Speckled Pocketbook
(Lampsilis streckeri Frierson 1927*)*

5-Year Review:
Summary and Evaluation

Photo Courtesy: Chris Davidson, US Fish and Wildlife Service

U.S. Fish and Wildlife Service
Arkansas Ecological Services Field Office
Southeast Region

March 2015

5-YEAR REVIEW
Speckled Pocketbook (*Lampsilis streckeri* Frierson 1927)

I. GENERAL INFORMATION

A. Methodology used to complete review

We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period on March 25, 2014 (79 FR 16366). During the comment period, we did not receive any additional new information about Speckled Pocketbook from the public. Additional information used in this report was gathered from unpublished data collected by the Service's Arkansas Ecological Services Field Office (AES) and Arkansas Game and Fish Commission (AGFC) and unpublished reports in AES files. This review was completed by the lead recovery biologist in the AES.

A draft of this 5-year review was circulated to three persons for peer review. Comments and suggestions regarding the review were received from Bill Posey, Arkansas Game and Fish Commission; Josh Seagraves, Arkansas Highway and Transportation Department; and Dr. John Harris, Arkansas State University. No part of the review was contracted to an outside party. Recommendations are a result of thoroughly reviewing the best available information on this mussel and based in the author's expertise as one of the leading experts on this species.

B. Reviewers

Lead Region: Southeast Region: Kelly Bibb, (404) 679-7132

Lead Field Office: AES – Chris Davidson, (501) 513-4481

C. Background

1. **Federal Register Notice initiating this review:** (79 FR 16366), March 25, 2014.

2. **Species Status:** Stable. Monitoring data obtained by AES and AGFC from 2008 – 2009 indicates presence of individuals at a greater number of localities than previously known. Number of individuals at previously documented sites is equal to or greater than previous surveys.

3. **Listing History**
   Original Listing
   FR notice: 54 FR 8339
   Date listed: February 28, 1989
   Entity listed: Species
   Classification: Endangered

4. **Associated rulemakings:** None

5. **Review History**

5-Year Reviews

U.S. Fish and Wildlife Service. 2007. Speckled Pocketbook 5-year review: summary and evaluation. Conway, AR. 16 pp.

5-year review November 6, 1991 (56 FR 56882) – In this review, different species were simultaneously evaluated with no in-depth assessment of the five factors, threats, etc. as they pertained to the different species' recovery. In particular, no changes in status were proposed for this mussel.

Status Reviews

Harris, J.L., W.R. Posey II, C.L. Davidson, J.L. Farris, S.R. Oetker, J.N. Stoeckel, B.G. Crump, M.S. Barnett, H.C. Martin, M.W. Matthews, J.H. Seagraves, N.J. Wentz, R. Winterringer, C. Osborne, and A.D. Christian. 2010a. Unionida (Mollusca: Margaritiferidae, Unionidae) in Arkansas, Third Status Review. Journal of the Arkansas Academy of Science 63 (2009):50-86.

Harris, J. L., P. J. Rust, A. C. Christian, W. R. Posey II, C. L. Davidson and G. L. Harp. 1998. Revised status of rare and endangered Unionacea (Mollusca: Margaritiferidae, Unionidae) in Arkansas. Journal of the Arkansas Academy of Science 51 (1997):66-89.

Clarke, A. E. 1987. Status survey of *Lampsilis streckeri* Frierson (1927) and *Arcidens wheeleri* (Ortmann and Walker 1912). A report to the U. S. Fish and Wildlife Service. 24pp. plus field notes.

6. **Species' Recovery Priority Number at start of review (48 FR 43098)**: 8. This number reflects a moderate degree of threat and a high recovery potential.

7. **Recovery Plan :**
Name of plan: Speckled Pocketbook Mussel (*Lampsilis streckeri*) Recovery Plan.
Date issued: January 2, 1992

II. REVIEW ANALYSIS

A. **Application of the 1996 Distinct Population Segment (DPS) policy:** The DPS policy only applies to vertebrate species. Since the Speckled Pocketbook is an invertebrate, the DPS policy does not apply.

B. Recovery Plan and 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?** No.
The objective of this plan is to reclassify the Speckled Pocketbook from endangered to threatened status. The Speckled Pocketbook may be reclassified when:

(1) four additional populations are discovered or reestablished,
(2) all five populations are viable and the habitat fully protected, and
(3) viable population levels are maintained for a period of at least 20 years.

The recovery criteria for reclassification are stringent considering only five stream populations are known from historical literature and the species is endemic to the Little Red River watershed in Arkansas. The main stem Little Red River population has been permanently lost due to inundation in Greers Ferry Reservoir and cold water releases in its tailwaters. The Middle Fork Little Red River was believed to be the only remaining stream population at listing (Service 1989) and as recently as 2003. However, populations persist in the four forks of the Little Red River and Big Creek, a tributary to the Little Red River downstream of Greers Ferry Reservoir. Given this information, no additional populations could be added to develop delisting criteria.

The definition of a viable population in the recovery plan does not provide a measure for reproductive capability other than to state it must "*...sustain itself without immigration of individuals from other populations.*" Mussel populations generally are considered persistent and viable if there is demonstrated and sustainable natural reproduction and recruitment as evident by multiple age classes of individuals, including naturally recruited juveniles, and recruitment rates exceeding mortality rates for a period of five consecutive years or three consecutive surveys at three to five year intervals. Since three of five stream populations are fragmented by Greers Ferry Reservoir, immigration of individuals from other populations is unlikely to occur. Observations of gravid females and recruitment of Speckled Pocketbook young into the population has only been documented in two of the four forks. However, it is unknown at this time whether recruitment rates exceed mortality rates in these populations.

The recovery plan is a departure from the normal recovery process to expect 100 percent recovery of stream populations for reclassification. Revising the recovery criteria to better address the five listing factors is required so measurable recovery

criteria can be developed and applied to downlist and delist this species. Delisting also may not warrant recovery in 100 percent of populations.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threats)? No.

3. List the recovery tasks as they appear in the recovery plan, and discuss how each task has or has not been achieved?

The 1992 Recovery Plan (USFWS 1992) for Speckled Pocketbook includes the following recovery tasks. Each recovery task and extent to which it has or has not been met is discussed below. New information is available for Tasks 1.1, 1.2, 3.1, 3.2 and 4.2 since the previous five year review.

Task 1.1 Conduct population surveys

A comprehensive status survey for Speckled Pocketbook in Big Creek is still required to establish baseline information on distribution and abundance. A 1992 status survey provides baseline data on distribution and abundance of Speckled Pocketbook in the lower reaches of the South, Middle, and Archey forks Little Red River (Harris 1992). The four forks of the Little Red River were comprehensively surveyed in 2004 – 2005 and 2008 – 2009 (C. Davidson pers. comm.; ANHC database 2014). Long-term monitoring sites were established during the 2008 – 2009 assessment and will be monitored at a seven year interval. A summary of additional surveys follows.

1991 – Harris, J. L. – Conducts a survey for *Lampsilis streckeri* in the Middle Fork Little Red River at the proposed NOARK pipeline crossing prepared for ENSR Consulting and Engineering.

1993 – Harris, J. L. – Habitat characterization and species associates of the Speckled Pocketbook (*Lampsilis streckeri*) in the Middle Fork Little Red River, Arkansas.

2003 – Winterringer, R. – Population dynamics and reproductive patterns of the federally endangered freshwater mussel, *Lampsilis streckeri.*

2005 – AES – Survey for Speckled Pocketbook in a selected reach of Big Creek, a northern tributary of the Little Red River below Greers Ferry Reservoir.

2006 – AES and AGFC – Survey for Speckled Pocketbook in Middle Fork Little Red River from Little Red Creek confluence to Winterringer (2003) upstream Speckled Pocketbook occurrence.

Task 1.2 Use legislation to protect habitat

Sources of nonpoint source pollution in the Little Red River watershed include a variety of land uses that allow bare earth to enter streams (e.g., timber harvesting, natural gas development, unpaved roads, etc.). Current federal and state laws do not adequately protect Speckled Pocketbook habitat from nonpoint source pollution, as the laws to prevent sediment and other contaminants from entering waterways are poorly enforced. Best management practices (BMPs) for erosion control are often recommended or required through industry certifications or state and federal permits. Compliance, monitoring, and enforcement of these recommendations are often poorly implemented, but implementation is improving in the upper Little Red River watershed.

The Arkansas Department of Environmental Quality has designated the Archey, Middle, South, and Devils forks Little Red River as ecologically sensitive waterbodies. This designation provides for more stringent water quality criteria and restricts certain activities that may degrade water quality or habitat (*e.g.*, instream gravel mining). However, short-term activity authorizations to exceed existing water quality protections for up to 30 days for construction activities are routinely issued to permit applicants. Therefore, existing regulatory mechanisms have been insufficient to significantly reduce and remove threats to Speckled Pocketbook.

Task 2.1 Characterize habitat

Preferred habitat types for adult Speckled Pocketbook have been described by Harris (1993) and Winterringer (2003).

Task 2.2 Determine associate species

Several surveys (refer to Task 1.1) have documented associate species and composition in the upper Little Red River watershed and Big Creek. A population dynamics (refer to Task 1.1) study was completed by Winterringer in 2003 that provides mussel community abundance and composition for the Middle Fork Little Red River.

Task 2.3 Develop life history data

Winterringer (2003) determined reproductive patterns, including fish host identification and refined artificial propagation techniques, for Speckled Pocketbook.

Harris *et al.* (2004) investigated the limits and phylogeography of Lampsilinae in Arkansas with emphasis on species of *Lampsilis*. Speckled Pocketbook specimens formed a well supported monophyletic group, within the *Lampsilis reeveiana* complex, that is significantly divergent from *L. reeveiana*. This finding was consistent with the Speckled Pocketbook's current taxonomic status as a distinct species.

Harris *et al.* (2010b) further explored genetic relationships between Speckled Pocketbook and *L. reeveiana*. They suggested that *L. reeveiana* and Speckled Pocketbook may co-occur in the Little Red River basin. However, there is no reason to assume that *L. reeveiana* like individuals/populations could maintain genetic isolation among a population that is overwhelmingly Speckled Pocketbook. Speckled Pocketbook is a relatively recent divergence from *L. reeveiana* and the divergence is shallow. Therefore, some Speckled Pocketbook specimens may come out more closely aligned with *L. reeveiana* in some analyses, but they are still Speckled Pocketbook (Harris 2015 pers. comm.).

Task 3.1 Develop plan to restore historic habitat

The recovery plan identified the need to restore habitat in the lower Archey and South forks Little Red River (3.5 river miles) that once supported Speckled Pocketbook but currently does not due to channel modifications for flood control in the mid – 1980s. A coalition of partners began developing a plan in 2008 to restore this 3.5 river mile reach. Restoration efforts were completed in 2014. The endemic Yellowcheek Darter, which also was extirpated from this river reach, was collected within the restored reach in October 2014.

A programmatic Safe Harbor Agreement (SHA) for the upper Little Red River watershed was signed by the AES, Arkansas Game and Fish Commission, Natural Resources Conservation Service, and The Nature Conservancy in 2007. To date, 12,195 acres have been enrolled under the programmatic agreement and approximately 49,000 acres have draft property owner management agreements (POMAs). Total perennial and intermittent stream length protected via signed (POMAs) is 47.7 river miles. Conservation measures implemented on enrolled properties in the South and Middle Forks have resulted in a reduction of approximately 1,400 tons of sediment/year from reaching waterways (Service 2013).

The programmatic agreement was amended in 2014 to include additional federally protected and aquatic species of greatest conservation need. The associated permits are currently pending review by the Service and should be issued in 2015. While enrollment of properties has been delayed for two years due to requirements to amend the permits, enrollment is expected to begin again in 2015.

Other efforts to restore historical habitat include an unpaved roads inventory, unpaved road workshops in the watershed, a statewide initiative to develop an unpaved roads program, development of BMPs for natural gas development activities, plans to remove two fish passage barriers on the Middle Fork, and the ECH_2O (Energy Conserving Water) initiative started by Southwestern Energy with a goal, among others, to reforest 300 acres/year of pastureland in the watershed.

Task 3.2 Develop plan for reestablishing mussel populations
Significant progress has been achieved during the past six years in restoring and improving historical and occupied habitat for Speckled Pocketbook. Propagation techniques have been developed for Speckled Pocketbook, but no plan to reestablish or augment populations exists or is planned at this time. It is the opinion of species experts that distribution and abundance is sufficient to sustain extant populations and at current levels should allow for population expansion into suitable habitat as habitat quality continues to improve.

Task 3.3 Implement plan to restore historic habitat
Refer to Task 3.1.

Task 3.4 Implement plan to reestablish populations in historical habitat
Refer to Task 3.2.

Task 4.1 Determine minimum population levels
Refer to Task 3.2.

Task 4.2 Develop plan to monitor populations
Long-term monitoring sites (N = 35) were established in 2008 – 2009 for the four forks of the Little Red River. Sites will be monitored at seven year intervals. Due to limited access and the remoteness of Big Creek, a monitoring plan has not been established yet.

Task 4.3 Implement monitoring plan
Refer to Task 4.2.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Spatial distribution, abundance and population trends

The current distribution for Speckled Pocketbook is unchanged since the Service's (2007) previous five year review. It is restricted to the Middle Fork Little Red River from the influence of Greers Ferry Reservoir upstream to the confluence of Little Red Creek (63 river miles (rmi)), the South Fork Little Red River extending from 0.5 rmi downstream of Arkansas Highway 95 upstream to near the western boundary of Gulf Mountain Wildlife Management Area and the Ozark National Forest (15 rmi), Archey Fork Little Red River from approximately one rmi upstream of Arkansas Highway 65 to the confluence of Castleberry Creek (16 rmi), lower Turkey Creek (2 rmi), and Beech Fork (11rmi; Figure 1). The known range of Speckled Pocketbook in Big Creek includes the reach from Tylar Road to the western (also most downstream) boundary of Big Creek Natural Area (17 rmi; Figure 1).

All extant populations continue to appear stable. Based on 2008 – 2009 sampling at long-term monitoring sites, 59 individuals were collected in the South Fork, 34 individuals in the Archey Fork, 127 individuals in the Middle Fork, and 12 individuals in the Devils Fork complex (Turkey Creek and Beech Fork). Newly established long-term monitoring sites are expected to contribute to a better understanding of population trends. Populations in Archey and Middle forks have documented reproduction and recruitment, but natural recruitment rates and mortality rates are unknown.

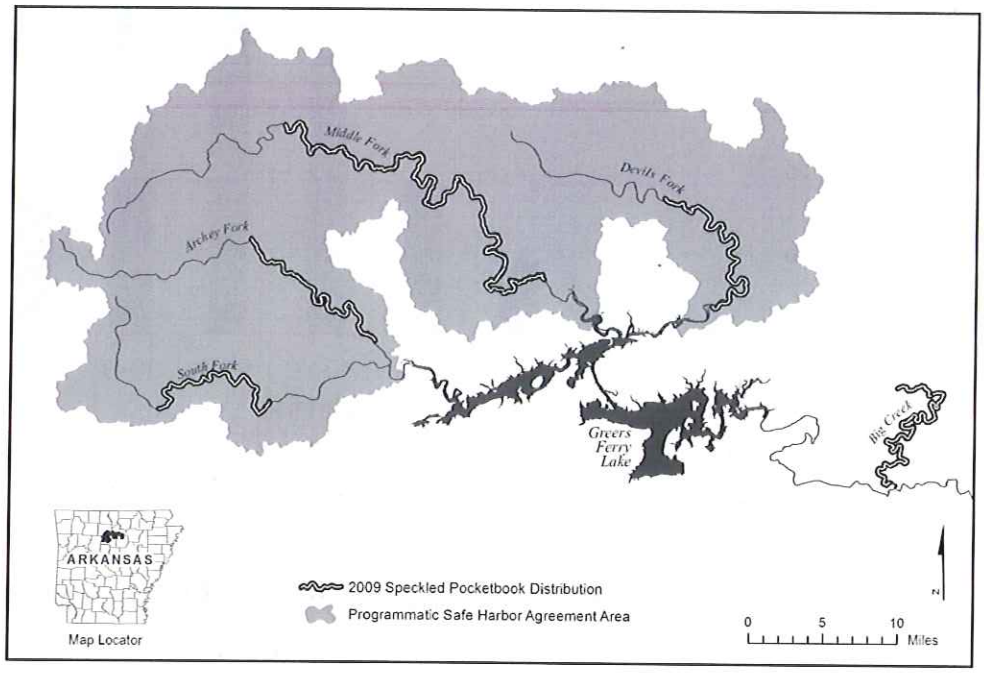

Figure 1. Distribution of Speckled Pocketbook in the Middle, South, Archey, and Devils Forks Little Red River.

b. Demographic characteristics

Winterringer (2003) analyzed 49 Speckled Pocketbook individuals from the Middle Fork for sex, size, and gravidity status. Sex ratio was near 1:1 (23 females, 26 males). Combining 145 individuals collected since Winterringer's (2003) sampling in 2001, sex ratios range from 1:1 – 1:1.5 for the Middle Fork (76 females, 118 males), Archey Fork (13 females, 18 males), South Fork (26 females, 27 males), and Devils Fork complex (5 females, 7 males). Sex ratios were not reported for Big Creek collection sites in 2005.

Winterringer (2003) reported age structure for the Middle Fork of five to 11 year old individuals. Several 1 year old juveniles were collected from Archey Fork in 2005 (C. Davidson, pers. comm.). Mean lengths for Speckled Pocketbook in the Middle, South, Archey, and Devils forks are 62.9 (SD = 14.3), 66.3 (SD = 8.7), 73.1 (SD = 8.4), and 63.2 mm (SD = 10.1), respectively (Figures 2 – 5). Measurement data were not reported for Big Creek collection sites in 2005.

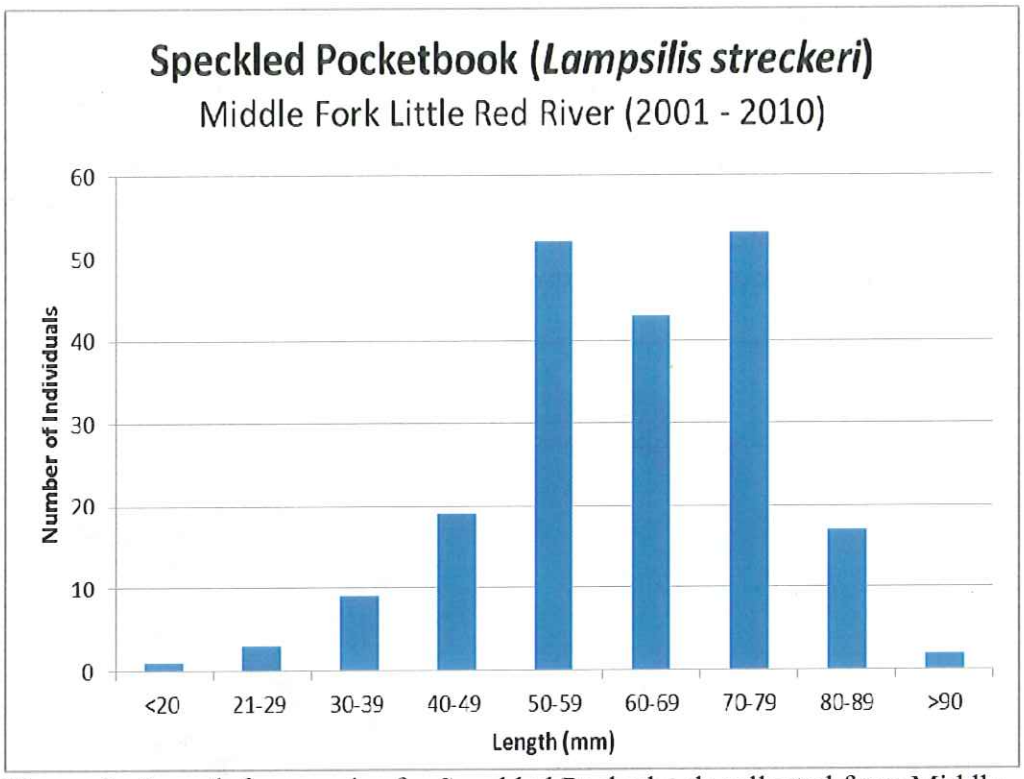

Figure 2. Length frequencies for Speckled Pocketbook collected from Middle Fork Little Red River, 2001 – 2010 (Winterringer 2003; C. Davidson, pers. comm.).

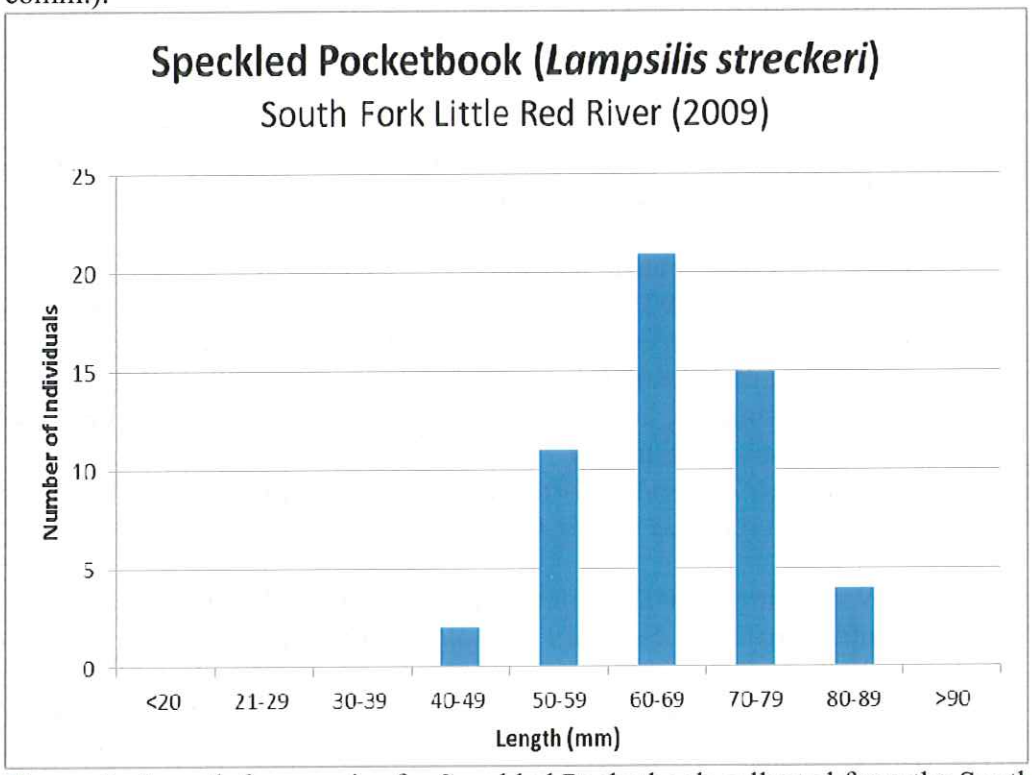

Figure 3. Length frequencies for Speckled Pocketbook collected from the South Fork Little Red River in 2009 (C. Davidson, pers. comm.).

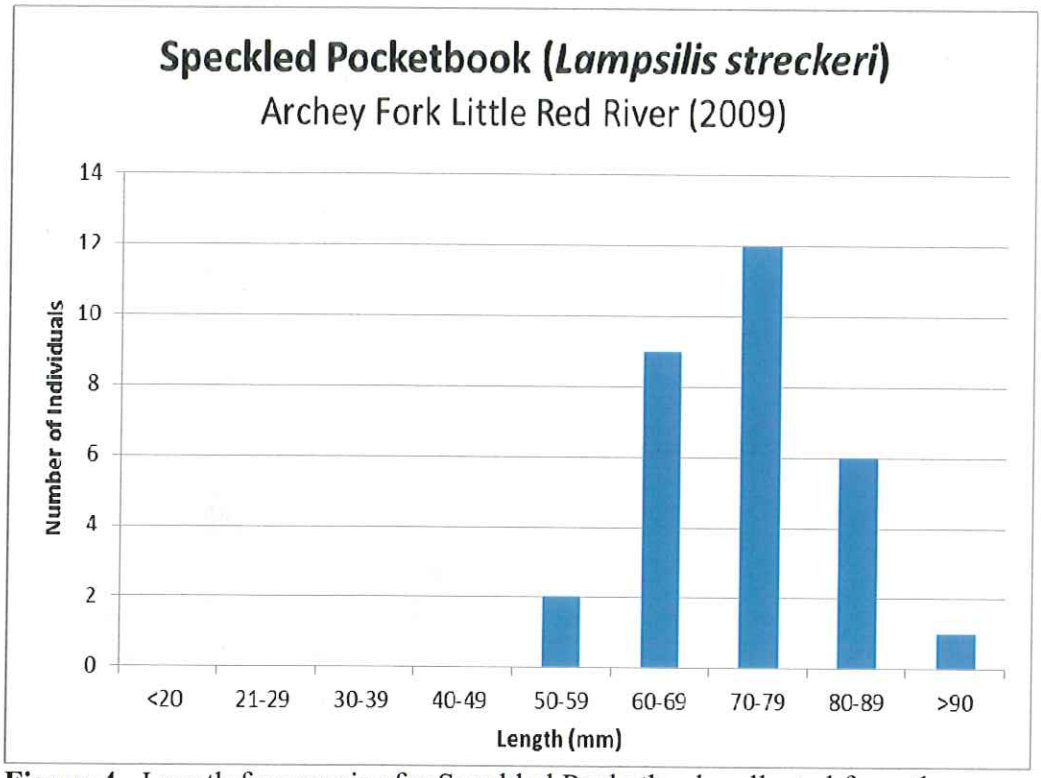

Figure 4. Length frequencies for Speckled Pocketbook collected from the Archey Fork Little Red River in 2009 (C. Davidson, pers. comm.).

The reproductive cycle of the Speckled Pocketbook is similar to other native freshwater mussels. Males release sperm into the water column. The sperm are then taken in by the females through their siphons during feeding and respiration. The females retain the fertilized eggs in their gill marsupium until the larvae (glochidia) fully develop. The gill marsupium, which is used as a lure to mimic host fish prey, is attacked by a potential fish host, the female releases the larvae which then infest the fish, but will only transform to juveniles if it is a suitable host.

Gravid females have been observed from June – August in the Archey, Middle, and South Forks (Davidson and Wine 2004; Winterringer 2003; C. Davidson pers. comm.). Females have been observed releasing glochidia in February. Winterringer (2003) tested 22 fish species for their potential as suitable host. Larvae successfully transformed on sunfishes (Centrarchidae), with greatest success occurring with the green sunfish (*Lepomis cyanellus*; Table 1).

c. Habitat

There is no new information on habitat suitability for the Speckled Pocketbook. Suitable habitat occurs in pools and runs with small to large boulders which have some accumulation of sand/gravel. Individuals are typically located in crevices between boulders or underneath perched boulders (Harris 1993; Winterringer 2003; C. Davidson pers. comm.).

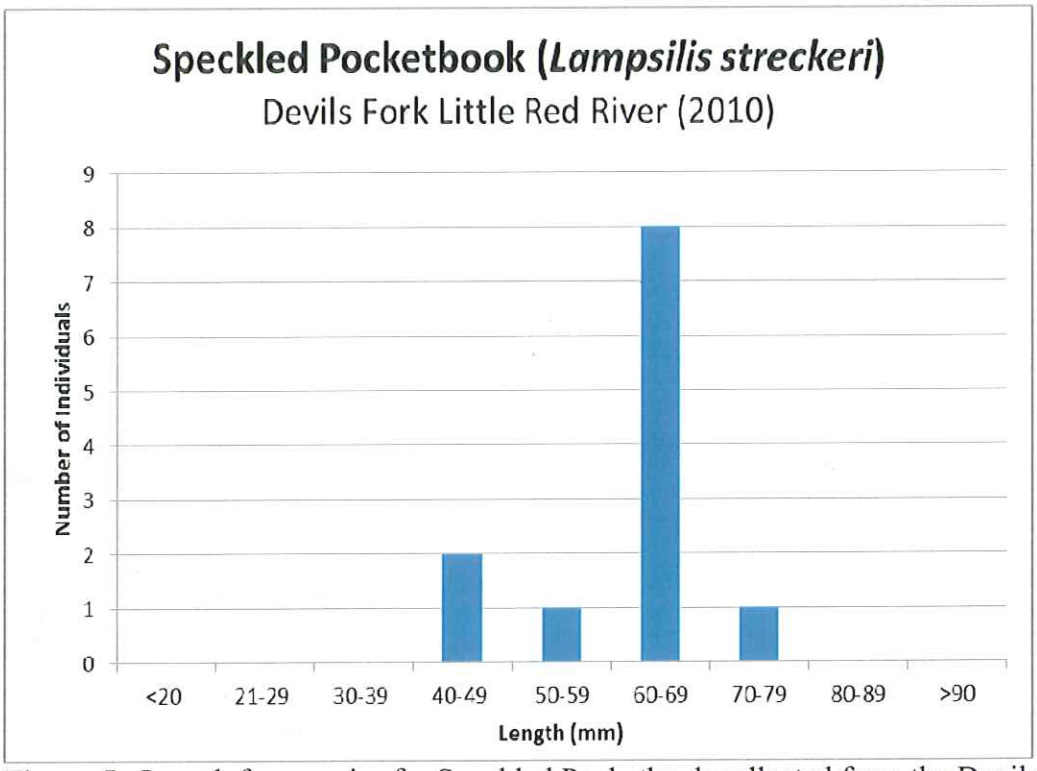

Figure 5. Length frequencies for Speckled Pocketbook collected from the Devils Fork (Turkey Creek and Beech Fork) Little Red River in 2010 (Service unpubl. data).

Table 1. Suitable fish hosts for the Speckled Pocketbook (Winterringer 2003).

Scientific Name	Common Name	First Trial	Second Trial	Transformation Rate (%)
Ambloplites ariommus	Shadow Bass	23	NT	0.9
Lepomis cyanellus	Green Sunfish	195	692	36.5
Lepomis macrochirus	Bluegill	341	NT	14.0
Lepomis gulosus	Warmouth	417	33	18.5
Lepomis megalotis	Longear Sunfish	466	25	20.2
Micropterus dolomieu	Smallmouth Bass	0	47	1.9
Micropterus punctulatus	Spotted Bass	27	167	8.0
Total Glochidia		1,469	964	100.0
NT = Not tested				

2. Five Factor Analysis (threats)

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

Existing threats include sediment and other contaminants derived from a variety of land use practices (*i.e.*, nonpoint source pollutants) and water consumption for fracking natural gas wells (primarily in the South Fork and Big Creek watersheds). Natural gas infrastructure development has subsided substantially since circa 2012. It appears unlikely, at this time, that substantial development of

mineral resources (*i.e.*, natural gas) will occur in the upper South Fork, mid to upper Middle Fork, Archey Fork, and upper Devils Fork watersheds due to insufficient quantities of natural gas for profitability. While threats posed by natural gas development in the watershed have subsided, sediment and other chemical contaminants derived from gravel and rock mining, agricultural practices, and dirt and gravel road maintenance and construction appear to continue degrading suitable Speckled Pocketbook habitat.

A major threat at the time of listing was channelization of the lower Archey and South forks. With completion of the Archey Fork restoration project in 2014, this threat has been alleviated and suitable habitat for recolonization is present. The construction of Greers Ferry Reservoir resulted in the permanent loss of habitat and isolation of populations (Middle and Devils forks, Big Creek) due to inundation and cold tailwater releases downstream of the dam. Information on gene flow between populations and effective population size is lacking at this time. Fragmentation and isolation of small populations, particularly in Big Creek and the Devils Fork complex, may play a magnified role in population extirpation associated with stochastic events.

b. Overutilization for commercial, recreational, scientific, or educational purposes:
There is no evidence to suggest that overutilization is a threat.

c. Disease or predation:
Muskrats and turtles are known to prey on Speckled Pocketbook, but predation is not considered a substantive threat at this time. We also have no evidence of disease in Speckled Pocketbook.

d. Inadequacy of existing regulatory mechanisms:
Regulatory mechanisms (*e.g.*, Clean Water Act [CWA] and ADEQ Regulation 2) are in place to protect water quality and habitat for Speckled Pocketbook. However, these regulatory mechanisms remain largely ineffective due to permitting practices that allow permittees to exceed water quality standards for 30 days (*i.e.*, ADEQ short-term activity authorization; refer to Task 1.2 for additional information). Despite some reductions in point source discharges, adequate protection may not be provided by the CWA for filter feeding animals, such as Speckled Pocketbook, that can be affected by extremely low levels of contaminants. Speckled Pocketbook populations in the Middle Fork and South Fork Little Red River may be subjected to pervasive, albeit subtle, effects of chronic, low-level contamination that is ubiquitous in the upper Little Red River watershed. However, there is no specific information known about the sensitivity of Speckled Pocketbook to common point source pollutants from industrial and municipal effluents. Because there is very little known about water quality parameters necessary to fully protect Speckled Pocketbook, it is difficult to determine whether the CWA is adequately addressing threats to Speckled Pocketbook.

e. **Other natural or manmade factors affecting its continued existence:** Alterations in stream temperature regimes associated with channel widening, riparian tree canopy removal, and climate change may affect Speckled Pocketbook biological processes. Exact critical thermal limits for survival and normal functioning of Speckled Pocketbook are unknown. However, high water temperatures can reduce dissolved oxygen concentrations, which slows growth, reduces glycogen stores, impairs respiration, and may inhibit reproduction of mussels (Fuller 1974). Low temperatures also may significantly delay or prevent metamorphosis (Watters and O'Dee 1999). Altered thermal regimes may shorten the period of glochidial encystment, reduce righting speed (various reflexes that tend to bring the body into normal position in space and resist forces acting to displace it out of normal position), increase oxygen consumption, and slow burrowing and movement responses (Fuller 1974; Bartsch *et al.* 2000; Watters *et al.* 2001; Schwalb and Pusch 2007). Several studies have documented the influence of temperature on the timing aspects of mussel reproduction (Gray *et al.* 2002; Allen *et al.* 2007; Steingraeber *et al.* 2007). Peak glochidial releases are associated with water temperature thresholds that can be thermal minimums or maximums, depending on the species (Watters and O'Dee 2000).

Cumulative Effects of Threats

The life-history traits and habitat requirements of Speckled Pocketbook, and other freshwater mussels in general, make them extremely susceptible to environmental change. Unlike other aquatic organisms (*e.g.*, aquatic insects and fish), mussels have limited refugia from stream disturbances (*e.g.*, droughts, sedimentation, chemical contaminants). Mechanisms leading to Speckled Pocketbook imperilment range from local (*e.g.*, riparian clearing, chemical contaminants, etc.), to regional influences (*e.g.*, altered flow regimes, population isolation, etc.), to potentially global climate change. The synergistic (interaction of two or more components) effects of threats are often complex in aquatic environments, making it difficult to predict changes in mussel and fish host(s) distribution, abundance, and habitat availability that may result from these effects. While these stressors may act in isolation, it is more probable that many stressors are acting simultaneously (or in combination) (Galbraith *et al.* 2010) on Speckled Pocketbook populations.

3. Conservation Measures

There is new information regarding implementation of conservation measures that benefit the Speckled Pocketbook.

A rangewide programmatic SHA was signed in 2007 by AES, AGFC, NRCS, and TNC. An amendment to the agreement is currently being processed by the Southeast Regional Office and is expected to be finalized in 2015. The amendment does not affect currently enrolled properties or future conservation measures implemented for Speckled Pocketbook. It adds two species to the SHA and 19 species of greatest conservation need to the candidate conservation agreement with assurances, all which have similar conservation needs as the Speckled Pocketbook. Service (2013)

provides a detailed status report (2007 – 2012) of current enrolled properties and conservation measures implemented on enrolled properties under the SHA (also refer to Section II.B.3, Task 3.1).

Section II.B.3 provides a summary of conservation measures implemented for Speckled Pocketbook. Additionally in 2014, TNC acquired approximately 1,000 acres adjacent to the Archey Fork. This land acquisition perpetually protects approximately 2.5 river miles of the Archey Fork that is currently inhabited by Speckled Pocketbook. Pastureland on TNC's Archey Fork Preserve was reforested in partnership with Southwestern Energy's ECH_2O program.

D. Synthesis

At the time of listing, the only known population of Speckled Pocketbook was in the Middle Fork from the confluence of Meadow Creek downstream to near Shirley (approximately 10 rmi). Surveys in recent years have expanded the distribution of extant populations of Speckled Pocketbook to include the Middle Fork extending upstream of the Meadow Creek confluence to the confluence of Little Red Creek (an increase of 53 rmi). Extant populations also have been discovered in 14 rmi of the South Fork, 16 rmi of Archey Fork, two rmi of Turkey Fork, 11 rmi of Beech Fork, and ten rmi of Big Creek. Collectively, current extant populations occupy 102 rmi more than at the time of listing and four (Turkey and Beech Forks are considered one population) additional extant populations are known.

Characteristics of population demographics (*e.g.* suitable habitat, male to female sex ratio, etc.) are better understood now than at the time of listing. Primary and secondary suitable host fish have been identified and successful propagation techniques have been developed for the Speckled Pocketbook. These techniques will be extremely valuable in recovery efforts, should the need to conduct population augmentations or reintroductions arise. Additionally, phylogenetic analysis of the *Lampsilis* species in Arkansas support taxonomic status of the Speckled Pocketbook. Information on size structure of Speckled Pocketbook populations is better understood. However, the age structure, gene flow between populations, effective population size, and status of host fish are lacking at this time. These are important population biology issues that need to be determined in order to ensure the continued existence of Speckled Pocketbook.

The threat of natural gas development activities in the Fayetteville Shale poses an imminent threat (*e.g.* water quality and quantity and habitat fragmentation) to the species, albeit diminished now that most of the infrastructure is in place to access and transport natural gas out of the region. The Service and partners have developed BMPs to help minimize adverse effects from these activities to the Speckled Pocketbook and its habitat.

A programmatic SHA was signed in 2007 to encourage private landowner conservation efforts. The SHA has enabled resource agencies and conservation groups to prioritize recovery efforts, achieve substantive conservation measures (e.g.,

Archey Fork restoration project) while fostering partnerships with private landowners, municipalities, and industry to promote recovery for this species.

The status of the Speckled Pocketbook continues to improve. However, Speckled Pocketbook should remain listed as an endangered species due to threats listed under Factors A, D and E above. The Service and its partners continue to make progress in obtaining additional monitoring data. When additional monitoring data is available, it will allow us to better ascertain population trends and status. We recommend reexamining the recovery criteria to measure future recovery progress towards reclassification and delisting.

III. RESULTS

A. Recommended Classification:

The status of Speckled Pocketbook should remain unchanged.

B. Recovery Priority Number 8

The degree of threat to the Speckled Pocketbook is moderate because there is a continual threat to its habitat (*e.g.* primarily from poor land use practices, illegal activities such as gravel mining, and habitat fragmentation). The recovery potential is high because the biology is well understood as well as ecological factors affecting the biology. Threats are well understood and these threats should be alleviated through the SHA and other conservation initiatives.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Increase landowner enrollment in the programmatic SHA. Successful implementation of this agreement is essential to alleviating threats to water quality and habitat, thereby allowing for natural expansion of populations into uninhabited stream reaches and providing protection for existing extant populations.

2. The recovery plan should be revised to refine reclassification criteria, define delisting criteria, and better address the five factors.

3. Continue to collect data on size structure of extant Speckled Pocketbook populations.

4. Determine importance of gene flow between different stream populations.

5. Determine status of suitable host fish in the upper Little Red River watershed (*e.g.*, how does their distribution match the distribution of Speckled Pocketbook?).

6. Determine habitat requirements of suitable host fish, condition/status of habitat (e.g., pristine, degraded, etc), and restoration/protection needs.

7. Continue to foster a working partnership with county governments, municipalities, industry, and private landowners to help minimize threats and promote recovery of Speckled Pocketbook.

8. Monitor population status in the four forks of the Little Red River.

9. Collect baseline information on distribution and abundance of Speckled Pocketbook in Big Creek.

V. REFERENCES

Allen, D. C., B. E. Sietman, D. E. Kelner, M. C. Hove, J. E. Kurth, J. M. Davis, J. L. Weiss, and D. J. Hornbach. 2007. Early life-history and conservation status of Venustaconcha ellipsiformis (Bivalvia, Unionidae) in Minnesota. American Midland Naturalist **157**:74-91.

Bartsch, M. R., D. L. Waller, G. W. Cope, and S. Gutreuter. 2000. Emersion and thermal tolerances of three species of unionid mussels: survival and behavioral effects. Journal of Shellfish Research 19:233-240.

Clarke, A.E. 1987. Status survey of *Lampsilis streckeri* Frierson (1927) and *Arcidens wheeleri* (Ortmann and Walker 1912). A report to the U. S. Fish and Wildlife Service. 24pp. plus field notes.

Davidson, C. and M. Wine. 2004. Threats assessment for the Speckled Pocketbook (*Lampsilis streckeri*) and yellowcheek darter (*Etheostoma moorei*) in the upper Little Red River watershed, Arkansas. Unpubl. Report. U. S. Fish and Wildlife Service, Arkansas Field Office, Conway, Arkansas. 28pp. + appendix.

Davidson, C. 2005. Threats assessment for the Speckled Pocketbook (*Lampsilis streckeri*) and yellowcheek darter (*Etheostoma moorei*) in the upper Little Red River watershed, Arkansas. Addendum 1: Archey Fork Little Red River. Unpubl. Report. U. S. Fish and Wildlife Service, Arkansas Field Office, Conway, Arkansas. 7pp.

Fuller, S.L.H. 1974. Clams and mussels (Mollusca: Bivalvia). Pp. 215-273 *in*: C.W. Hart, Jr., and S.L.H. Fuller, eds. Pollution ecology of freshwater invertebrates. Academic Press, New York.

Galbraith, H.S., D.E. Spooner, and C.C. Vaughn. 2010. Synergistic effects of regional climate patterns and local water management on freshwater mussel communities. Biological Conservation 143:1175-1183.

Gray, E. V. S., W. A. Lellis, J. C. Cole, and C. S. Johnson. 2002. Host identificaiton for *Strophitus undulatus* (Bivalvia:Unionidae), the Creeper, in the Upper Susquehanna River Basin, Pennsylvania. Am. Midl. Nat. 147:153-161.

Harris, J.L. 1991. Survey for *Lampsilis streckeri* in the Midle Fork Little Red River at the proposed NOARK pipeline crossing, Van Buren County, Arkansas. Prepared for ENSR Consulting and Engineering, Houston, TX. 10pp.

Harris, J.L. 1992. Status of *Lampsilis streckeri* in segments of the Middle, South, and Archey forks of the Little Red River, Stone and Van Buren counties, Arkansas. Prepared for the U. S. Fish and Wildlife Service, Endangered Species Office, Jackson, MS. 23pp. + field notes.

Harris, J.L. 1993. Habitat characterization and species associates of the speckled pocketbook (*Lampsilis streckeri*) in the Middle Fork Little Red River, Arkansas. Prepared for the U. S. Fish and Wildlife Service, Endangered Species Office, Jackson, MS. 28pp. plus appendices.

Harris, J.L., P.J. Rust, A.C. Christian, W.R. Posey II, C.L. Davidson, and G.L. Harp. 1998. Revised status of rare and endangered Unionacea (Mollusca: Margaritiferidae, Unionidae) in Arkansas. Journal of the Arkansas Academy of Science 51 (1997):66-89.

Harris, J.L., W. R. Hoeh, A.D. Christian, J. Walker, J.L. Farris, R.L. Johnson, and M.E. Gordon. 2004. Species limits and phylogeography of Lampsilinae (Bivalvia: Unionida) in Arkansas with emphasis on species of *Lampsilis*. Prepared for Arkansas Game and Fish Commission and U. S. Fish and Wildlife Service. 61pp. + appendix.

Harris, J.L., W.R. Posey II, C.L. Davidson, J.L. Farris, S.R. Oetker, J.N. Stoeckel, B.G. Crump, M.S. Barnett, H.C. Martin, M.W. Matthews, J.H. Seagraves, N.J. Wentz, R. Winterringer, C. Osborne, and A.D. Christian. 2010a. Unionida (Mollusca: Margaritiferidae, Unionidae) in Arkansas, Third Status Review. Journal of the Arkansas Academy of Science 63 (2009):50-86.

Harris, J.L., A.D. Christian, and W.R. Hoeh. 2010b. Hidden diversity in Arkansas freshwater mussels: description of new species and new genera with determination of species ranges for members of the genus Lampsilis (Bivalvia: Unionida). Unpubl. Report submitted to Arkansas Game and Fish Commission, Little Rock, AR. 31pp. + appendices.

Schwalb, A. N., and M. T. Pusch. 2007. Horizontal and vertical movements of unionid mussels in a lowland river. Journal of the North American Benthological Society 26:261-272.

Steingraeber, M. T., M. R. Bartsch, J. E. Kalas, and T. J. Newton. 2007. Thermal Criteria for Early Life Stage Development of the Winged Mapleleaf Mussel (*Quadrula fragosa*). American Midland Naturalist 157:297–311.

U. S. Fish and Wildlife Service. 1989. Endangered and threatened wildlife and plants: endangered status for the Speckled Pocketbook (*Lampsilis streckeri*). Federal Register 54(38):8339-8341.

U. S. Fish and Wildlife Service. 1992. Speckled Pocketbook Mussel (*Lampsilis streckeri*) Recovery Plan. U. S. Fish and Wildlife Service. Jackson, MS. 14pp.

U. S. Fish and Wildlife Service. 2005. Conservation strategy for the Speckled Pocketbook (*Lampsilis streckeri*) and Yellowcheek Darter (*Etheostoma moorei*). U. S. Fish and Wildlife Service. Conway, AR. 22pp.

U.S. Fish and Wildlife Service. 2007. Speckled Pocketbook (Frierson 1927) five year review: summary and evaluation. U.S. Fish and Wildlife Service. Conway, AR. 15pp.

U.S. Fish and Wildlife Service. 2013. Status report: programmatic safe harbor agreement and candidate conservation agreement with assurances in the upper Little Red River watershed, Arkansas. U.S. Fish and Wildlife Service. Conway, AR. 11pp.

Watters, G.T. and S.H. O'Dee. 1999. Glochidia of the freshwater mussel *Lampsilis* overwintering on fish hosts. The Journal of Molluscan Studies 65(4):453-459.

Watters, G.T. and S.H. O'Dee. 2000. Glochidial release as a function of water temperature: Beyond bradyticty and tachyticty. Pp. 135-140 *in:* R.A. Tankersley *et al.*, eds. Proceedings of the Conservation, Captive Care, and Propagation of Freshwater Mussels Symposium, 1998. Ohio Biological Survey Special Publications, Columbus, Ohio.

Watters, G.T., S.H. O'Dee, and S. Chordas. 2001. Patterns of vertical migration in freshwater mussels (Bivalvia: Unionoida). Journal of Freshwater Ecology 16:541-549.

Winterringer, R. 2003. Population dynamics and reproductive patterns of the federally endangered freshwater mussel, *Lampsilis streckeri* (Frierson 1927). M.S. thesis. Arkansas State University, State University, Arkansas. 74pp.

VI. PEER REVIEW

A draft copy of this 5-year review was sent to the following knowledgeable individuals for their review and comment:

Bill Posey, Arkansas Game and Fish Commission

Josh Seagraves, Arkansas Highway and Transportation Department

Dr. John Harris, Arkansas State University

Results of Peer Review:

Josh Seagraves provided minor editorial changes.

Dr. John Harris provided minor editorial changes. Dr. Harris also questioned whether the recovery potential is high for Speckled Pocketbook.

Our Response: The Service recovery priority guidelines (48 FR 43104) establishes a process for determining a species recovery priority based on taxonomy (*i.e.,* monotypic genus, species, subspecies), degree of threat (*e.g.,* high, moderate, low) and recovery potential (*e.g.,* high or low). Our guidance defines a moderate threat as the species will not face extinction if recovery is temporarily held off, although there is continual population decline or threat to its habitat. A high threat priority for Speckled Pocketbook is not appropriate because extinction is not almost certain in the immediate future. A low threat priority also is not appropriate because Speckled Pocketbook populations are not experiencing short-term, self-correcting, or unknown threats to its habitat.

High or low recovery potential is based on our understanding of biological and ecological limiting factors (*i.e.*, well understood or poorly understood), threats to species existence (*i.e.,* well understood and easily alleviated or poorly understood, pervasive, and difficult to alleviate), and management needs (*i.e.*, intensive management not needed or techniques with high probability of success or intensive management with uncertain probability of success). We acknowledge that construction of Greers Ferry Reservoir isolated populations in three of four forks of the Little Red River and permanently extirpated the species from the main stem Little Red River. However, biological and ecological requirements for the species are well understood, threats are being addressed through the SHA and similar conservation efforts (*e.g.*, Archey Fork restoration project), and propagation techniques are established and have been proven successful should the need arise to augment or reintroduce populations. Based on our criteria for establishing recovery potential, it is the Service's opinion that recovery potential is overwhelmingly high for Speckled Pocketbook. Therefore, a species with moderate threat and high recovery potential should be assigned a recovery priority number of eight (8).

Bill Posey provided one comment related to Harris *et al.* (2004). Harris *et al.* (2004) revealed that *Lampsilis reeviana* co-occurs with Speckled Pocketbook in the Little Red River basin. He concludes that this information confounds the known number of Speckled Pocketbook in the Little Red River basin due to morphological similarity of appearance and may result in an over estimate for Speckled Pocketbook.

Our Response: Mr. Posey mistakenly referenced Harris *et al.* (2004). The reference about co-occurrence of Speckled Pocketbook and *Lampsilis reeviana* occurs in Harris *et al.* (2010b). We addressed this comment by adding the following paragraph to page 5 under Task 2.3.

> Harris *et al.* (2010b) further explored genetic relationships between Speckled Pocketbook and *L. reeveiana*. They suggested that *L. reeveiana* and Speckled Pocketbook may co-occur in the Little Red River basin. However, there is no reason to assume that *L. reeveiana* like individuals/populations could maintain genetic isolation among a

population that is overwhelmingly Speckled Pocketbook. Speckled Pocketbook is a relatively recent divergence from *L. reeveiana* and the divergence is shallow. Therefore, some Speckled Pocketbook specimens may come out more closely aligned with *L. reeveiana* in some analyses, but they are still Speckled Pocketbook (Harris 2015, pers. comm.).

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
Speckled Pocketbook (*Lampsilis streckeri*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Review Conducted By Chris Davidson, USFWS Arkansas Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 3/17/2015