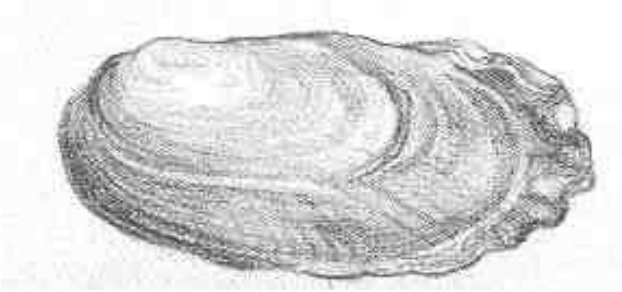
Scaleshell Mussel
(Leptodea leptodon)

5-Year Review:
Summary and Evaluation



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Columbia, Missouri

5-YEAR REVIEW
Scaleshell mussel/*Leptodea leptodon*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Carlita Payne, Midwest Regional Office (Region 3), 612-713-5339

Lead Field Office: Andy Roberts, Columbia, Missouri Field Office, 573-234-2132, ext. 110

Cooperating Field Offices:
Chris Davidson, Conway, Arkansas Field Office (Region 4), 501-513-4481
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Cooperating Regional Offices:
Wendy Brown, Southwest Regional Office (Region 2), 505-248-6664
Kelly Bibb, Southeast Regional Office (Region 4), 404-679-7132
Seth Willey, Mountain-Prairie Regional Office (Region 6), 303-236-4257

1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service's (USFWS) Columbia, Missouri Field Office completed this 5-year review. Biologists in the Arkansas (Region 4) and Oklahoma (Region 2) Ecological Services Field Offices provided assistance and information for this review. The main source of information used for this status review is the scaleshell mussel recovery plan approved in February 2010 (USFWS 2010). The recovery plan contains a current compilation of information regarding status, distribution, and threats for the species. The plan also contains objective, measurable recovery criteria that are up-to-date. The recovery plan and the literature cited within the plan are on file at the Columbia, Missouri Field Office. Outside peer review was not required for this document per the 5-year review guidance (USFWS 2006) because 1) no recommendations were made, as a result of this review, to change the status of the scaleshell; 2) information used in this review has already undergone peer review; 3) scientific uncertainty of the information used is low; and 4) public interest is low. All recommendations resulting from this review are the result of thoroughly reviewing all available information on this species. The *Federal Register* notice of initiation was published on Thursday, October 4, 2007 (72 FR 56787), with a 60-day public comment period. It requested new scientific or commercial data and information that may have a bearing on the species' classification of endangered. Comments were received, evaluated, and incorporated as appropriate.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: 72 FR 56787, October 4, 2007

1.3.2 Listing history

Original Listing
FR notice: 66 FR 51322
Date listed: October 9, 2001
Entity listed: Species
Classification: Endangered

1.3.3 Associated rulemakings: N/A

1.3.4 Review History: N/A

1.3.5 Species' Recovery Priority Number at start of 5-year review: 2, indicating a high degree of threat and high recovery potential.

1.3.6 Recovery Plan

Name of plan: Scaleshell Mussel Recovery Plan
Date issued: February 2010
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? *No.*

2.2 Recovery Criteria

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

2.2.2 Adequacy of recovery criteria.

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

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

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information: The following recovery criteria were taken from the final scaleshell recovery plan (USFWS 2010). These recovery criteria have not been met as described below.

The scaleshell will be considered for downlisting to threatened status when the following criteria have been achieved:

1. Through protection of existing populations, successful establishment of reintroduced populations, or the discovery of additional populations, four stream populations exist, each in a separate watershed and each made up of at least four local populations located in distinct portions of the stream. Each stream population must exist in a separate watershed so that a single stochastic event, such as a toxic spill or disease outbreak, will not affect more than one of the four stream populations. This criterion is based on the available information and the best professional judgment of species experts, and may be revised based on additional biological, demographic, or genetic information obtained through Recovery Actions 3.1 and 3.4.

This criterion has not been fully met, but progress is being made. Currently, two stream populations exist in separate watersheds (Gasconade and Meramec river basins) that have at least four local populations (USWS 2010). Recovery actions 3.1 and 3.4 have been initiated and are partially complete.

2. Each local population in Criterion 1 is viable in terms of population size, age structure, recruitment, and persistence. Currently, what constitutes a viable population of the scaleshell is not known. Population viability will be defined when Action 3.4.2 (Research Population Dynamics of the Scaleshell) is completed. In the future, this criterion will be revised to incorporate the definition of population viability resulting from this recovery action (3.4.2).

This criterion has not been fully met, but progress is being made. A collaborative, two-year research project that will partially complete action 3.4.2 was funded and is scheduled to begin in 2011 between Iowa State University, Missouri Department of Conservation (MDC), and USFWS (Steve McMurray, Missouri Department of Conservation, pers. comm. 2010).

3. Threats to local populations in Criterion 1 have been identified and addressed per measurable criteria developed in Action 2.3. Currently it is not feasible to identify in this criterion the specific threats to populations and thresholds at which those threats are reduced to the level where criteria 1 and 2 are achieved.

However, the thresholds for this criterion will be defined through the implementation of key actions in the plan as follows. Step 1: identify and map present and foreseeable threats to local populations in a GIS database (Action 2.2). Step 2: Define measurable criteria for alleviating/reducing each of those threats and prioritize threats according to effects to local populations (Action 2.3). Step 3: Apply the appropriate recovery actions outlined in this plan to alleviate/reduce threats. Step 4: Track the progress of recovery implementation (Action 7.2).

This criterion has not been fully met, but progress is being made. Steps one and two (Actions 2.2 and 2.3) of criterion 3 are partially complete for the Meramec River basin (Andy Roberts, USFWS, pers. obs. 2010)

The scaleshell will be considered for removal from the protection of the Endangered Species Act when the following criteria are achieved:

1. Through protection of existing populations, successful establishment of reintroduced populations, or the discovery of additional populations, a total of eight stream populations exist, each in a separate watershed and each made up of at least four local and geographically distinct populations. At a minimum, one stream population must be located in the Upper Mississippi River Basin, four in the Middle Mississippi River Basin (two of these must exist east of the Mississippi River), and three in the Lower Mississippi River Basin. Completion of action 3.4.2 or 3.4.3 may indicate more local populations, streams, or geographical regions are required. This criterion is based on the available information and the best professional judgment of species experts, and may be revised based on additional biological, demographic, or genetic information obtained through Recovery Actions 3.1 and 3.4.

This criterion has not been met. See downlisting criterion 1 for current progress toward this criterion.

2. Each local population in Criterion 1 is viable in terms of population size, age structure, recruitment, and persistence. Currently, what constitutes a viable population of the scaleshell is not known. Population viability will be defined when Action 3.4.2 is completed. In the future, this criterion will be revised to incorporate the definition of population viability resulting from this recovery action (3.4.2).

This criterion has not been met. See downlisting criterion 2 for current progress toward this criterion.

3. Threats to local populations in Criterion 1 have been identified and addressed per measurable criteria developed in Action 2.3. Currently it is not feasible to identify in this criterion the specific threats to populations and thresholds at which those threats are reduced to the level where criteria 1 and 2 are achieved.

However, the thresholds for this criterion will be defined through the implementation of key actions in the plan as follows. Step 1: identify and map present and foreseeable threats to local populations in a GIS database (Action 2.2). Step 2: Define measurable criteria for alleviating/reducing each of those threats and prioritize threats according to effects to local populations (Action 2.3). Step 3: Apply the appropriate recovery actions outlined in this plan to alleviate/reduce threats. Step 4: Track the progress of recovery implementation (Action 7.2).

This criterion has not been met. See downlisting criterion 3 for current progress toward this criterion.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history: No new information has been obtained since the issuance of the listing rule (USFWS 2001) or the recovery plan (USFWS 2010).

2.3.1.2 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: Assessing abundance and population trends of the scaleshell is difficult because of its rarity. When the species was listed in 2001, it was known from 14 rivers in three states (USFWS 2001). These rivers include the Meramec, Bourbeuse, Big, Gasconade, and Osage rivers in Missouri; Frog Bayou and the St. Francis, Spring, South Fork Spring, South Fourche LaFave, and White rivers in Arkansas; and the Little, Mountain Fork, and Kiamichi rivers in Oklahoma. An additional six streams were listed in 2001 as possibly supporting the species in Arkansas and Oklahoma including the Cossatot, Little Missouri, Saline, and Strawberry rivers, and Myatt and Gates creeks (USFWS 2001). Since 2001, living specimens have only been found in the Meramec, Bourbeuse, and Gasconade rivers in Missouri. Fresh-dead specimens have been found in the Big River in Missouri, Missouri River in South Dakota, and the Kiamichi River in Oklahoma. In addition to the limited number of rivers it has been found since 2001, we consider extant populations to be declining because the species remains very difficult to find (even at the best known extant sites) and 60 percent of resurveyed scaleshell sites have been lost or have declined significantly (see sections 2.3.1.6 and 2.3.2.1 below) (Clarke 1987; Galbraith *et al.* 2005; Galbraith *et al.* 2008; Galbraith *et al.* 2010; Isely 1925; Mather 2005; Mehlhop and Miller 1989; MDC Mussel Database 2009; Spooner and Vaughn 2000; Valentine and Stansbery 1971). No new information is available on demographic features.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.): No new information has been obtained since the issuance of the listing rule (USFWS 2001).

2.3.1.4 Taxonomic classification or changes in nomenclature: No new information has been obtained since the issuance of the listing rule (USFWS 2001).

2.3.1.5 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.): Fragmentation and the loss of scaleshell sites discussed in Section 2.3.1.2 has contributed to the decline of this species. As in 2001, the Meremec, Bourbeuse, and Gasconade rivers continue to be a strong-hold for this rare species as it is still consistently found living during surveys (USFWS 2010). The Kiamichi River in Oklahoma supports a detectable population as three fresh-dead shells have been found since 2001, but the species is extremely rare in this river (see Section 2.3.2.1). However, very few specimens have been recovered in the last 50 years in the remaining streams of its historical range (Clarke 1987; Galbraith *et al.* 2005; Galbraith *et al.* 2008; Galbraith *et al.* 2010; Mather 2005; Mehlhop and Miller 1989; Spooner and Vaughn 2000; Valentine and Stansbery 1971).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem): Several scaleshell sites known when the species was listed in the 2001 no longer appear to be suitable for mussels. These sites were also mussel beds supporting a diversity and an abundance of other mussel species. Of the 78 extant scaleshell sites, 21 have been resurveyed since 2001. Mussel beds have entirely disappeared, or significant declines have occurred at 13 (62%) of the 21 resurveyed sites (Table 1). This includes 4 of 5 revisited sites in the Meramec River, 3 of 5 revisited sites in the Bourbeuse River, and 2 of 5 revisited sites in the Gasconade River in Missouri. In Oklahoma, 4 of 5 revisited sites have been lost from the Kiamichi River (Clarke 1987; Galbraith *et al.* 2005; Galbraith *et al.* 2008; Galbraith *et al.* 2010; Isely 1925; Mather 2005; Mehlhop and Miller 1989; MDC Mussel Database 2009; Spooner and Vaughn 2000; Valentine and Stansbery 1971). The exact causes of these declines are unknown, but the lack of mussels at these sites is an indication that the areas no longer provide suitable habitat. It is doubtful that these sites will support viable scaleshell populations or support populations much longer.

2.3.1.7 Other: No new information has been obtained since the issuance of the listing rule (USFWS 2001).

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

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

Range: The scaleshell mussel was listed as a federally endangered species in 2001. At that time, the historical distribution of the species was reported to include 55 streams in 13 states including Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Minnesota, Missouri, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin. The extant distribution reported in 2001 included only 14 (possibly 20) streams in Missouri, Arkansas, Oklahoma. Of these streams, only the Meramec, Bourbeuse, and Gasconade river populations in Missouri were based on more than a single or small number of specimens (USFWS 2001). These three streams continue to be a strong-hold for the species and are the only streams where it has been collected live since 2001 (MDC Mussel Database 2009). Live individuals have been collected in the Meramec, Bourbeuse, and Gasconade rivers as recently as 2009, and some new sites have been found (Table 1). However, the scaleshell mussel remains very rare in these streams and many populations still occur in small, isolated patches (USFWS 2010).

The scaleshell has been reported from three other rivers within its range since 2001, but these collections are based on dead shells. These rivers include the Kiamichi, Missouri, and Big rivers in Oklahoma, South Dakota, and Missouri respectively (Galbraith *et al.* 2005; Galbraith *et al.* 2008; Roberts *et al.* 2009; USFWS 2010). Three fresh-dead shells were collected in the Kiamichi River in Oklahoma from three different sites in 2004/2005 (Galbraith *et al.* 2005, 2008). Based on this evidence, there is likely a living population in this stream, although very rare. A single fresh-dead shell was collected in the Missouri River below Gavin's Point Dam in South Dakota in 2005 in the vicinity of another fresh-dead shell that was found in the early 1980's (USFWS 2010). Lastly, one fresh-dead shell fragment was found at a new site in the lower Big River in 2008 (Roberts *et al.* 2009).

Destruction of habitat: The major causes of habitat loss are still present in streams throughout its range including water quality degradation, sedimentation, channelization, sand and gravel mining, dredging, and impoundments (USFWS 2010). New information has been discovered with respect to water quality. In studies since 2001, mussels have been found to be very sensitive to ammonia, which is one of the most common pollutants in streams (Augspurger *et al*. 2003; Wang *et al*. 2007*a*; Wang *et al*. 2007*b*). These studies have called into question whether or not the Environmental Protection Agency's (EPA) current national water quality criteria are protective of freshwater mussels because those criteria were derived from a toxicity database predating data recently available for

freshwater mussels. The EPA is currently in the process of updating the 1999 national water quality criteria for ammonia (EPA 2009). Ammonia is a common pollutant in streams occupied by the scaleshell range-wide and is associated with both point and nonpoint sources. Ammonia is associated with animal feedlots, nitrogenous fertilizers, industrial effluents, and municipal wastewater treatment plants (Goudreau *et al*. 1993; USFWS 2010).

Declines of mussel populations in the Big River have been attributed to the effects of past and present lead mining (USFWS 2010). Recent studies have confirmed that stream sediments in the Big River are contaminated with high levels of heavy metals (e.g., lead, zinc, cadmium) as a result of lead mining in the upper portion of the watershed (Roberts *et al.* 2009). These contaminated sediments have greatly affected mussel populations in the Big River. Sites with impacted mussel communities included over 158.7 km (98.6 mi) of the river, including the reach from river mile 113 to 14.4 (Roberts *et al.* 2009). The scaleshell is known to occur at two sites in the lower 16.1 km (10 mi) (MDC Mussel Database 2009; Roberts *et al.* 2009). If contaminated sediments continue to migrate downstream, scaleshell populations in the lower Big River would be impacted, as well as populations in the Meramec River downstream from the confluence of the two rivers. The USFWS is currently monitoring mussel populations and sediment contamination in the lower 10 miles of the Big River.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes: No new information has been obtained since the issuance of the listing rule regarding this factor (USFWS 2001). The scaleshell is not a commercially valuable species because of its small size and thin shell. However, over-harvesting activities that removed entire mussel beds likely impacted scaleshell populations. Today, intensive mussel collecting activity could have adverse affects on existing smaller populations because the species now occurs in isolated areas. The destruction of only a few individuals could be a contributing factor in the extirpation of some populations (USFWS 2001). As scaleshell mussels become more uncommon, the interest of scientific and shell collectors could increase. Scaleshell mussel occurrences are easily accessible and exposed during low flow periods and, therefore, are also vulnerable to take (i.e., collection) for fish bait, curiosity, or acts of vandalism. Up to five freshwater mussels per day, including scaleshell, may be legally collected in Missouri and used for fishing bait (Missouri Code of Regulations 2011). However, the low density of scaleshell mussels minimizes the likelihood of a scaleshell being collected (USFWS 2001).

2.3.2.3 Disease predation: No new information has been obtained since the issuance of the listing rule regarding this factor (USFWS 2001). While the large size or thick shells of some species afford protection from predators such as small mammals and fish, the small and fragile shell of the scaleshell makes it an easy and desirable prey species. Small mammals, such as muskrats and raccoons, are common predators throughout the range of this species, particularly during periods of low water. Likewise, disease and parasites have been reported to cause

major die-offs of freshwater mussels. Bacteria and protozoans persist at unnaturally high concentrations in streams with high sediment load or in water bodies affected by point source pollution, such as sewage treatment plants. Although natural predation and disease are not usually factors for stable, healthy mussel populations, they can pose a problem for scaleshell populations. Small populations are less resilient to these natural factors, and therefore, are much more threatened by them. Consequently, predation and disease could exacerbate ongoing population declines of scaleshell mussels (USFWS 2010).

2.3.2.4 Inadequacy of existing regulatory mechanisms: Despite the implementation of the Clean Water Act of 1972 (2010), degraded water quality still presents problems for sensitive aquatic organisms such as freshwater mussels. Point source discharges are typically regulated; however, non-point inputs such as silt, nitrogen, and other contaminants may not be sufficiently regulated, particularly those originating some distance from a waterway. Regulated point sources may also adversely affect the scaleshell. Freshwater mussels appear to exhibit more sensitivity to some pollutants than do the organisms typically used in toxicity testing such as fish and daphnids (water fleas). As a result, some of the water quality criteria established by the EPA to protect aquatic life may not be protective of mussels. Augspurger *et al*. (2003) found that the current EPA numeric criteria for ammonia may not be protective of mussels. Consequently, even those sewage treatment plants that comply with their ammonia effluent limits may still be discharging water that is toxic to unionids. Additionally, most states allow mixing zones, or zones in which numeric water quality criteria can be exceeded. Because mussels are sessile, they cannot move away from local water quality degradation. As discussed above in 2.3.2.1, the EPA is currently in the process of updating the 1999 national water quality criteria for ammonia, but this process may take years to complete. Few substances have been tested for their toxicity to mussels, and therefore, protective concentrations for the species are not yet known.

2.3.2.5 Other natural or manmade factors affecting its continued existence: Recent findings indicate that global climate change could pose a potential threat to the scaleshell mussel in the future. Current climate change predictions around the extent of the range of the species (i.e., Midwest) indicate warmer air temperatures, more intense precipitation events, and increased summer drying (United States Global Change Research Program [USGCRP] 2009). These changes are likely to have complex and unpredictable effects upon freshwater biota. However, some potential impacts, related to extreme low and high water events and overall temperature changes to mussel populations, are intuitive. Increased occurrence of both major flood events and drought in the Midwest would affect remaining populations of the scaleshell (Haag and Warren 2008; Hastie *et al.* 2001; Johnson *et al.* 2001). The scaleshell is particularly vulnerable to drought because the species frequently is found in shallow riffles (USFWS 2010). Additionally, the human response to drought would be increased water

withdrawal from streams for crop irrigation, further intensifying the effects of drought by decreasing water levels in streams.

Water temperatures would increase in Midwestern streams with the predicted increases in air temperatures (USGCRP 2009). More periods of drought would intensify this effect within streams, particularly in smaller streams. Because freshwater mussels are ectotherms (i.e., body temperature depends on the environment), their physiological processes and reproductive success are constrained and controlled by water temperature. Mussels appear to have varying temperature optima, which strongly influences filtration rates, excretion rates and other processes (Spooner and Vaughn 2008). Therefore, increased water temperatures would be expected to cause changes in the distribution and abundance of species, and local extirpations could occur. Species would be expected to respond differently to climate change, and therefore, it is uncertain whether or how changes in water temperature would affect the scaleshell.

Ficke *et al.* (2005) described the general potential effects of climate change on freshwater fish populations worldwide. Overall, the distribution of fish species is expected to change including range shifts and local extirpations. Because freshwater mussels are entirely dependent upon a fish host for successful reproduction and dispersal (Gordon and Layzer 1989; Parmalee and Bogan 1998; Watters 1995), any changes in local fish populations would also affect freshwater mussel populations. Therefore, mussel populations will reflect local extirpations or decreases in abundance of fish species. Species such as the scaleshell that have one or a small number of suitable fish host species would be more likely to be affected by changes in the fish community.

As the climate changes, species across the United States are expected to undergo large shifts in their range (USGCRP 2009). With increases in air temperature, the range of some species may gradually shift northward to stay within their optimal temperature. However, species like the scaleshell mussel, with limited and highly fragmented suitable habitat and populations, may have a more difficult time adjusting their ranges or may not be able to respond to changing conditions at all (USFWS 2010). Dispersal of mussel populations into more suitable regions of the country via fish hosts would be possible, provided fish host populations are thriving. Mussel populations are sometimes capable of traveling long distances while attached to their fish hosts. Freshwater drum, the host of the scaleshell, is a wide-ranging species (Priegel 1967), and therefore, may be more likely to facilitate the dispersal and colonization of the mussel into new, more favorable regions in a changing climate.

2.4 Synthesis

The scaleshell should continue to remain listed as an *endangered* species because it continues to decline, threats have not been ameliorated, and the criteria for downlisting to threatened have not been met. Since it was listed as an endangered species in 2001,

living or fresh-dead specimens have only been found in the Meramec, Bourbeuse, and Big rivers in Missouri, the Missouri River in South Dakota, and the Kiamichi River in Oklahoma. The Meramec, Bourbeuse, and Gasconade rivers continue to be a strong-hold for the species, but several mussel beds known to support the scaleshell in these rivers have been lost since 2001. This indicates that the scaleshell continues to decline. Habitat destruction and degradation continues to contribute to the decline of the scaleshell throughout its range. New research has shown that the scaleshell is highly sensitive to ammonia, a common pollutant throughout its range. Contaminated sediments from mineral mining operations threaten remaining populations in the lower Big River.
In sum, our current understanding of the scaleshell's status leads us to conclude that this species continues to be in danger of extinction throughout all or a significant portion its range, thereby meeting the definition of endangered under the Endangered Species Act.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ **No change is needed**

3.2 New Recovery Priority Number: 5

Brief Rationale: Threats to the scaleshell and its habitat are high and still present in streams throughout its range. The species has a low recovery potential because threats to populations occur widely throughout watersheds occupied historically. Because improvements need to take place throughout entire watersheds, a long period of time will be required before habitat improvements begin having beneficial effects on populations and associated habitat.

3.3 Listing and Reclassification Priority Number: NA

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The scaleshell recovery plan, issued February 2010, outlines a recovery strategy with recovery actions needed to recover the species (USFWS 2010). The recovery actions, and their assigned priorities, are still appropriate in light of the new information reviewed in this 5-year review. Of the Priority-1 actions listed in the recovery plan, we recommend continuation or initiation of the following actions before the next 5-year review:

Action 1.1 Assemble a scaleshell recovery implementation team.

Action 2.1.2 Conduct searches for additional populations within historic range where the species may potentially occur.

Action 2.5 Augment and stabilize populations by artificial propagation.

Action 2.6 Conduct water quality studies.

2.6.1 Determine tolerance to various contaminants suspected to have adverse affects to the scaleshell (e.g., ammonia, chlorine, and heavy metals).

2.6.2 Conduct field studies to determine seasonal ambient exposure conditions of contaminants evaluated in Action 2.6.1.

Action 3.4 Research population biology.

3.4.1 Determine genetic differentiation among and within populations.

3.4.2 Research population dynamics of the scaleshell.

3.4.3 Determine the number of local and stream populations needed to maintain the species and the optimal geographic distribution for those populations.

Action 7.1.1 Conduct surveys to determine persistence and viability of local populations (i.e., monitor extant populations).

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Table 1. Known sites of the scaleshell mussel (*Leptodea leptodon*) (based on living or fresh-dead shells) where local mussel communities have been lost or have declined significantly. Numbers represent local populations of scaleshell in each river (referred to as "sites") (Clarke 1987; Galbraith *et al.* 2005; Galbraith *et al.* 2008; Galbraith *et al.* 2010; Isely 1925; Mather 2005; Mehlhop and Miller 1989; MDC Mussel Database 2009; Spooner and Vaughn 2000; Valentine and Stansbery 1971).

River	*Number of sites known at the time of listing (2001)	Number of new sites discovered since 2001	Number of known sites resurveyed since 2001	**Number of resurveyed sites where the complete loss or significant decline of the mussel bed has been observed
Meramec	23	3	5	4
Bourbeuse	22	16	5	3
Big	1	1	1	0
Gasconade	28	5	5	2
Osage	1	0	1	0
Missouri	2	0	0	0
Kiamichi	2	3	5	4
Total	78	28	21	13 (62 %)

*Number includes sites where living or fresh-dead specimens have been collected since 1985.

**Scaleshell sites are typically areas where other freshwater mussel species are concentrated (i.e., "mussel bed"). The presence of a mussel bed is a reflection of the quality and health of the habitat. Sites where a loss or significant decline of mussels has occurred, indicates that the habitat is no longer suitable for mussels.

U.S. FISH AND WILDLIFE SERVICE 5-YEAR REVIEW of *Leptodea leptodon*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Appropriate Recovery Priority Number: 5

Appropriate Listing/Reclassification Priority Number, if applicable: Not applicable.

Review Conducted By: Andy Roberts

FIELD OFFICE APPROVAL:
Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve _____ Date 11/2/2010

REGIONAL OFFICE APPROVAL:
Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Midwest Region

Approve Lynn M Lewis Date 12/3/10

Cooperating Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Southwest Region

Signature _____ Date 12/9/10

Cooperating Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Southeast Region

Acting Signature Franklin J Arnold III Date 12/9/2010

Cooperating Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Mountain-Prairie Region

Signature Noreen E. Walsh Date 12/10/10