In the Chipola River drainage, ten new subpopulations were located in the Chipola River, Cowarts Creek, Dry Creek, and Big/Marshall Creek (J. Garner and S. McGregor unpubl data 2006; C. Stringfellow unpubl data 2006; M. Gangloff, unpubl data 2006). In addition, Dr. Michael Gangloff recently documented one new subpopulation in Econfina Creek, where it has never been documented historically (M. Gangloff, unpubl data 2006). See Section II.C.1.d for more information about shinyrayed pocketbook in Econfina Creek.

Reclassification criteria have been partially fulfilled. Range increases exceed the required 142 RM, but we have documented only one of four required subpopulations, and the viability of many subpopulations is unknown. In addition, the generation time for the shinyrayed pocketbook has not been determined; thus, it is unknown whether ten viable subpopulations have persisted in the ACF and Ochlockonee for three generations.

Gulf moccasinshell:

Recovery criteria require an increase of 332 RM to achieve occupation in 50 percent of its historical range. An increase of two subpopulations is necessary to meet the minimum number of subpopulations per watershed and large basin: one in Econfina Creek and one in the lower Chattahoochee River.

We have not discovered or established new subpopulations in Econfina Creek. However, three new subpopulations have been located in the lower Chattahoochee River in Early County, GA: two in Sawhatchee Creek at Dowry Road and Still Road, and the other in Sheffield Mill Creek at Sowhatchee Road (C. Stringfellow, unpubl data 2003; USFWS unpubl data 2003). These subpopulations represent a range increase of 15 RM.

In addition to these required subpopulations, we have also documented several range extensions totaling 40 RM (USFWS unpubl data 2003-2006; C. Stringfellow, unpubl data 2006; M. Gangloff, unpubl data 2006). Four new subpopulations resulting in range increases were documented in the Flint River drainage: Limestone Creek, Chokee Creek, Jones Creek, and Iveys Mill Creek. In the Chipola River drainage, one new subpopulation was located in Big Creek. Also, one new subpopulation was recently documented in Econfina Creek (M.

Gangloff, unpubl data 2006).

Reclassification criteria have not been met because we have documented only one of two required subpopulations, the range has not increased to the required 332 RM, and viability of many subpopulations is unknown. In addition, the generation time for the Gulf moccasinshell has not been determined; thus, it is unknown whether ten viable subpopulations have persisted in the ACF for three generations.

Ochlockonee moccasinshell:

At the time of the recovery plan, it was unknown whether any subpopulations of the Ochlockonee moccasinshell persisted in its historical range within the Ochlockonee River basin. No live individuals had been collected since 1993, and the Service tentatively based the extent of current occurrence on the collection of shell material. Recovery criteria require an increase in tentative current range by 21 RM to achieve occupation in 50 percent of its historical range. An increase of nine additional subpopulations is necessary to meet the minimum number of subpopulations per large basin.

This criterion has not been met. The Service is currently conducting a large-scale survey throughout the entire historic range of the species during multiple seasons. In August, we located one potential subpopulation. Two live and two dead individuals were collected from this location. These collections possibly represent one subpopulation; however, it occurs within the tentative extent of occurrence and is therefore not a range extension. In addition, these individuals were relatively small, and it is likely that they were recently (2-3 years) recruited. However, the extent and viability of this subpopulation is unknown. We hope to locate additional subpopulations during this survey, which will be complete during the summer of 2008.

Oval pigtoe:

Recovery criteria require an increase of 296 RM to achieve occupation in 50 percent of its historical range. An increase in 17 subpopulations is necessary to meet the recommended number of subpopulations per watershed and large river basin: one in Econfina Creek, two in the lower Chattahoochee River, six in the upper Ochlockonee River, and eight in the Santa Fe River.

We have not discovered or established any new subpopulations in Econfina Creek or the Santa Fe River. However, biologists have discovered three new subpopulations in the lower Chattahoochee River in Early County, GA: two in Sawhatchee Creek at Dowry Road and Still Road, and the other in Sheffield Mill Creek at Sowhatchee Road (C. Stringfellow, unpubl data 2003; USFWS, unpubl data 2003). These subpopulations represent a range increase of 15 RM. In addition, one new subpopulation was located in the upper Ochlockonee River in

Barnetts Creek, Thomas County, GA (USFWS, unpubl data 2004). This represents a range increase of about 12 RM.

In addition to these required subpopulations, we have also documented several range extensions totaling 116 miles (USFWS, unpubl data 2003-2006; C. Stringfellow, unpubl data 2006, M. Gangloff, unpubl data 2006). We documented nine new subpopulations resulting in range increases in the Flint River drainage: Line Creek, Limestone Creek, Little Muckalee Creek, Chokee Creek, Muckalee Creek, Dry Creek, Spring Creek, and North Branch Swift Creek (USFWS unpubl data 2003-2006; GDNR unpubl data 2005; G. Dinkins unpubl data 2006). In the Chipola River drainage, fourteen new subpopulations were located in Big/Marshall Creek, Baker Creek, Dry Creek, Cowarts Creek, and the Chipola River.

There is also one potential range increase and subpopulation in Spring Creek where biologists from USFWS recently found several fresh dead individuals in Early County, GA above County Road 152 (B. Bouthillier pers comm. 2007). Additional surveys are necessary at this site to verify that live individuals persist at this location.

Reclassification criteria have not been met because we have only documented three of seventeen required subpopulations, the range has not increased to the required 296 RM, and viability of many subpopulations is unknown. In addition, the generation time for the oval pigtoe has not been determined; thus, it is unknown whether ten viable subpopulations have persisted in the ACF and Ochlockonee for three generations.

2) Delisting of the five endangered mussels, the Chipola slabshell and purple bankclimber will be considered when biennial monitoring shows that an increase of the current number of subpopulation/sites and extent of occurrence is enough to ensure population viability, reduce isolation among populations, and increase the potential for genetic exchange. Specific increases in subpopulations and river miles needed are currently unknown and will be determined by completing Recovery Tasks 1.3.6, 1.3.7, and 1.3.8.

We have not made progress on these Recovery Tasks; therefore, this criterion has not been met.

Listing/Recovery Factor Criteria:

Factor A – Present or threatened destruction, modification or curtailment of its habitat or range:

3) Water quality and quantity are fully supporting a designated use of fishing or fish and wildlife habitat (Section 305(b) of the Clean Water Act) in all stream reaches where the seven mussels occur.

This criterion has not been met. As reviewed in the proposed critical habitat rule, water quantity is a problem in the lower Flint River and upper Chipola river basins during droughts, as irrigated agriculture is the largest consumptive water use (Marella et al. 1993). These streams are highly sensitive to groundwater withdrawal, and they can and do go dry during droughts (Albertson and Torak 2002). Spring Creek and other streams containing listed mussels went dry during droughts in 2000 and 2006-2007 (USFWS, unpubl data 2000 and 2007). In addition, according to the water quality agencies of the three States in their periodic assessments under Section 305(b) of the Clean Water Act (CWA), water quality is impaired or potentially impaired in some portions of all four river basins within the current range of the seven mussels. We reviewed specific impairments and segments in the recent proposed critical habitat rule for these 7 mussels (71 FR 32746).

4) Sub-basins currently supporting subpopulations of the seven mussels and those needed for recovery are not further fragmented by new dams, water withdrawals, or other habitat alterations that may preclude the movement of host fish species between occupied sites.

This criterion has not been met. The construction of Lake McIntosh has been proposed in Line Creek near Peachtree City, GA. This area was surveyed in 2006 in the vicinity of the Peachtree City airport and eight live oval pigtoes of various sizes were found (G. Dinkins unpubl data 2006). These individuals were found downstream of the area that will be inundated by Lake McIntosh, and this is currently the only known subpopulation in the Line Creek watershed. The construction of this impoundment may result in the extirpation of this subpopulation. In addition, the U.S. Army Corps of Engineers (Corps) is considering a permit to impound Tired Creek, which is a large tributary to the Ochlockonee River. This proposed reservoir may impact water quality and quantity of flows to the Ochlockonee River, thus potentially affecting listed species downstream. In addition, streams in the lower Flint and upper Chipola rivers are susceptible to drying during droughts. Dry portions of streams represent further habitat fragmentation resulting from water withdrawals.

5) Stream channels at all sites occupied by the seven mussels are stable (not actively aggrading or degrading or undergoing excessive bank erosion) and adjacent riparian zones are adequately vegetated.

This criterion is not met. As summarized in the proposed critical habitat rule, channel instability is an almost ubiquitous threat in the range of the seven mussels. A wide variety of activities, such as livestock grazing, road and bridge construction, unpaved roads, clear-cut logging, and off-road vehicle use, are common in all basins. We are currently undertaking large-scale habitat threats assessments in the Chipola and Ochlockonee rivers to assess the amount of channel instability and to prioritize areas for restoration.

Factor B – Overutilization for commercial, recreational, scientific, or educational purposes:

6) Encourage States to continue to prohibit commercial and recreational harvest of these seven species and enforce existing regulations regarding harvest.

This criterion is currently met. Commercial and recreational harvest of all seven species is illegal in Alabama, Florida, and Georgia. The three states enforce regulations through the law enforcement divisions of the Alabama Department of Conservation and Natural Resources, Florida Fish and Wildlife Conservation Commission, and Georgia Department of Natural Resources. We do not consider overutilization for commercial or recreational purposes a threat at this time.

7) Limit harvest for scientific and educational purposes to activities that support recovery and tasks outlined in this recovery plan or updated versions.

This criterion is currently met. Alabama, Georgia, and Florida require scientific collecting permits for all seven species. All three states have special, stringent requirements for permanent retention/harvest of these species. The lead recovery biologist also reviews required federal permits to ensure the proposal addresses recovery plan actions. We do not consider overutilization for scientific and educational purposes a threat at this time.

Factor D – Inadequacy of existing regulatory mechanisms:

8) Complete research to identify if numerical criteria for pollutants are protective of the different life stages for freshwater mussels. If criteria are not protective, work with other regulatory agencies to revise the criteria.

This criterion is partially met. A comprehensive work detailing recent research assessing contaminant sensitivity of early life stages of freshwater mussels will be published in September 2007 in an entire issue of the journal Environmental Toxicology and Chemistry. In this issue, results of numerous studies indicate that early life stages of mussels generally were more sensitive to copper and ammonia than other organisms, and the current ammonia and copper criteria are not protective (Wang et. al, in press a; Wang et. al, in press b; Newton and Bartsch, in press; March et. al, in press). However, the Florida criterion for ammonia is lower than the U.S. Environmental Protection Agency (EPA) requirements and is currently protective for mussels. In addition, early life stages of mussels may be particularly sensitive to pesticides and herbicides such as glyphosate and atrazine (Bringolf et al, in press a; Bringolf et. al, in press b).

9) Ensure that all stream reaches that support subpopulations of these listed species meet existing and new water quality criteria that may be developed.

This criterion is not met. As mentioned under criterion #3, water quality is impaired or potentially impaired throughout the range of these seven species. In addition, once the September issue of Environmental Toxicology and Chemistry is available, we will work with the EPA to ensure the ammonia and copper criteria are based on the best available science and are protective of mussels.

Factor E – Other natural or manmade factors affecting its continued existence:

10) Zebra mussels and black carp are not introduced or established in the sub-basins supporting the seven species.

These species are not currently found in these watersheds; therefore, this criterion has been met. Alabama, Georgia, and Florida either prohibit the possession of live black carp or require a permit for their import, possession and/or distribution of individuals that are either sterile, non-sterile (e.g., diploid, triploid), or both. Zebra mussels are also a prohibited species in Florida.

11) Relatively stable, non-imperiled populations of host-fish are present in each sub-basin.

This criterion cannot be confirmed. Known fish hosts for these species include common species: largemouth bass, spotted bass, bluegill, redear sunfish, weed shiner, sailfin shiner, blackbanded darter, and brown darter. Populations of these species exist in these basins, and none of the eight fishes is protected under the Act or considered imperiled range-wide (Williams et al. 1989). However, monitoring data from FWC indicate that some species of native shiners, redbreast sunfish, madtoms, bullhead catfish have declined in catch and percent abundance numbers and in some cases have become increasingly rare in several river basins in Florida (T. Hoehn, pers comm. 2007). Preliminary information also indicates that largemouth bass, bluegill, redear sunfish, spotted suckers, and redbreast sunfish year-class and abundance numbers are affected by flow regime in the Apalachicola River (Cailteux et al 2007; T. Hoehn pers. comm. 2007).

12) Genetic diversity is sufficient within sub-basins.

This criterion has not been met. We have not completed work to determine how much genetic diversity is necessary within sub-basins.

13) Weak links in the life cycle of each species are identified and remedied through research, habitat improvement, propagation, translocation, or other means.

This criterion has not been met. We have not yet identified weak links in the life cycles of these species or begun propagation or translocation efforts.

C. Updated Information and Current Species Status

1. Biology and Habitat:

In the following sections, we note only updates in the biology and habitat of the species that is new since the Recovery Plan and/or proposed critical habitat rule.

a. New information on the species' biology and life history:

Fat threeridge:

The fat threeridge is generally found at water depths less than 5 feet in the Apalachicola River (Miller 2005; EnviroScience 2006a; EnviroScience unpubl data 2006). Miller (2005) found that it was most abundant at depths ranging from 3 to 5 ft (highest abundance at 4 ft). EnviroScience (2006a) found most fat threeridge within 5 m of the shoreline at depths less than 5 ft. Both of these surveys were conducted at discharges generally greater than 9,000 cfs; however, similar patterns of fat threeridge distribution depths are also observed when flows are much lower (about 5800-6000 cfs) (EnviroScience unpubl data 2006; Drew Miller unpubl data 2007). Because the fat threeridge was found at similar depths at various flows, it likely prefers depths of less than 4-5 ft, and moves to maintain these depths in response to changing river stage.

Chipola slabshell:

Researchers from Columbus State University recently documented the successful transformation of glochidia on bluegill (*Lepomis macrochirus*) (L. Preister unpubl data 2007). Thus, bluegill is likely one of the host fish species for the Chipola slabshell.

b. 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:

The fat threeridge, shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee moccasinshell, oval pigtoe, Chipola slabshell, and purple bankclimber have all undergone significant reduction in abundance.

Fat threeridge:

In 2005, the Florida Department of Environmental Protection (EnviroScience 2006a) commissioned a survey of listed mussels in the Apalachicola River.

During qualitative surveys of over 160 sites in the Apalachicola and Chipola River system, the fat threeridge was the fourth most common species detected (CPUE/hr = 6.5), comprising 25% of the total live individuals in both qualitative and quantitative samples. They found the greatest numbers of fat threeridge in relatively shallow habitats along channel margins, secondary channels, and the upstream-most segment of Swift Slough (average density of 2.3/m^2 (±0.3 SE) and a maximum density of 28/m^2 in Swift Slough and Apalachicola River margin RM 44.3) (EnviroScience 2006a). In the Chipola River and Chipola Cutoff, they also found the fat threeridge in deeper, but stable mid-channel habitats.

In the 2006 Recovery data call, we classified the fat threeridge as declining. During the summer of 2006, a basin-wide drought occurred (which continues today), and we received reports of mass stranding and mortality of fat threeridge in the Apalachicola River and Swift Slough. Surveys of the river in 2005 and 2006 (EnviroScience, 2006a; USFWS, unpubl data 2006) demonstrated that the fat threeridge was more abundant than previously believed; however, most of the areas of high density surveyed in 2005 and 2006 were also subjected to high mortality as river levels decreased during the summer. This represents a significant impact to the population and is the reason we classified the species as declining. Pending results of current distribution and abundance studies, the mortality observed in 2006 may represent a short-term population decline and not a long-term trend. More information regarding the implications of this drought-based mortality can be found in a recent Biological Opinion (USFWS 2006). Preliminary results of surveys this summer (2007) indicate that mortality continues in high numbers in Swift Slough (G. Zimmerman, EnviroScience, pers. comm.), but large numbers of fat threeridge have been found alive in the main channel (D. Miller, unpubl data 2007; USFWS unpubl data 2007).

EnviroScience (2006b) also completed a population estimate for fat threeridge in Swift Slough during the summer of 2006. The estimate applies to the upstream-most mile of the stream and follows quantitative methods outlined by Strayer and Smith (2003). The estimated abundance per sampled reach was used to calculate an average abundance estimate of 787 (462-1473 90% confidence interval) fat threeridge per 50m reach, which was then multiplied by 23 50-m reaches representing the upstream-most segment of Swift Slough for a population estimate of 18,101 (10,626 – 33,879 90% CI). This estimate excludes pool habitats, areas occupied outside of the upstream segment, and bed elevations above the stage associated with 6,300 cfs at the Chattahoochee gage. All of these excluded areas contain some fat threeridge; therefore, the total number of fat threeridge in Swift Slough is likely greater than 18,101. Swift Slough is currently not flowing and disconnected from the main channel, and biologists from EnviroScience are re-visiting these locations to determine survival of this population.

We also began to collect age-specific demographic data for fat threeridge during the summer of 2006. As described in detail in the ACF Biological Opinion (2006), the Service collected fresh-dead shells for age and growth analysis. We

sent eight shells of various sizes to Virginia Tech (J. Jones, USFWS) for aging via examination of internal annuli (Neves and Moyer 1988). Ages of the eight shells ranged from 3 years old (42 millimeter total length) to 32 years old (82 mm total length). We used these data to estimate total annual mortality and survival (Anthony et al. 2001; San Migel et al. 2004; van den Ayvle and Hayward 1999; Slipke and Maceina 2001). Results indicated that the overall annual mortality rate is about 18% (i.e., 82% survival from year to year) for individuals aged 8 and older. These data also indicated that year class strength was variable by year and by location.

We have continued to age additional shells collected during the summer of 2006 in order to increase the sample size and confidence in these analyses. Currently, we have aged 31 individuals ranging from 31-85 mm total length. Ages range from 2-27 yrs old (USFWS, unpubl data 2007). Additional data indicated that the overall annual mortality rate was about 23% (77% survival from year to year), and year class strength continued to vary (USFWS, unpubl data 2007). This work will continue though FY2008.

Shinyrayed pocketbook and oval pigtoe:

A recent study completed by GDNR and the Georgia Cooperative Fish and Wildlife Research Unit found that detection of shinyrayed pocketbook in the Lower Flint River Basin was 76% while detection for oval pigtoe was 37%. This suggests that it may require several repeat visits to collect rare species at a site (J. Wisniewski pers. comm. 2007).

Purple bankclimber:

Although recent survey data suggest the purple bankclimber is relatively stable in the Ochlockonee and Flint rivers, it is perhaps the rarest member of the Apalachicola River mussel fauna (USFWS, unpubl data 2003-2006). It represented less than 2% of the Corps' survey findings from 1996 to 2002 (Miller 2005), and 1% of the EnviroScience (2006a) survey findings in 2005, half of which were detected at a single location. The species represented much less than 1% of USFWS surveys in 2006 (USFWS, unpubl data 2006). In addition, we are aware of only two reports of relatively small (size class 75-96 mm) purple bankclimbers collected recently in Apalachicola River: one in the Chipola Cutoff (EnviroScience 2006a) and the other in Swift Slough (EnviroScience unpubl data 2006), which suggests either poor reproductive success or sampling methods that are not suited to detecting juveniles of this species. We do not know the extent and viability of many subpopulations throughout the range of the species, and further surveys for juveniles are necessary in all basins.

Chipola slabshell:

During the 2005 survey by EnviroScience (2006a), biologists located only one single live Chipola slabshell in the Chipola River downstream of Dead Lake (EnviroScience 2006a). The Service is presently funding a mussel survey to determine the status and distribution of the Chipola slabshell (and other species) in the Chipola Basin. Those surveying in conjunction with this study have currently collected over 300 individuals from ten new subpopulations and six previously known subpopulations. Results from this study are expected in FY2008.

c. Taxonomic classification or changes in nomenclature:

Shinyrayed pocketbook:

As discussed in the proposed critical habitat rule, we listed the shinyrayed pocketbook under the scientific name *Lampsilis subangulata*. It is currently assigned to the newly recognized genus *Hamiota* (Roe and Hartfield 2005), and we plan to formally recognize the name change in a separate rule-making.

Oval pigtoe:

As discussed in the recovery plan and proposed critical habitat rule, the taxonomic status of the oval pigtoe is unclear. A recent study using molecular genetic techniques compared tissue samples from three of the four basins where the oval pigtoe occurs (Econfina Creek, ACF, and Suwannee), and concluded that the Suwannee samples were distinctive and warranted specific status as *P. reclusum* (Kandl et al. 2001). We have deferred any revisions to the listing taxonomy pending review of an analysis that includes samples from the Ochlockonee Basin as well. Peer review and publication of a genetic analysis of samples from all four basins is expected sometime in 2007 (J.D. Williams, pers. comm. 2007).

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

We estimate that the fat threeridge, shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee mocassinshell, and oval pigtoe are each extirpated from over half of their historical ranges, and the Chipola slabshell and purple bankclimber are extirpated from about one-third of their historical ranges.

Shinyrayed pocketbook:

Biologists recently collected 16 shinyrayed pocketbooks from Econfina Creek at Florida Hwy 388, Bay County, FL (M. Gangloff, unpubl data 2006). The historic distribution of the shinyrayed pocketbook does not extend to Econfina Creek. Either this collection constitutes a change in its historic distribution or a potential introduction to this drainage. Further research is necessary to document the range of shinyrayed pocketbooks in Econfina Creek.

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

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

The declining range and abundance of the seven mussels is due mostly to changes in their riverine habitats resulting from dams, dredging, mining, channelization, pollution, sedimentation, and water withdrawals. These threats continue today, (refer to USFWS 2003 and 71 FR 32746 for further detail). In addition, the review of recovery criteria under Factor A (Section II.B.3, Listing Criteria) describes the status of many of these threats.

Sedimentation and water pollution continue to be an almost ubiquitous threat in the range of the seven mussels. The construction and operation of dams, water withdrawals, and water diversions may alter features of the flow regime important to the mussels and their host fishes. This threat is present to some degree throughout the entire range of the seven listed species, but it is greatest in the Flint, Apalachicola, and lower Ochlockonee, which are downstream of the major mainstem dams or in areas of relatively high municipal, industrial, or agricultural water use. Sand and gravel mining, dredging, and channelization also affect channel stability and improper road crossing structures may prevent passage of fish hosts. All of these activities currently occur throughout the range of these seven listed mussels.

In addition, we have documentation of several specific new threats:

1. Recent activities conducted in Spring Creek, Miller County, GA, involved driving mechanized equipment along stretches within the stream channel, uprooting mature trees from stream banks, and removal of partially-embedded large, woody debris from the stream channel. This reach of Spring Creek harbored shinyrayed pocketbook and oval pigtoe prior to the drought in 2000-2001 when the channel went dry. During this drought, we rescued mussels from this portion of the channel and held them in refugia at Warm Springs National Fish Hatchery. We returned shinyrayed pocketbooks and oval pigtoes to this area after the drought. Resulting from current drought conditions, this reach is now dry again. We recently revisited it and collected fresh dead oval pigtoes and shinyrayed pocketbooks, indicating that these species do persist in this portion of the

creek (S. Abbott, pers comm. 2007). Although we have no direct evidence that these activities resulted in take, mussel habitat was altered/destroyed. The Georgia Environmental Protection Division directed Miller County officials to perform habitat restoration throughout the creek, but unauthorized habitat alteration likely will continue to threaten habitat of Spring Creek.

2. We recently completed a biological opinion on the effects of U.S. Army Corps of Engineers operations for Jim Woodruff Dam and the Associated Releases to the Apalachicola River (USFWS 2006). The channel of the Apalachicola River appears to be continuing to change (Light et al. 2006; Price et al. 2006) as the river seeks dynamic equilibrium. We described how channel morphology changes have likely contributed to a substantial decline of the fat threeridge and purple bankclimber in the upstream-most 30 miles of the river. Mean bed elevation declined to some degree from 1960 to 2001 throughout the nontidal portion of the Apalachicola River (Price et al. 2006), and this decline is greatest in the upper river. These data suggest that dam-induced bed degradation continues to migrate downstream beyond RM 65 (Light et al. 2006). This reach may also narrow slightly due to deposition of eroded material at the river training structures. Some additional widening and aggradation may occur in the middle reach before narrowing begins.

   In the RM 50 to RM 40 reach, including the Chipola Cutoff, and Swift Slough, channel instability most likely explains an unprecedented mussel mortality during low flow in the summer of 2006. The long-term effects of the channel instability in this reach are unknown. We believe that the reach between RM 50 and RM 40 is still susceptible to a substantial redistribution of sediments during future high-flow events and potential substantial mussel mortality during low-flow events. We are currently working with the Corps to investigate channel instability and mussel distribution in this section of the river, and we will continue to monitor potential drought-induced mortality.

   At this time it appears that the main channel habitats favored by the fat threeridge are moderately depositional areas associated with eddies (USFWS unpubl data 2007). Eddies shift location over time through the process of lateral channel migration. When the shift is relatively abrupt, mussels may be stranded in areas that are later exposed. It is possible we observed such an episode in 2006. In 2007, the stranding sites are becoming terrestrial habitat and mussels are found in high numbers downstream of these habitats (D. miller unpubl data 2007; USFWS unpubl data 2007). It is important to note that this system is dynamic and mussels are adapted to some degree of habitat change; however, we do not yet know if we are observing normal rates of habitat change. Our work with

the Corps should help us understand the rate of habitat change and implications for mussels in the Apalachicola River.

In addition to continuing main channel instability, Swift Slough appears to have substantially aggraded with sediment in the period since 2002. Swift Slough was connected to the main channel at a flow of about 5,000 cfs during 2000 (which is the minimum release from Jim Woodruff Dam), and now becomes disconnected from the main channel at a flow of about 5,600 cfs. At the time of this review, Swift Slough is disconnected from the main channel, and flows in the Apalachicola River are about 5,100 cfs (USGS unpubl gage data 2007). Last year, mussels experienced high mortality rates in Swift Slough, and high mortality rates continue this year (G. Zimmerman, pers. comm. 2007). The threat of loss of perennial flow to this population of fat threeridge (which is estimated to be over 18,000) is substantial.

3. During surveys for the Ochlockonee moccasinshell, we recently visited portions of the main channel of the Ochlockonee River from U.S. Interstate 10 to Florida State Road 12. Substantial habitat alteration is occurring in this portion of the river. Eroding banks are common and the channel is aggrading, resulting in reduction of habitat quantity and quality in the Ochlockonee River. We are currently conducting a large-scale habitat threat assessment to investigate potential causes of channel instability and to prioritize areas for habitat restoration. Results from this study are expected in FY2008.

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

We do not consider overutilization a threat at this time (Section II.B.3, Listing/Recovery Factor Criteria).

c. Disease or predation:

Although natural predation is not considered a threat, it may be a problem during low-water years. Predation on mussels has been observed during the drought of 2007 in the Spring Creek watershed (J. Wisniewski pers comm. 2007). Numerous, half-eaten unionids have been observed in the vicinity of raccoon and otter tracks. However, this predatory behavior is more likely due to insufficient water levels in these creeks and minimally impacts mussels during normal and wet years.

d. Inadequacy of existing regulatory mechanisms:

The review of recovery criteria under Factor D (Section II.B.3, Listing Criteria) describes the status of these threats. The final listing rule stated that existing authorities, such as the CWA, may not have been fully utilized in the protection of

aquatic systems. All three state agencies are currently applying regulatory mechanisms under CWA to both point and nonpoint source problems identified throughout the range of these seven species; however, water quality threats continue to persist. In addition, as described in the review of recovery criteria under Factor D, EPA water quality criteria for ammonia and copper may not be protective of early life stages of freshwater mussels (Wang et. al, in press a; Wang et. al, in press b; Newton and Bartsch, in press; March et. al, in press). Although far less defined, information is becoming available that suggest that unregulated pesticides (or their carriers) in surfaces waters may pose risk to some mussel species (Doran et al. 2001; Bringolf et al, in press a; Bringolf et. al, in press b). Evaluation of these limitations to the national water quality criteria may be warranted. Also, little is known about thermal tolerances of mussels, and water quality criteria for temperature also may not be protective of all life stages of mussels (Bartsch et al. 2000).

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

The review of recovery criteria under Factor E (Section II.B.3, Listing Criteria) describes the status of these threats which include the presence and potential introduction of non-indigenous species (especially zebra mussel and black carp); insufficient densities of host-fish species in streams supporting the seven mussels; lack of subpopulation connectivity (leading to inbreeding depression and other genetic considerations); and possible weak links in the species' life cycles.

Although zebra mussels and black carp have not been introduced in the range of the seven mussels, the potential consequences of introduction (especially for zebra mussels and black carp) continue to be severe. In addition, flathead catfish and blue catfish have been introduced in the ACF. These fishes are known to consume mussels and fishes and negatively impact fish populations that may be hosts for endangered unionids. Monitoring data from FWC indicate that populations of redbreast sunfish, snail and spotted bullhead catfish, and other species have declined since the late 1980s, which may be the result of predation by the flathead catfish (T. Hoehn, pers comm.). Lack of subpopulation interconnectivity also continues to remain high, as dams continue to fragment populations. We have not made any progress on the recovery tasks that identify weak links in species life cycles.

The risk of insufficient host fish densities also continues because we do not know all of the host fish for these species. Riverine fish populations in the Southeast generally have been adversely affected by a variety of the same habitat alterations that have contributed to the decline of the region's mussel fauna (Etnier 1997; Neves et al. 1997; Warren et al. 1997). We described specific declines in fish host species in Florida in Section II.B.3. As described in Section II.C.2.a., sedimentation, water pollution, dam construction and operation, water withdrawal, dredging, mining and channelization continue to be an almost ubiquitous threat to fish hosts in the range of the seven mussels. In addition, the

specific threats to Spring Creek, the Apalachicola River, and the Ochlockonee River also apply to host fish.

Lastly, we have received information that mussel translocations of non-listed Elliptio and Villosa species are occurring in Whitewater Creek, which is proposed critical habitat for purple bankclimber, shinyrayed pocketbook, oval pigtoe, and Gulf moccasinshell. The effect of the translocations on listed species is unknown. Although oval pigtoes are difficult to distinguish from Villosa lienosa, no oval pigtoes are currently known to occur in Whitewater Creek. GADNR and the Service will continue to evaluate the situation.

D. Synthesis

We do not recommend a change to the classification or priority ranking of any of the seven listed mussels. The seven species are highly restricted in distribution, occur in generally small subpopulations, and show little evidence of recovering from historical habitat losses without significant positive human intervention. The species and their habitats continue to be impacted by excessive sediment, channel instability, gravel mining, reduced water quality, developmental activities, water withdrawal, impoundments, and invasive species. Their limited distributions and small populations render them vulnerable to random natural or human-induced events such as droughts or spills. The degree of threat to the persistence of the five endangered species remains high (and moderate for the two threatened species), and the potential for recovery for all seven species remains low.

While some progress has been made on achieving the recovery of these mussels, with the exception of range increases in the shinyrayed pocketbook, none of the subpopulation recovery criteria have been met for any of the seven species. Importantly, we do not yet understand how many subpopulations are necessary to ensure population viability, reduce isolation among populations, and increase the potential for genetic exchange. These data gaps were to be addressed in three specific recovery tasks; however, no progress has been made on these tasks. In addition, many of the listing/recovery criteria (threats) are not currently met. Water quality is not meeting designated use (CWA – Section 305(b)) and stream channels are not stable with intact riparian zones throughout the range of the seven species. Further, recent research indicates some numerical criteria for pollutants are not protective of early life stages of these mussels. Because all seven species continue to have reduced fragmented distribution and continued threats, the status of all seven species should remain unchanged.

III. RESULTS

A. Recommended Classification

__X__ **No change is needed**

B. New Recovery Priority Number _No change is needed_

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. The subpopulation recovery criteria defining a subpopulation as a site is vague and less meaningful than actual density or population estimates. As we acquire more information about population characteristics, we should revise recovery criteria. We recommend using quantitative methods to monitor changes in population size with each sub-basin.
2. Define "viable subpopulation" through implementation of Recovery Tasks 1.3.6, 1.3.7, and 1.3.8.
3. Reduce/prevent threats to existing populations and their habitats through habitat restoration programs and partnerships with various stakeholders
4. Continue to work with State and Federal partners to incorporate conservation approaches into flow requirements and water allocation strategies
5. Work with the EPA and States to modify numerical water quality criteria for ammonia and copper
6. Develop and implement a program to monitor subpopulation levels and habitat conditions of existing subpopulations
7. Continue re-evaluating threats to these mussels

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW OF THE
Fat Threeridge (*Amblema neislerii*)
Shinyrayed Pocketbook (*Lampsilis subangulata*)
Gulf Moccasinshell (*Medionidus penicillatus*)
Ochlockonee Moccasinshell (*Medionidus simpsonianus*)
Oval Pigtoe (*Pleurobema pyriforme*)
Chipola Slabshell (*Elliptio chipolaensis*)
Purple Bankclimber (*Elliptoideus sloatianus*)

Current Classification:

Fat threeridge: Endangered
Shinyrayed pocketbook: Endangered
Gulf moccasinshell: Endangered
Ochlockonee moccasinshell: Endangered
Oval pigtoe: Endangered
Chipola slabshell: Threatened
Purple bankclimber: Threatened

Recommendation resulting from the 5-Year Review:

__X__ **No change is needed**

Appropriate Listing/Reclassification Priority Number, if applicable N/A

Review Conducted By Karen Herrington, Panama City Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Jay A. Carmody Date 8/15/07

REGIONAL OFFICE APPROVAL:

for **Lead Regional Director, Fish and Wildlife Service**

Approve Noreen E. Walsh Date 9/17/07

APPENDIX A: Summary of peer review for the 5-year review of the Fat Threeridge (*Amblema neislerii*), Shinyrayed Pocketbook (*Lampsilis subangulata*), Gulf Moccasinshell (*Medionidus penicillatus*), Ochlockonee Moccasinshell (*Medionidus simpsonianus*), Oval Pigtoe (*Pleurobema pyriforme*), Chipola Slabshell (*Elliptio chipolaensis*), Purple Bankclimber (*Elliptoideus sloatianus*)

A. Peer Review Method:

The peer reviewers were asked to provide comment on the document, with emphasis on the overall assessment of the status of the seven mussels, including the data summarized and any other pertinent data of which they might be aware.

B. Peer Review Charge:

Potential reviewers were initially contacted (via individual email dated 07/05/07) to see if they were available to review the document. If they were available, a formal request was sent (via individual emails dated 07/14/2007) requesting comments on the 5-year review. We also provided electronic copies of the guidance for peer reviewers and USFWS 1994 peer review policy. Requests were sent to Mr. Chris Crow (CCR Environmental), Mr. Jeff Garner (ADCNR), Mr. Ted Hoehn (FWC), Ms. Megan Pilarczyk, Mr. Douglas Shelton (Alabama Malacological Research Center), and Mr. Jason Wisniewski (GDNR).

C. Summary of Peer Review Comments/Report

We did not receive comments from Ms. Megan Pilarczyk (Wake Forest University) or Mr. Douglas Shelton (Alabama Malacological Research Center).

Mr. Chris Crow, CCR Environmental, Inc., Atlanta, GA:
Mr. Crow noted that he did not have formal comments, but he provided summaries of recent field surveys (by his company and others) in the Flint River drainage as part of the Lake Blackshear hydro re-licensing effort, Still Branch Reservoir, and several Georgia Department of Transportation projects including the State Road 32 bridge replacement, PoDiddy Road, and Line Creek. He also expressed concern and his belief that the mussel community in the upper Flint River mainstem is near extirpation. He noted that monitoring projects at several sites indicate a decrease in mussels and the need for additional studies.

Mr. Jeff Garner, Alabama Department of Conservation and Natural Resources, Florence, AL:
Mr. Garner responded with a letter of support for the Service's recommendation in the 5-year review. No additional comments were received from Mr. Garner.

Mr. Ted Hoehn, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL:
In general, Mr. Hoehn concurred with most statements in the document. He concurred with our assertion that subpopulation criteria are vague and may not be biologically accurate, and he noted once criteria are revised, the number of subpopulations for each species may be decreased. He suggested that we consider the home ranges of the host fish species to help define the extent of a subpopulation because higher densities of mussels may be found where the host fish

populations overlap with known mussel locations. He discussed a specific method for analyzing the spatial extent of known mussel collections using home ranges of host fish which can be found in the DFO file.

Mr. Hoehn also expressed concern that purple bankclimber is in more of a decline than characterized in the document because critical life history data is lacking and the extent and viability of the populations are not known. He believes that further surveys for juveniles are necessary. He also suggested we expand our discussions on non-native species to include flathead catfish as a species that can have significant impacts upon the host fish populations, thereby affecting mussel populations.

Mr. Hoehn did not agree with the statement that relatively stable populations of the host fish species exist in each of the basins. He noted that monitoring data from FWC indicate that some species of native shiners, madtoms, bullhead catfish and other short-lived species are declining in catch and percent abundance numbers and in some cases have become increasingly rare in several river basins. Preliminary information indicates that largemouth bass, bluegill, redear sunfish, spotted suckers, and redbreast sunfish year-class and abundance numbers are affected by flow regime in the Apalachicola River (Cailteux et al 2007; Mesing pers. comm). Populations of redbreast, snail and spotted bullhead catfish, and other species have declined since the late 1980s, which may be the result of predation by the flathead catfish.

He also noted that the statement that mussels may be stranded or deposited by high flows is still a matter of further discussion and possible disagreement, and mark recapture surveys may be one of the only methods to confirm that this assertion is accurate. With regard to Swift Slough, he agreed that there has been bed aggradation, but that one reason for the changes in connection flow is the duration of the decline in river flow. He detailed how Swift Slough connection flows have ranged from 4,500 cfs to 5,600 cfs over the past 10-years; therefore, the rate of decline in the mainstem greatly affects the ability of downcutting through the sediments at the head of Swift Slough in providing connection flow.

Mr. Jason Wisniewski, Georgia Department of Natural Resources, Social Circle, GA:
Mr. Wisniewski noted that overall the document appears to be accurate and includes most of the pertinent information available for the review. He also provided the following additional information and concerns:

1. The two new subpopulations of shinyrayed pocketbook, oval pigtoe, and Gulf moccasinshell in the Lower Chattahoochee River Basin should not be considered separate subpopulations. Sheffield's Mill Creek is a tributary to Sawhatchee Creek and is less than one kilometer from the best-known population of these three unionids on Sawhatchee Creek. No barriers to fish passage appear to occur in this reach, which could allow gene flow to occur between the two locations.
2. There is little information to support the statement that recent recruitment has occurred in Sawhatchee Creek. The range in total length for these three species in small, and mark recapture data indicate that mean growth between 2005 and 2007 was less than 1 mm for all three species. One of 15 female H. subangulata collected in 2007 had an inflated marsupium; however, the stage of development of the eggs/glochidia in this individual was not checked.

3. He and Gerry Dinkins of Dinkins Biological Consulting discovered an additional subpopulation of H. subangulata and P. pyriforme in North Branch Swift Creek during a 2005 survey. Two live individuals of each species were collected at the site at Warwick-Arabi Road in Crisp County GA. However, it is likely that this subpopulation is closely connected to the subpopulation of these species in Swift Creek.
4. Estimates of Amblema neislerii density in Swift Slough do not indicate the precision of this estimate. Because unionids tend to occur in clumped distributions in very specific habitats, density estimations are often imprecise. Standard error should be added in order to give credibility to this estimate.
5. A recent study completed by Mr. Wisniewski and Dr. Jim Peterson (Georgia Cooperative Fishery and Wildlife Research Unit) found that detection of H. subangulata in the Lower Flint River Basin was 76% while detection for P. pyriforme was 37% suggesting that it may require several repeat visits to collect rare species at a site (Wisniewski and Peterson, in review).

Mr. Wisniewski also noted several additional threats that should be included in this document:

1. The construction of Lake McIntosh has been proposed in Line Creek near Peachtree City, GA. Gerry Dinkins surveyed Line Creek in the vicinity of the Peachtree City airport and found 8 live P. pyriforme in May 2005. These individuals were found in the area that will be inundated by Lake McIntosh and are currently the only known population of these unionids in the Line Creek watershed. The construction of this impoundment will likely result in the extirpation of this subpopulation.
2. Alleged illegal unionid translocations are being conducted in Whitewater Creek, a tributary to Line Creek. It is possible that endangered unionids, such as P. pyriforme, are being moved.
3. The introduction of flathead catfish into the Chattahoochee and Flint rivers and the introduction of blue catfish into the Chattahoochee River was not included in the review. These fishes are known to consume both unionids and negatively impact fish populations that may be hosts for endangered unionids.
4. Predation on unionids has been observed during the drought of 2007 in the Spring Creek watershed. Numerous, half eaten unionids have been observed in the vicinity of raccoon and otter tracks. However, this predatory behavior is more likely due to insufficient water levels in these creeks and minimally impacts endangered unionids during normal and wet years.

D. Response to Peer Review

Mr. Chris Crow, CCR Environmental, Inc., Atlanta, GA:
With the exception of Line Creek, the surveys he described were already included in the status review. We incorporated changes from the Line Creek survey as appropriate.

Mr. Jeff Garner, Alabama Department of Conservation and Natural Resources, Florence, AL:
No action was necessary as he only commented on our recommendation.

Mr. Ted Hoehn, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL:

We agreed with most comments and incorporated them into the document. We did not incorporate his comments relative to Swift Slough at this time because this issue is unresolved and currently in litigation. We noted his suggestion to consider the home ranges of the host fish species to help define the extent of a subpopulation, and we will address it in the future when we re-define the subpopulation criteria.

Mr. Jason Wisniewski
Georgia Department of Natural Resources, Social Circle, Georgia, (770) 918-6411
We agreed with most comments and incorporated them into the document. Although Mr. Wisniewski may be correct that the subpopulations of shinyrayed pocketbook, oval pigtoe, and Gulf moccasinshell in the Lower Chattahoochee River Basin are not separate, we currently consider them separate based on the criteria described in the recovery plan. If we revise these criteria in the future as recommended, we will revisit this comment.

All minor editorial comments provided by the reviewers were incorporated into the document. Additionally, we re-assessed the status of each species, given the added information from peer reviewers; no changes in status recommendations were made.