Spectaclecase
(*Cumberlandia monodonta*)

5-Year Review:
Summary and Evaluation

Photo: Tamara Smith

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U.S. Fish and Wildlife Service, Midwest Region
Minnesota/Wisconsin Ecological Services Field Office
Bloomington, Minnesota

5-YEAR REVIEW

Spectaclecase – *Cumberlandia monodonta*

1.0 GENERAL INFORMATION

1.1 Reviewers

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1.2 Methodology used to complete the review:

Public notice was given in the *Federal Register* (82 FR 18156) requesting new scientific or commercial data and information that may have a bearing on the spectaclecase classification of endangered status. Pertinent data was obtained from recent reports of freshwater mussel surveys and from data submitted by U.S. Fish and Wildlife Service Field Offices and State and Provincial natural resource agencies within the range of the species. This 5-year review was completed by Tamara Smith, Fish and Wildlife Biologist with the Minnesota/Wisconsin Ecological Services Field Office. The focus of this 5-year review is to summarize new information regarding the status of the spectaclecase.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

82 FR 18156 (April 17, 2017) – Endangered and Threatened Wildlife and Plants; Initiation of a 5-Year Status Reviews of Eight Endangered Animal Species: Iowa Pleistocene snail (*Discus macclintocki*), Karner blue butterfly (*Lycaeides melissa samuelis*), Kirtland's warbler (*Setophaga kirtlandii* [=*Dendroica kirtlandii*]), Ozark hellbender (*Cryptobranchus alleganiensis bishop*), rayed bean (*Villosa fabalis*), sheepnose (*Plethobasus cyphyus*), snuffbox (*Epioblasma triquetra*), and spectaclecase (*Cumberlandia monodonta*).

1.3.2 Listing history

Original Listing
FR notice: 77 FR 14914
Date listed: March 13, 2012
Entity listed: Spectaclecase (*Cumberlandia monodonta*); Species
Classification: Endangered

1.3.3 Associated rulemakings: none

1.3.4 Review History: none

1.3.5 Species' Recovery Priority Number at start of 5-year review: 4. The "4" indicates that this species, which is in the monotypic genus *Cumberlandia*, faces a high degree of threat, but a low recovery potential.

1.3.6 Recovery Plan: none

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? No

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 since the time of listing:

Genetics

Recent genetic studies of spectaclecase have been conducted; genetics tissue was sampled from populations from the Clinch River, Hancock County, TN; the St. Croix River, Chisago County, MN; the Gasconade River, Osage County, MO; the Meramec River, Franklin County, MO; and from the Ouachita River, Ouachita County, AR (Inoue et al. 2014, p. 2). The results of this study show that the gene flow within this species has maintained high levels of genetic diversity in most populations, but all populations have experienced some fragmentation (Inoue et al. 2014, p. 7). The authors of the study hypothesized that the extirpation of spectaclecase from the center of its historical range (centered around Indiana and Ohio) has isolated the remaining populations due to the geographic distances between those populations (Inoue et al. 2014, p. 7). Further, the study found that the Ouachita population is distinct from others and has the lowest genetic diversity, signifying that this is a peripheral population (Inoue et al. 2014, pp. 7-8).

Another study used spectaclecase as a model species to investigate the effects of climate change on population connectivity (Inoue 2017, pp. 2-3). Spectaclecase was chosen because a majority of its extant populations are panmictic (random mating within a breeding population). The study combined ecological niche models with population genetic simulations to examine the effects of two climate change scenarios (RCP2.6 and RCP8.5 scenarios, IPCC 2013) on population connectivity and genetic diversity of spectaclecase (Inoue 2017, p. 4). Simulations indicated that climate change under both scenarios would significantly reduce genetic diversity and connectivity due to loss of suitable habitat (based on precipitation, maximum temperature, diurnal temperature, and flow accumulation) across populations (Inoue 2017, p. 8). Results suggest that a single, large population of spectaclecase in the Mississippi Basin will become fragmented into smaller populations. It is predicted that each of these smaller populations will then begin to differentiate genetically due to isolation (Inoue 2017, p. 8).

Recently, qPCR (quantitative polymerase chain reaction) markers were developed to identify mussel larvae on wild caught fish and for eDNA (environmental DNA) detection of natural populations. These qPCR markers will be used as a tool to detect additional populations of spectaclecase and aid in recovery efforts for the species (Lor et al. 2017, p.1, Waller et al. 2017, entire; Waller, in prep.).

Williams et al. (2017, p. 45, and references therein) provide a summary of taxonomy providing evidence that *Cumberlandia* is a junior synonym to *Margaritifera*.

Host Fish
Two fish hosts for spectaclecase were confirmed in 2017; mooneye (*Hiodon tergisus*) and goldeye (*H. alosoides*) (Sietman et al. 2017, p. 18). Host research is now focused on these two species, although efforts continue to identify additional hosts. Identification of host species now allows for propagation of juvenile mussels. Research continues on husbandry of host fish and juvenile mussels in laboratory conditions.

In early 2018, the Kentucky Department of Fish and Wildlife Resources mussel facility successfully transformed several hundred spectaclecase larvae into juvenile mussels using the "in-vitro" method, which is the first time this was ever done (L. Koch, USFWS, 2018, pers. comm.). This method provides another recovery tool for this species.

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:

Since the time of listing, a relatively large spectaclecase population was discovered on the Ouachita River in Arkansas and an apparent reproducing population was found in the Green River in Kentucky in 2012 (Lewis Environmental Consulting 2013, p. 4). Both of the rivers with these new populations were known to be occupied at the time of listing, thus the spectaclecase is still currently considered to be extant in 20 streams. Table 1 provides a population summary for all streams thought to harbor extant spectaclecase populations.

We categorized the extant population (typically, distinct river segments) trends into four groups (Table 1). The population trend is considered ''increasing'' if there was evidence that the numbers of individuals have been on a substantial increasing trend over the past 20 years or more (post 1997). The population trend is considered "stable" if there was evidence that the numbers of individuals have remained relatively steady over the past 20 years or more (post 1997) and is considered "declining" if there was evidence that the numbers of individuals have been on a substantial decreasing trend over the past 20 years or more (post 1997). Population trends were categorized as "unknown" if there was insufficient evidence to estimate trends. We further categorized the extant populations by population size. Populations were considered to be "small" if 5 or fewer individuals were observed during the last survey, "medium" if 6-29 individuals were observed during the last survey, "large" if 30-74 individuals were observed during the last survey,"extra-large" if 75 or more individuals were observed during the last survey, and "unknown" if there was insufficient evidence to place

them into a population size category. Finally, length of stream occupied and evidence of recruitment (presence of juveniles less than or equal to 4 years of age) were considered.

These categories were combined to form an overall "status" category. Populations were considered to be a "stronghold" if they were defined as large or extra-large populations, generally distributed over a substantial and more or less contiguous length of stream (>30 river mi, many local sites), ample evidence of recent recruitment, and currently considered viable. Populations were categorized as "weakened" if they were small, generally restricted populations with limited recent recruitment and viability. Populations were considered to be "notable" if they were defined as very small and highly restricted, with no evidence of recent recruitment, of questionable viability, and that may be on the verge of extirpation in the immediate future (e.g., less than one generation). Populations labeled as "unknown" had insufficient evidence to categorize. Although we are uncertain what exactly constitutes a "viable population" of spectaclecase, we can, for now characterize viability more generally, in terms of population size, age structure, recruitment, and persistence.

Following these criteria (above), as of 2017-2018 there are 5 "stronghold", 5 "weakened", 3 "notable", and 15 "unknown" spectaclecase populations (Table 1). A few rivers were evaluated in multiple segments, and therefore may have fallen into multiple categories (e.g., if data were notably dissimilar in different stream reaches).

The Service currently has no updated occurrence data information since the time of listing for the Ohio River (IL and KY) and Mississippi River (MO).

At the time of listing, the spectaclecase was considered to be extirpated from 24 streams, declining at 5 streams, stable at 5 streams, and unknown at 10 streams. No streams were categorized as improving at the time of listing. Although we classified streams on a slightly different scale and used different terms for this review, the status of most populations (Table 1) remains unchanged since the species was listed in 2012. Changes to the status of populations that have occurred since listing are outlined below.

Table 1. Spectaclecase extant stream population summary by stream of occurrence. Some streams are broken into segments (stream reaches) for this analysis (*e.g.*, if data was notably dissimilar in different stream reaches).

Stream	River Mile (up)	River Mile (low)	Year of Last Live or Fresh Dead Observ.	Evidence of Juveniles ≤ 4 yrs	Population Trend Since 1997	Population Size	Est. number of occupied river miles	2012 Status	2017 Status	Notes
Upper Mississippi River										
Mississippi River (IA)-I74 Bridge	586	586	2018	No	Stable	Small	<1 mi	Declining	Notable	
Mississippi River (IA/IL downstream of dam)	586	586	2018	No	Stable	Medium	1-5 mi	Unknown	Stronghold	
Mississippi River (IL)	486	485	2018	Unknown	Stable	Large	<1 mi	Unknown	Notable	
Mississippi River (IA)	403.1	403.1	2015	No	Unknown	Small	< 1 mi	Declining	Unknown	
Mississippi River (WI/MN)	635	630	1982	Unknown	Unknown	Small	1-5 mi	Declining	Weakened	
Mississippi River (WI/MN)	760.5	760	2009	Unknown	Unknown	Small	< 1 mi	Declining	Unknown	2 Indiv.
Mississippi River (MO)	285.5	284.7	2003	No	Unknown	Small	< 1 mi.	Unknown		
St. Croix River (MN) above dam	110	60	2013	No	Declining	Medium	30+ mi	Unknown	Weakened	Old indiv.
St. Croix River (MN) below dam	50.5	49	2017	Yes	Stable	Large	1-5 mi	Stable	Stronghold	
Meramec River (MO)	145	18	2016	Unknown	Stable	Extra Large	30+ mi	Stable	Stronghold	
Bourbeuse River (MO)	10	0.5	2014	Unknown	Stable	Extra Large	1-5 mi	Stable	Unknown	
Big River (MO)	1.5	1	2014	No	Stable	Small	-1-5 mi	Unknown	Unknown	
Lower Missouri River										
Osage River (MO)	80	13	2016	No	Unknown	Medium	20 -30 mi	Unknown	Unknown	
Sac River (MO)	15	1.5	2001	Unknown	Declining	Small	5-10 mi	Declining	Unknown	3 Indiv.
Gasconade River (MO)	215	6	2016	Unknown	Stable	Extra Large	30+ mi	Stable	Weakened	
Big Piney River (MO)	60	2	2014	Unknown	Stable	Extra Large	20 -30 mi	Unknown	Unknown	
Osage Fork (MO)	13.9	0	2005	Unknown	Unknown	Medium	1-5 mi	Unknown	Unknown	

Ohio River										
Ohio River (IL)			1994	No	Unknown	Small	< 1 mi	Declining	Weakened	
Ohio River (KY)								Unknown		
Kanawha River (WV)	78.75	76.75	2017	no	Unknown	Unknown	1-5 mi	Unknown	Unknown	Few, older individuals
Green River (KY)	206.3	155.0	2016	Yes	Stable	Extra Large	30+ mi	Unknown	Stronghold	
Cumberland River										
Cumberland River (TN)	350	350	2004	No	Declining	Small	Unknown	Unknown	Unknown	Single Indiv.
Cumberland River (KY)	10.5	9.0	2008	No	Unknown	Small	<1 mi	Unknown	Weakened	Single Indiv.
Tennessee River										
Tennessee River (AL)	334	334	2015	No	Unknown	Small	<1 mi	Unknown	Unknown	Single Indiv.
Tennessee River (TN)	197	156	2001	No	Declining	Small	30+ mi	Unknown	Unknown	
Nolichucky River (TN)	35	10	2017	No	Unknown	Medium	20 -30 mi	Unknown	Notable	
Clinch River (TN)	202	152	2017	Unknown	Declining	Small-Medium	30+ mi	Declining	Weakened	Single Indiv.
Clinch River (VA)	359.7	338.9	2017	Unknown	Unknown	Medium	Unknown	Unknown	Unknown	
Duck River (TN)			1999	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Single Indiv.
Lower Mississippi River										
Mulberry River (AR)	35.5	35.5	~1995	No	Unknown	Unknown	Unknown	Unknown	Extirpated?	Single Indiv.
Ouachita River (AR)	401	333	2017	Yes	Stable	Extra Large	30+ mi	Declining	Stronghold	

Upper Mississippi River Sub-basin

The spectaclecase was historically known from 13 streams in the upper Mississippi River system. Currently, in addition to the mainstem, five streams in the system are thought to have extant spectaclecase populations (*i.e.*, Mississippi, St. Croix, Meramec, Bourbeuse, and the Big River).

Mississippi River – Since the species was listed in 2012, three new records have been documented from the Upper Mississippi River, one at Mississippi River Pool (MRP) 15 (Quad Cities area, Illinois and Iowa; in 2018), one at MRP 19 (Burlington area, Illinois and Iowa in 2015), and one at Sylvan Slough (Illinois in 2018).

St. Croix River –Surveys of the St. Croix River (MN) in 2013 indicate that the population above the St. Croix Falls dam (between RMs 60 and 110) is in decline, with a medium sized population consisting of only extremely old individuals. Surveys conducted below the St. Croix Falls dam (RM 49-50.5) in 2017, however, indicate a stronghold for the species, with a large stable population with evidence of recent recruitment (L. Kitchel, Wisconsin Department of Natural Resources (WIDNR), pers. comm. 2017). The population below the dam is frequently used for glochidia collections for fish host trials and was the source of females used in the successful transformation of larvae to juveniles using mooneye and goldeye (B. Sietman, Minnesota Department of Natural Resources (MNDNR) 2018 pers. comm.).

Meramec River - The population in the Meramec River (MO) was last visited in 2016 (i.e., spot surveys; not a complete survey of the entire stretch), is large (more than 75 individuals) and continues to be considered stable and a stronghold for the species (Missouri Department of Conservation (MDC) unpublished heritage database updated January 24, 2018).

Bourbeuse River –The Bourbeuse River (MO) was sampled again in 2014 and found to have a large population (>75 individuals) and is considered a stable population covering an estimated 1 to 5 miles of the river (Missouri Department of Conservation unpublished heritage database updated January 24, 2018).

Big River - The Big River (MO) was last surveyed in 2014 and the population is thought to be relatively small (5 or fewer individuals) but stable, occupying 5-10 miles of river (Missouri Department of Conservation unpublished heritage database updated January 24, 2018). The small number of individuals observed in 2014 is likely due to the type of sampling (systematic survey with quadrats); 114 individuals were observed in 2008 (A. Roberts, USFWS, 2018 pers. comm). The bed was monitored in 2010, 2011, and 2012 with quadrats resulting in 7, 12, and 7 individuals observed, respectively (A. Roberts, USFWS, 2018, pers. comm.).

Lower Missouri River system

The spectaclecase was historically known from 10 streams in the Missouri River system. Currently, five of these streams are thought to have extant populations (*i.e.*, Osage, Sac, Gasconade, Big Piney, and Osage Fork).

Osage River: Spectaclecase was observed in the Osage River (MO) in 2013, 2014, and 2016 at four different sites (A. Roberts, USFWS, 2018, pers. comm.). Since the time the species was listed, we have learned more details about this population. It is thought to be of relatively medium size (6-29 individuals observed), occupying 20-30 miles of river (Missouri Department of Conservation unpublished heritage database updated January 24, 2018).

Sac River: Missouri Department of Conservation unpublished heritage database (updated January 24, 2018) had no records of the species since 2001 in the Sac River (MO).

Gasconade River: The spectaclecase was last observed in the Gasconade River (MO) in 2016. Since the time the species was listed, we have learned more details about this population. It is thought to be relatively large (30-74 individuals), occupying roughly 200 miles of river (Missouri Department of Conservation unpublished heritage database updated January 24, 2018).

Big Piney River: The spectaclecase was last observed in the Big Piney River (MO) in 2014. Since the time the species was listed, we have learned more details about this population. It is thought to be stable, extra-large (75+individuals), occupying 20-30 miles of river (Missouri Department of Conservation unpublished heritage database updated January 24, 2018).

Ohio River system

The spectaclecase's continued existence in the Ohio River is extremely uncertain. Once known from five rivers, it has been extirpated from two, and two of the remaining three are recently represented by only one or two individuals each.

Kanawha River: Spectaclecase was observed in the Kanawa River (WV) in 2017, but is thought to occupy only a few river miles and only individuals older than 15 years were observed (WVDNR 2017, p. 2). It is doubtful that a recruiting spectaclecase population occurs in the Kanawha River due to the small number of individuals found and their advanced age.

Green River: After listing, later in 2012, an apparent reproducing population was found in the Green River (KY). Surveys in 2016 resulted in eleven locations within Pool 4 and three locations within Pool 6 of the Green River. Since the

time the species was listed, we have learned more details about this population. The population is considered to be large (over 75 individuals observed) and stable, occupying over 30 miles of the river with evidence of recruitment (L. Koch, USFWS, 2018, pers. comm.). The removal of Lock and Dam 6 in 2017 may provide additional habitat for the spectaclecase to occupy (L. Koch, USFWS, 2018, pers. comm.).

Tennessee River system

The spectaclecase was originally known from the Tennessee River and nine of its stream systems. The spectaclecase is now known only from the Tennessee mainstem and three of its tributaries.

Tennessee River: Older records (e.g., 2001, Hubbs 2004) indicate a small population and since the listing, one survey near RM 334 in Alabama resulted in one live individual (AST Environmental 2015, p. 3).

Nolichucky River: Spectaclecase was observed in the Nolichucky River (TN) in 2017. Since the time the species was listed, we have learned more details about this population. It is thought to be of medium size occupying 20-30 miles of the river (D. Hua, Tennessee Wildlife Resources Agency and T. Lane, Virginia Department of Game and Inland Fisheries, 2018, pers. comm.). The current status of the Nolichucky River population is thought to be notable, due to documented recruitment recently (D. Hua, Tennessee Wildlife Resources Agency and T. Lane, Virginia Department of Game and Inland Fisheries, 2018, pers. comm.). This population has been used for propagation studies.

Clinch River: Spectaclecase is currently known from three key areas in the Clinch River; one site in Scott County, Virginia and two sites in Tennessee (Kyles Ford and Grissom Island) but quantitative searches resulted in only a few individuals (Jones et al. 2014, p. 7, 12; Jones et al. 2018, p. 42). The specific habitat for the species is under-surveyed in this river, but all three areas are still thought to contain dozens of individuals (J. Jones, USFWS, 2018, pers. comm.). The population is estimated to be small to medium and may be declining in some areas. Some populations of other mussel species in the Clinch River, however, are showing signs of recovery (Jones et al. 2014, p. 9).

Lower Mississippi River system

The spectaclecase was apparently never widely distributed in the lower Mississippi River system. Records from only two streams are known, both from Arkansas.

Mulberry River: The status of the spectaclecase in the Mulberry River (AR) is unknown. This river was last searched in 2012, but spectaclecase was not observed (Bouldin et al. 2015, p. 6).

Ouachita River: At the time of listing, the population in the Ouachita River (AR) was considered very small and declining (Harris *et al.* 2009, p. 67; J. Harris, Arkansas State University, 2010, pers. comm.). In 2012, a relatively large spectaclecase population was discovered on the Ouachita River upstream of the 1990 collections in Clark and Dallas counties. The species was last observed during 2017 surveys and is thought to be stable and a stronghold for the species. The population is considered large (more than 75 individuals), occupying over 30 miles of stream, with young (<=4 years old) individuals (K. Moles, Arkansas Game and Fish Commission, 2018, pers. comm.).

2.3.1.4 Taxonomic classification or changes in nomenclature:
Williams et al. (2017, p. 26, 45) proposed a change in the family *Margaritiferidae*: the placement of the formerly monotypic genus *Cumberlandia* in the synonymy of *Margaritifera*. Therefore, *Cumberlandia monodonta* has been reassigned to *Margaritifera monodonta* (Say, 1829) (Williams et al. 2017, p. 36). With the placement of *Cumberlandia* in the synonymy of *Margaritifera*, the number of recognized *Margaritifera* species in the United States and Canada is five (Williams et al. 2017, p. 45).

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 historical range, etc.):

Since the time of listing, the new location discoveries (new locations within streams with previous extant records, including those in the upper Mississippi River, Ouachita River, and the Green River) did not add to the known current or historical range.

There is no new information available on habitat or ecosystem conditions since the publication of the final rule in 2012.

2.3.2 New Information on threats, conservation measures, and regulatory mechanisms since the time of listing

Large-river habitat throughout most of the spectaclecase's range has been impounded, leaving short, isolated patches of habitat in areas between dams. Other threats include impoundments, point and nonpoint source pollution, sedimentation, and physical changes in streambed structure. These threats are

exacerbated as a result of the small size and isolation of remaining populations. See the 2012 listing rule (77 FR 14914) for a detailed discussion of these factors.

We have no new information on destruction, modification, or curtailment of the spectaclecase's habitat or range; overutilization; disease or predation; existing regulatory mechanisms; or other factors affecting the species (such as effects of climate change and population fragmentation and isolation). However, a mass mortality (of unknown cause) of freshwater mussels in the Clinch River, Tennessee, has been ongoing since 2016 (Richard 2016, pp. 2-16) and impedes the Service's efforts to restore imperiled species, such as the spectaclecase, in the Upper Tennessee River Basin (U.S. Fish and Wildlife Service 2014, p. 6).

Conservation Measures:

The removal of Lock and Dam 6 on the Green River in Kentucky in 2017 may provide additional habitat for the spectaclecase to occupy (L. Koch, USFWS, 2018 pers. comm.) and will likely support the migratory habits of its *Hiodon* hosts (Hilton et al., 2014).

As part of the mitigation for I-74 bridge replacement over the Mississippi River, the Iowa Department of Transportation is coordinating with Iowa Department of Natural Resources to develop artificial structures (Spectaclecase "motels") that will be placed in areas with otherwise good habitat to encourage inhabitation (H. Dunn, EcoAnaylsts, Inc., 2018, pers. comm.). Some individuals were moved to a different location nearby as a result of the bridge replacement.

The Service is cooperating with state, federal, and local agencies, universities, and other partners to develop and implement a propagation and reintroduction plan for this species in order to comply with the Service's controlled propagation policy. As such, we are using International Conservation of Nature (IUCN) guidelines to facilitate our assessment of ecological, social, and economic risks, and to aid development of collection, release, and monitoring strategies. The propagation and reintroduction plan is still in development. Reintroducing populations to former parts of its historical range will add redundancy by adding new populations and will help to mediate the effects of habitat fragmentation. Diversifying to new locations may also help mediate effects of zebra mussels, particularly if reintroductions take place in areas where the threat of zebra mussels or other invasive species are low. Augmenting existing populations will make populations more resilient to stochastic events and may help address the threat of small population genetics.

2.4 Synthesis

The spectaclecase is a federally listed endangered species that is currently considered extant in 20 streams in Alabama, Arkansas, Illinois, Kentucky, Minnesota, Missouri,

Tennessee, Virginia, West Virginia, and Wisconsin. Records indicate that the species historically occurred in at least 44 streams and also historically occurred in Indiana, Kansas, and Ohio.

The spectaclecase host fish have recently been identified as mooneye (*Hiodon tergisus*) and goldeye (*H. alosoides*) (Sietman et al. 2017, p. 18). Due to the recent identification of the host fish, propagation techniques for the spectaclecase are just starting to be developed. Propagation has started at three facilities: MNDNR Center for Aquatic Mollusk Programs, Genoa National Fish Hatchery, and Kentucky Department of Fish and Wildlife's Center for Mollusk Conservation. No augmentation or reintroduction of spectaclecase has occurred to date.

Minnesota DNR is currently holding juvenile spectaclecase in Lake Pepin (St. Croix River), Minnesota, in a cage to allow the mussels to grow to a stock-able size. Kentucky Department of Fish and Wildlife's Center for Mollusk Conservation has successfully transformed larvae to juveniles using in-vitro method and is currently holding juveniles in their laboratory.

Since listing, there has been no change in the species' spatial distribution. Three streams listed as having declining or unknown trends in the final listing rule have had notable discoveries - newly discovered reproducing extant populations (Ouachita River (AR) and Green River (KY), and Mississippi River (IL/IA)). Due to the close proximity of these newly discovered populations to other extant populations, these new records cannot be considered to be a range expansion for the species.

Two streams (Ohio River (IL) and Duck River (TN)) where the species was thought to be extant at the time of listing are now questionable due to the small number of individuals observed and the number of years since the last detection of the species (1994 and 1999, respectively) despite more recent surveys. The species is now presumed extirpated in the Mullberry River in Arkansas (it was considered unknown at the time of listing).

The spectaclecase should remain listed as *endangered* because the species status has not improved since listing and threats have not been ameliorated. Threats persist for the remaining spectaclecase populations, including habitat degradation and the effects of climate change. Extant populations in 5 stream segments (out of 31 segments believed extant at the time of listing) are considered to be strongholds. The 5 strongholds are distributed in 3 of the 5 river systems currently inhabited by the species. One stream segment of the 31 segments is now believed to be extirpated, and none are considered notable or weakened. In summary, the species' status has not significantly changed since the time of listing.

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

New Recovery Priority Number: 5
Brief Rationale: The change from "4" to "5" is because, at the time of listing, the species was recognized as a monotypic genus *Cumberlandia*, with a high degree of threat and low recovery potential (77 FR 14914). Although there is still some uncertainty, the reclassification of the species to *Margaritifera monodonta*, would mean that the species is no longer a monotypic genus (Williams et al. 2017, p. 45). Based on this review, the high degree of threat and low recovery potential has not changed since the time of listing. Recovery of this species will likely require intensive human intervention (e.g., propagation and reintroduction). The recovery potential may be improving, however, due to the discovery of the host fish and early in-vitro propagation technique successes, although these techniques are in very early stages (e.g., no reintroductions have occurred so the success of those programs is unknown). Preliminary success in propagation management indicates that the species' recovery potential may increase from low to moderate in future years.

RECOMMENDATIONS FOR FUTURE ACTIONS

Develop a recovery plan for the species.

Perform surveys in known streams to assess the status of known populations and search for additional populations in appropriate habitat to evaluate their potential role in the recovery strategy.

Develop a propagation and reintroduction plan.

Develop a genetics management plan to inform recovery efforts.

Continue to develop and refine the technology and protocols for rearing juveniles in captivity using host fish and in-vitro techniques for future augmentation and reintroductions.

Investigate potential sites for future augmentation or reintroduction of captivity reared juveniles and/or adults, including criteria such as suitable habitat, water quality, presence of fish host, and absence of significant threats.

Maintain and increase vegetated riparian buffers of streams throughout the range of the species.

Initiate watershed-level, community based riparian habitat restoration projects in rivers with spectaclecase or upstream in the watersheds harboring the spectaclecase.

Where current numerical criteria of certain pollutants may not be protective of the spectaclecase and other mussels, these standards should be adjusted to better conserve mussel resources.

A monitoring program should be developed and implemented to evaluate efforts and to monitor population parameters and habitat conditions.

Assess the long-term viability of extant, newly discovered spectaclecase populations, and any populations that may result from reintroductions or be supplemented by augmentations.

Monitor invasive species (e.g., zebra mussels) and continue to investigate invasive species control measures.

Investigate the extent of impoundments, dams, pollutants, and sedimentation to the spectaclecase and investigate the species sensitivity to those threats.

5.0 REFERENCES

AST Environmental. 2015. Protected species survey/relocation: Lacey's Spring Docking Facility, Tennessee River, Morgan County, AL.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Spectaclecase (*Cumblerlandia monodonta*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

New Recovery Priority Number: 5
Brief Rationale: The change from "4" to "5" is because, at the time of listing, the species was recognized as a monotypic genus *Cumberlandia*, with a high degree of threat and low recovery potential (77 FR 14914). Although there is still some uncertainty, the reclassification of the species to *Margaritifera monodonta*, would mean that the species is no longer a monotypic genus (Williams et al. 2017, p. 45). Based on this review, the high degree of threat and low recovery potential has not changed since the time of listing. Recovery of this species will likely require intensive human intervention (e.g., propagation and reintroduction). The recovery potential may be improving, however, due to the discovery of the host fish and early in-vitro propagation technique successes, although these techniques are in very early stages (e.g., no reintroductions have occurred so the success of those programs is unknown). Preliminary success in propagation management indicates that the species' recovery potential may increase from low to moderate in future years.

Appropriate Delisting Priority Number: N/A

Review Conducted By: Tamara Smith, Fish and Wildlife Biologist

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 8/6/2019

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, Ecological Services, Fish and Wildlife Service

LORI NORDSTROM Digitally signed by LORI NORDSTROM Date: 2019.08.12 16:45:37 -05'00'

Approve _____ Date _____