

**Fat Pocketbook Pearly Mussel
(*Potamilus capax*)**

**5-Year Review:
Summary and Evaluation**



Photo: Mississippi Museum of Natural Science

2019

**U.S. Fish and Wildlife Service
Southeast Region
Mississippi Ecological Services Field Office
Jackson, Mississippi**

5-YEAR REVIEW

Fat pocketbook pearly mussel (*Potamilus capax*)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

We announced initiation of this review and requested information in a published *Federal Register* notice on May 7, 2018 (83 FR 20092) and opened a 60-day comment period. Information regarding recent collections of fat pocketbook mussels (FPM) and active or potential threats to known populations was requested directly from biologists and other representatives from State and Federal agencies, university and private biologists, and other persons working with or familiar with the species. In conducting this review, we obtained and considered peer reviewed scientific publications, unpublished field observations by Service, State, and other experienced biologists; unpublished survey reports, notes and communications from other qualified biologists or experts; and recent conservation programs developed and implemented by the U.S. Army Corps of Engineers (USACE). Information received was evaluated and used to update the 2012 5-year review, as appropriate. The complete draft was then forwarded to five peer reviewers. Their comments were addressed and incorporated into this final document (Appendix A).

B. Reviewers:

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

Lead Field Office: Mississippi Ecological Services Field Office, Mississippi Basin Region: Paul Hartfield, 601-321-1125

Cooperating Field Offices: Conway, Arkansas Ecological Services: Jason Phillips, 870-503-1101; Lafayette, Louisiana Ecological Services: David Walther, 337 291-3122 Frankfort, Kentucky Ecological Services: Mike Floyd, 502-695-0468, ext. 102; Cookeville, Tennessee Ecological Services: Todd Shaw, 931-525-4985

Cooperating Region: Midwest Region: Laura Ragan, 612-713-5339; Columbia Missouri Ecological Services: Andy Roberts, 573-234-2132, ext. 110; Marion, Illinois, Ecological Services, Southern Illinois Sub-office: Mathew Mangan, 618-998-5945; Bloomington, Indiana Ecological Services: Lori Pruitt, 812 334-4261, ext. 213

C. Background

- 1. Federal Register Notice citation announcing initiation of this review:**
May 7, 2018 (83 FR 20092).

2. **Species status:** Improving. Habitat threats continue to be addressed under Federal programs; conservation actions are incorporated into Federal programs as Best Management Practices (BMPs); information on the species indicates increased resilience, redundancy, and representation.
3. **Recovery achieved:** 4 (75-100% recovery objectives achieved): The species' status has improved and expanded in the St. Francis River and Ohio River drainages, and it has expanded its range into the Lower Mississippi River. USACE conservation programs protective of FPM populations and habitats in the St. Francis and Mississippi Rivers have been developed, tested, and successfully implemented.
4. **Listing history:**
Original Listing
FR notice: 41 FR 24062
Date listed: June 14, 1976
Entity listed: Species
Classification: Endangered
5. **Review History:**
Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Since 2013, we have submitted information for the annual recovery data call that included an "Improving" status recommendation for the FPM. The most recent evaluation for this mussel was completed in 2019.

In 2012, a 5-year review of the FPM documented range extension within the St. Francis River Basin, and the existence of viable populations within the Ohio and Lower Mississippi River. Recovery priority was elevated from 8 to 14. No change in status was recommended due to the lack of protections from Federal programs affecting channel habitats.

Previous to 2012, 5-year reviews for this species were conducted in 1987 (52 FR 25523) and 1991 (56 FR 56882)). In these reviews, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors, threats, etc. as they pertained to the individual species. The published notices summarily listed these species and stated that no changes in the designation of these species were warranted at that time.
6. **Species' Recovery Priority Number at start of review:** 14
Degree of Threat: Low
Recovery Potential: High
Taxonomy: Species
7. **Recovery Plan**

Name of plan: Fat Pocketbook Pearly Mussel Recovery Plan
Date of original plan: October 4, 1985
Date of revision: November 14, 1989
Date of recovery criteria amendment: September 2019

II. REVIEW ANALYSIS

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

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPSs to only vertebrate species of fish and wildlife. Because the species under review is an invertebrate, the DPS policy is not applicable.

B. Recovery Criteria

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

The 1989 Recovery Plan objective was to reclassify the FPM from endangered to threatened status. Only two broad criteria for meeting this objective were provided. An amendment to the recovery plan which revised the recovery objective and criteria was finalized in September 2019. The recovery objective is to secure the conservation of the FPM to the extent that the protections of the Act are no longer required. This will require multiple, independent viable populations across the species' range, and securing management of those populations and their habitats for the foreseeable future.

2. Adequacy of recovery criteria.

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

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

3. List the recovery criteria as they appear in the most current recovery plan, and discuss how each criterion has or has not been met, citing information.

The FPM will be considered for delisting when:

- 1) **All three drainage populations (St. Francis, Ohio, and Mississippi River) exhibit a stable or increasing trend, evidenced by natural recruitment, and multiple age classes.**

Status: Criterion has been met. The 2012 5-year review provided data confirming the existence and viability of the three FPM populations: the St. Francis River drainage, Ohio River drainage, and the Lower Mississippi River (Service 2012). This review further documents the expansion of the species range within all three drainages since 2012 (see Table 1, below). FPM are early maturing, fast growing, and live only 8 to 10 years. The presence of small, medium, and large individuals within the three drainage populations demonstrates natural recruitment and persistence of multiple FPM generations.

Mussel surveys within the St. Francis and Ohio River drainages have demonstrated increasing range and natural recruitment of FPM for at least three decades, as evidenced by the documentation of multiple site locations and by the presence of multiple size classes and ages of FPM at most sites. In the St. Francis River drainage, recruitment and viability is also supported by studies demonstrating rapid recolonization of areas following ditch cleanouts. Trends and recruitment in the Ohio River drainage is supported by a change in FPM abundance from rare to common within the lower Wabash River, and by the discovery and persistence of multiple FPM reach and tributary populations over the past three decades.

FPM were first documented from the Lower Mississippi River drainage in the mid-1990's. FPM abundance and population trends are difficult to measure in the Lower Mississippi River; however, its known distribution continues to increase with survey efforts. As noted above, the species is short-lived and its persistence at numerous locations in the Lower Mississippi River for more than two decades is evidence of population stability and recruitment within that drainage.

- 2) **Fat pocketbook mussels are documented from a minimum of 12 sites along 200 kilometer (km) (125 mile (mi)) reaches of the St. Francis, Ohio, and Mississippi River drainages.**

Status: Criterion has been met. Recent collection records from the St. Francis River drainage include multiple sites encompassing about 480 km (300 mi) of 18 river, stream, and ditch channels. Within this area, occupied channel habitats range from relatively stable, to highly modified by channelization or geomorphic response to channelization, water withdrawal, and high sediment loads.

In the Ohio River drainage, fat pocketbook mussels have been collected from multiple locations within a 260 km (160 mi) reach of the Ohio River, and a 240 km (150 mi) of the Wabash River. Recent collections have also been made from one or more sites in the lower reaches of at least 10 other Ohio River tributaries.

In the Lower Mississippi River, FPM have been documented from at least 16 sites along an approximately 676 km (420 mi) reach of the Lower Mississippi.

3) Active USACE management programs are in place, and assured to continue into the foreseeable future, within each of the three drainages leading to maintenance or improvement of fat pocketbook mussel habitats and population expansion.

Status: Criterion has been met. Since the 2012 review, the U.S. Fish and Wildlife Service (Service), USACE Memphis District (MVM), and State partners have conducted research related to developing conservation strategies and best management practices (BMPs) for the FPM in the St. Francis drainage. A conservation program protective of the FPM and its habitats in the St. Francis River drainage has been developed, implemented, tested, and formally incorporated into the USACE MVM St. Francis Basin Construction and Maintenance Program (St. Francis CMP) (USACE 2018). Additionally, some USACE Districts, including MVM, have also formalized methods to consider conservation of the FPM under their regulatory permitting programs (USACE 2017). Therefore, the St. Francis River FPM population is protected from effects of habitat modification under provisions of the St. Francis CMP (USACE 2018) and regulatory program. (USACE 2017).

The USACE Channel Improvement Program in the Lower Mississippi River (LMR CIP) has been modified to protect FPM and maintain its habitats (USACE 2013). Actions to minimize adverse effects of the LMR CIP and to maintain channel habitat quantity and complexity have been incorporated as Standard Operating Procedures and BMPs in order to contribute to the conservation of the FPM and its habitats. USACE has also incorporated components of adaptive management protective of FPM into the CIP, including research, monitoring, and partnerships. As components of the St. Francis CMP and LMR CIP, conservation actions and BMPs protective of FPM and its habitats will continue regardless of a change in the species status under the Act.

Ohio River populations and habitats are currently managed under informal agreements between the Service and USACE, or under terms

and conditions identified within Biological Opinions. Under this management, FPM has expanded its known range into the lower Ohio River and tributaries, and the species is now considered common in the lower Wabash River. Although there is no formal USACE program in the Ohio River, some actions can be formalized as agency BMPs, to a degree that the conservation needs of the FPM might continue to be considered into the future.

C. Updated Information and Current Species Status

1. Biology and Habitat:

a. Abundance, population trends (e.g. increasing, decreasing, stable), demographic features, or demographic trends:

St. Francis River Drainage

At the time of the 1985 recovery plan, the only known viable population was estimated to consist of 11,000 to 24,000 individuals occupying a 43-mile reach of the St. Francis Floodway (Clarke 1985). Field verification of St. Francis River drainage FPM populations has been sporadic. Jenkinson (1989) reported collecting 2,321 FPM from a 6.4 km (4 mi) reach of the Clarke Corner Cutoff in the Floodway channel. Harris (1986) reported 82 FPM in 512 square meters of St. Francis River at Madison, AR, 32 in an 1,800 square meter area of the Floodway downstream of Clarke Corner Cutoff (1990), and 23 FPM from a 300 m reach of the St. Francis River at Parkin, AR (2002). FPM population estimates in a 5.6 km (3.5 i) reach of Stateline Ditch were found to exceed 6,000 individuals in 2005 (Harris et al., in litt. 2009). FPM abundance was estimated at approximately 550 individuals in a 6.1 km (3.8 mi) reach of Rivervale Outlet Ditch, Poinsett County, AR, before cleanout (USACE 2009), and about 1,868 (USACE 2018) post-cleanout. A pre-cleanout survey of a 10 km (6 mi) reach of Straight Slough estimated an FPM population of 2,137 (Service 2014a). All of these surveys noted the presence of multiple FPM age classes, including juveniles.

Ohio River Drainage

During the mid-1980's, only a few small FPM populations were suspected to survive outside of the St. Francis River drainage, within the historical range (Service 1985). By the time of the 1989 Recovery Plan revision, a few live FPM individuals, including young specimens, had been collected and verified in the lower Wabash River, Indiana and Illinois, White River, Indiana, and the lower Cumberland River, Kentucky, all within the Ohio

River drainage (U.S. Fish and Wildlife Service 1989). Over the past three decades, the species has been reported from the lower Ohio River, the lower Wabash River, and from the lower reaches of other major tributaries (Saline, Tennessee, White, Cumberland, Clarks, and Green Rivers), Kentucky, Illinois, and Indiana (Figure 1, Table 1).

FPM collections in the Ohio River drainage have generally been associated with surveys targeting specific areas (e.g., fleeting areas, loading/unloading facilities, impoundments), and there has been no comprehensive effort to quantify population size in the drainage. At some locations within the Ohio River, however, FPM represents a substantial proportion of the native bivalve fauna (e.g, Lewis 2007a, b), and recruitment (based on the presence of juvenile mussels) has been apparent at most collection sites in the Ohio River. A survey repeating 2010 mussel survey methods conducted at approximate ORM 929, demonstrated FPM persistence and recruitment (age classes 3-5 years) over 6 years within a barge staging area (Morgan and Fortenberry 2016b). The FPM has been monitored below Smithland Lock and Dam and at ORM 918.5 during and after construction of the Smithland Hydroelectric Project (EA Engineering, Science, and Technology, Inc. 2013, 2016, 2017, 2018). This monitoring indicates a decline in overall mussel abundance, possibly due to changes in substratum resulting from construction (EA Engineering, Science, and Technology, Inc. 2018); however, it has also demonstrated persistence and recruitment of FPM during and after construction of the Project.

Records of live FPM individuals from multiple sites in the Wabash River in Illinois and Indiana also demonstrate persistence and recruitment (Table 1). In one survey, the FPM was found at 13 of 26 locations surveyed in the Wabash River, and was overall 3rd in abundance of the mussel species collected (Frankland 1996). Tiemann et al. (2012) reported the distribution of the FPM in Illinois to include the Wabash, Little Wabash, Saline, and Ohio Rivers. They described the lower Wabash River FPM population as stable, noting that it is now one of the most common species in the lower river, and that it is expanding its distribution upstream. Sizes of FPM individuals reported indicate a fairly young population exhibiting recruitment. Live and fresh dead FPM specimens also have been observed or collected from tributaries of the Wabash River, including Little Wabash and White rivers (Table 1).

Mississippi River

Spot surveys and reported observations now indicate the species is widely distributed in the Lower Mississippi River, between the confluence of the St. Francis River and Natchez, Mississippi (Figure 1, Table 1, U.S. Fish and Wildlife Service *in litt.* 2009). Collections are localized in small areas

of relatively stable secondary channels and side channels. Population densities are extremely low in the secondary channel habitats where they are found, however, recruitment appears to be occurring based on the occurrence of young individuals (P. Hartfield, pers. obsv. 2003-2007).

Summary: Current data demonstrate increasing FPM population trends over the past 3 decades in the St. Francis, Ohio, and Mississippi river drainages, primarily through the discovery of new site locations. In the Ohio and Wabash rivers, the species populations have increased from locally rare in 1989, to locally common. Persistence and recruitment have been documented within multiple river and stream reaches in all three drainages. A comparison of the past and recent collection history of FPM indicates that the FPM is recruiting and increasing in abundance in the St. Francis, Ohio, and Lower Mississippi rivers and some of their tributaries.

b. Genetics, genetic variation, or trends in genetic variation:

Two shell morphotypes have been noted in the Ohio River FPM population and there was some concern that one of these morphotypes deviated significantly from other populations (P. Hartfield, pers. obsv. 2009). While genetic analysis found no evidence of divergence between the two putative morphotypes within the Ohio River population, there were significant genetic differences between the Ohio and St. Francis River FPM populations (Moyer *et al.* 2011). These results suggest the two populations should be managed as distinct evolutionary units.

c. Taxonomic classification or changes in nomenclature:

While two shell forms of FPM have been identified in the Ohio River drainage (see b, above); a thin-shelled small form with occasional faint rays on the posterior of the shell, and a larger heavier-shelled form with no rays that is similar to other portions of the range, a range-wide evaluation of shell variation found there was no quantifiable evidence of morphological divergence within the Ohio River population (Harris *et al.* 2011). This is supported by genetic analyses (Moyer *et al.* 2011). Therefore, no changes in taxonomic classification or nomenclature are under consideration.

d. Spatial distribution, trends in spatial distribution, or historic range:

The FPM was historically widely distributed in the Mississippi River drainage from the confluence of the Minnesota and St. Croix rivers downstream to the White River system (Figure 1). The species was documented in Minnesota, Wisconsin, Iowa, Illinois, Indiana, Missouri,

Kentucky, and Arkansas (NatureServe 2011). Most historical records for this species are from the upper Mississippi River (above St. Louis), the Wabash River in Indiana, and the St. Francis River in Arkansas (U.S. Fish and Wildlife Service 1989). When listed, only the St. Francis River and White River populations of FPM were believed to be extant and viable (41 FR 24064).

St. Francis River Drainage

In the St. Francis River Drainage, the FPM was historically known from scattered locations through less than 100 km of river and tributary channels (Service 1985). At the time of the 1985 recovery plan, the only known viable population occurred within a 43-mile reach of the St. Francis Floodway channel (Clarke 1985). In 1989, the recovery plan was updated (U.S. Fish and Wildlife Service 1989) to include new records from the St. Francis Floodway, the unchannelized St. Francis River, and a number of tributaries and/or drainage ditches associated with those channels (Ahlstedt and Jenkinson 1987). Since the 1989 Recovery Plan revision, an additional 5 stream populations have been discovered. The FPM is currently known from at least 18 river, stream, or ditch reaches in the St. Francis River drainage (Barnhart 1997a; Harris 2002; Ecological Specialists 2005; USACE 2009, 2012, 2013, 2014), and persistent recruitment has been documented from at least 8 of those reaches (Table 1).

Summary: Collection records from the St. Francis River drainage since listing show a significant expansion in spatial distribution of FPM in the St. Francis River drainage, from a historical range less than 100 km (60 mi) to a current range of about 480 km (300 mi) of river and stream reaches (Figure 1, Table 1).

Ohio River Drainage

The FPM was considered historically uncommon in the Ohio River Drainage, with records from only about a 100 km (60 mi) reach of the Wabash, Illinois and Indiana, and 25 km (15 mi) of the lower Ohio River, Kentucky and Tennessee (Service 1985). At the time of listing, the FPM was believed extirpated from this portion of the historical range (41 FR 24064). Over the past three decades, however, the species has been reported from scattered locations along 260 km (163 mi) of the lower Ohio River, the lower 240 km (150 mi) of the Wabash River, and from the lower reaches of other major tributaries (Saline, Tennessee, White, Cumberland, Clarks, and Green Rivers), Kentucky, Illinois, and Indiana (Figure 1, Table 1). Ohio River site records of FPM since 2012 were reported or confirmed from Ohio River Mile (ORM) 968 (Slack *et al.* 2014), ORM 943 (Morgan and Fortenberry 2016a), ORM 928 (Morgan

and Fortenberry 2015a), and ORM 858 (Morgan and Fortenberry 2015b). New Ohio River drainage records since the last 5-year review include the Saline River (Shasteen *et al.* 2012); Lower Clarks River, Kentucky (Lewis Environmental Consulting 2013); the Barkley Lock Approach on the Lower Cumberland River (Tennessee Wildlife Resources Agency 2018); and the Lower Green River, Kentucky (Koch *in litt.* 2015). Multiple age classes of FPM were represented within these collections.

Mississippi River

FPM was historically known from scattered records through about an 800 km (500 mi) reach of the upper Mississippi River between Wabasha, Minnesota, and Grafton, Missouri (Service 1985). The revised Recovery Plan identified a 1986 report of FPM shells from the upper Mississippi River in Missouri (U.S. Fish and Wildlife Service 1989). A previously unreported 2007 record of a weathered dead shell of FPM was reported from Upper Mississippi (UMR) Mile 507 in Iowa (H. Dunn email 4/8/2013). This is the first evidence of the species in the UMR for several decades.

There are no historical records of FPM from the Lower Mississippi River (LMR). In 1992, a population of the species was discovered in Gilliam Chute, a cutoff LMR channel in Jefferson County, Mississippi. In 1997, live and fresh dead FPM specimens were observed on Island No. 1, downstream from the Ohio River confluence. Between 2003 and 2007, the species was documented from scattered secondary channels along a 300 mi reach of the LMR between the confluence of the St. Francis River above Helena, Arkansas, and Natchez, Mississippi (P. Hartfield, pers. obsv. 2003-2007). Since the 2012 review, live or fresh dead shells of FPM have been collected from secondary channels or chutes at LMRM 791 and 801 (Posey *et al.* 2012, M. Thron email 3/7/2017), and LMRM 380, 404, 487, 558, 565, 622, and 665 (ERDC FPM 110618 Spreadsheet), extending its range in the LMR to about 400 river miles.

A single live FPM was reported from the White River, Arkansas (Harris and Christian 2003), however, there have been no subsequent reports of the species in this drainage.

Summary: The range of FPM in the St. Francis and Ohio River drainages has increased over the historically documented extent. While the species appears to remain extirpated from the upper Mississippi River, it has expanded its range into the Lower Mississippi River (Figure 1). The FPM is now known to occupy approximately 1,000 channel miles in three distinct drainages and 33 river or stream reaches (Table 1).

e. Habitat:

Habitats where the FPM is currently found range from relatively natural and stable (Wabash), to impounded (Ohio), and channelized (St. Francis). The species has apparently expanded its range into some secondary channels on the LMR where dike fields have been notched to improve low water flow and condition (USACE 2013).

Haag (2012) has considered FPM as an opportunistic species adapted "...for rapid colonization and persistence in disturbed and unstable but productive habitats." FPM is generally found in sand, mud, and silt substrates associated with depositional areas (e.g., Bates and Dennis 1983, Clarke 1985, Ahlstedt and Jenkinson 1987, Payne *et al.* 2007, Lewis 2007a). Parmalee (1967) reported the FPM from sand and mud bottoms, in flowing water a few inches to more than eight feet in depth. In the St. Francis River, Arkansas, the species has been collected in sand, mud, and fine gravel substrates (e.g., Bates and Dennis 1983, Clarke 1985, Ahlstedt and Jenkinson 1987). In the Ohio River drainage, FPM have been collected from sand, silt, and mixed sand/gravel substrates at depths ranging from a few inches to more than 20 ft. (e.g., Lewis 2007 a, b). In the Lower Mississippi River, the species has been collected in sand in secondary channel habitats, and in sand/silt/mud in side channels (P. Hartfield, U.S. Fish and Wildlife Service, pers. obsv. 2003-2007).

In the Ohio River, mussel species commonly collected with FPM include mapleleaf (*Quadrula quadrula*), pink papershell (*Potamilus ohioensis*), and fragile papershell (*Leptodea fragilis*) (Lewis 2007a). In the St. Francis River system, common associates include yellow sandshell (*Lampsilis teres*), fragile papershell, pink papershell, and bleufer (*Potamilus purpuratus*) (e.g., Harris, 1990). In the Lower Mississippi, mussel species commonly found with FPM include fragile papershell and pink papershell (Hartfield, pers. obsv. 2003-2007).

f. Other:

In laboratory studies, the freshwater drum (*Aplodinotus grunniens*) was the only suitable glochidial host of 28 fish species tested (Barnhart 1997b). However, the method of facilitating glochidial attachment to the host fish is unknown.

Figure 1: FPM records since publication of the Recovery Plan (Service 1985) relative to the historical range of the FPM (Ecological Services Field Office, Jackson, MS).

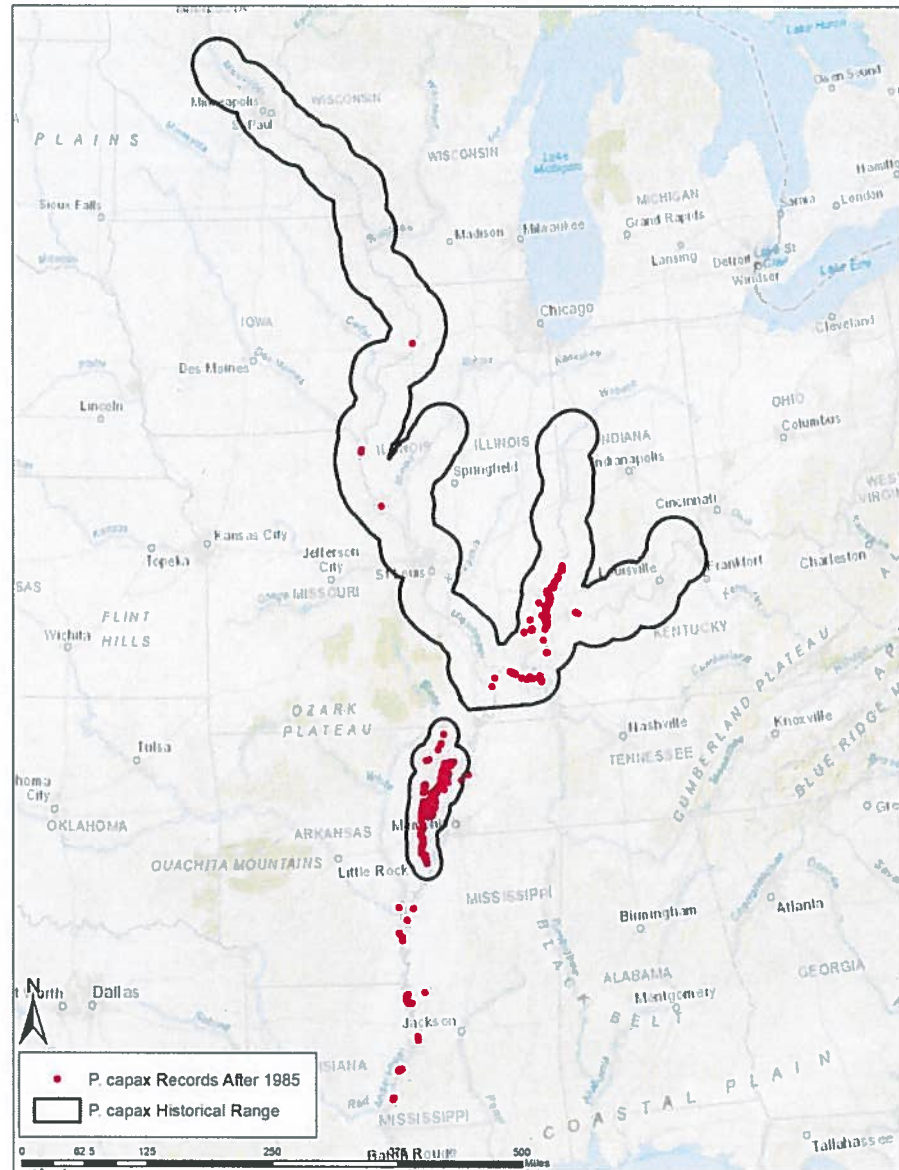


Table 1: Fat Pocketbook Mussel Records since 1985 (*in litt.*, Mississippi Ecological Services Field Office)

<i>Drainage Population</i>	<i>River</i>	<i>Tributary</i>	<i>Approximate Range</i>	<i>Status*</i>	<i>Date Last Observed*</i>
St. Francis River	St. Francis River Channel and Floodway		Scattered over 200 miles	Recruitment documented; persistent	2019
		L'Anguille River	1 site within 1 mile of confluence with floodway	Live	1987
		Right Hand Chute, Little River	17 sites over 38 miles	Recruitment documented	2001
		Ditch 1	5 sites over 6 miles	Live	2001
		Ditch 2	1 site	Live	2009
		Ditch 3	5 sites closely clustered	Live	2010
		Little Bay Ditch 9	1 site within 2 miles of confluence with Ditch 10	Live	1987
		Ditch 10	17 sites over 16 miles	Recruitment documented	2018
		Ditch 23 Tulot Seep	3 sites over 5 miles	Live	1987
		Ditch 60	2 sites over 2 miles	Live	1986

St. Francis (continued)		Ditch 61	2 sites over 16 miles	Live	1987
		Straight Slough	36 sites over 10 miles	Recruitment documented	2013
		Tyrtonza River	14 sites over 24 miles	Recruitment documented	2007
		Stateline Outlet Ditch and Stateline Outlet Ditch No. 29	38 sites over 3 miles	Recruitment documented; persistent	2017
		Iron Mines Creek	3 sites over 2 miles	Live	2010
		Rivervale Outlet Ditch	29 sites over 5.5 miles	Recruitment documented; persistent	2012
		Belle Fountain Ditch	6 sites over 1.2 miles	Recruitment documented; persistent	2007
		Elk Chute Drainage District Ditch No. 1	2 sites	Live	2019
Ohio River	Ohio River		Scattered over 160 miles	Recruitment documented; persistent	2017
	Wabash River		Scattered over ~ 150 miles	Recruitment documented; persistent and common	2016
		Little Wabash	4 sites	Live	2012
		White River	1 site	FD	2007

		East Fork White River	1 site	FD	2010
Ohio River (continued)		Big Creek	1 site	FD	2005
	Saline River				
		North Fork	2 sites	Live and FD	2010
		Middle Fork	2 sites	FD	2010
	Tennessee River		1 site	Weathered shell	2008
	Clarks River		1 site	Live	2013
	Green River		1 site	Live	2011
	Cumberland River		3 sites	Live	2019
Mississippi River	Upper Mississippi		1 site	Weathered shell	2007
	Lower Mississippi		Scattered over 420 miles of channel	Recruitment documented; persistent	2018
		White River	1 sites	Live	2003
3 Drainages		33 streams	~1,000 miles		

*There is no comprehensive monitoring or collecting strategy for FPM, and records are derived from project surveys or general mussel surveys. Under Status, "Recruitment documented" notes documentation of the presence of multiple age classes; persistent denotes multiple FPM collections over 2 or more decades.

2. Five-Factor Analysis

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

The primary threats identified for the FPM have included the destruction, modification, and curtailment of historical habitats throughout its range, primarily due to navigation and flood control activities (i.e., impoundment, channelization, channel maintenance, dredging) on the rivers where it was once found (Service 1989). There were also concerns about the effects of siltation and pollution on mussels in general (Service 1989), however, there was no information on these threats specific to the FPM. The 2012 FPM 5-year review identified on-going threats to habitat and range as impoundment, hydropower and hydrokinetic power development, channel dredging, and illegal discharges and spills (Service 2012). Potential stressors to the species included sedimentation and non-point source pollution (Service 2012). The current status of each of these stressors is addressed below.

Impoundment

Among the extant FPM populations, the Ohio River is the only one currently directly affected by impoundments; however, since listing, this species has expanded its range or been discovered in reaches of the lower river affected by navigation impoundments. FPM continues to survive and recruit in dam tailwaters as well as in riverine sections and the upper pools of impounded reaches through an approximately 160 mi reach of the lower Ohio River (Table 1).

The 2012 FPM 5-year review identified the construction of Olmsted Dam at ORM 964.6 as a potential factor in the species future status. This project is now completed, and the FPM continues to survive and recruit both upstream and downstream of the Olmsted Dam (Service 2019).

Hydropower

The construction of the Smithland Lock and Dam Hydroelectric Project (ORM 918) was completed in 2017. Monitoring during and post construction has demonstrated a decline in overall freshwater mussel abundance, possibly due to changes in substratum that has resulted from the project. However, persistence and recruitment of FPM during and after construction of the Smithland Hydroelectric Project has been demonstrated (EA Engineering, Science, and Technology, Inc. 2018).

Hydrokinetic Development

At the time of the 2012 5-year review, preliminary permits were active for hydrokinetic operations at J.T. Myers and Olmsted Lock and Dams, as well as for several flowing river sites between dams on the Ohio River, and for numerous riverine sites on the Lower Mississippi River (Ziewitz *in litt.* 2009). These permits are no longer active (<https://ferc.gov/industries/hydropower.asp>), and are no longer a factor potentially affecting the FPM.

Dredging

Channel dredging may have many direct and indirect effects on freshwater mussels, including direct mortality, accelerated channel erosion, decreased habitat diversity, increased bedload, and/or increased habitat instability (e.g., Hartfield 1993). The effects of channel dredging also may alter the behavior of host fish due to changes in flow patterns, resulting in altered species composition and abundance. Maintenance dredging is periodically required for navigation and barge fleeting areas in the Mississippi and Ohio rivers, and for flood control and drainage efficiency in tributaries and ditches of the St. Francis River drainage. In addition, the USACE requires permits from private sand and gravel dredging operations.

In the Mississippi River, maintenance dredging occurs in two general locations; the navigation channel, and ports. Within the navigation channel, dredging usually occurs at channel crossovers, locations where fine sediments rapidly accumulate and where mussels do not naturally occur. Ports also are areas that are generally not conducive to mussel survival due to high rates of sedimentation, as well as effects of prop wash on the substrate and routine dredging. Although there are no records of FPM from either the navigation channel or ports in the Mississippi River, USACE has developed BMPs for dredge disposal in both in order to minimize any potential adverse effect to the FPM (USACE 2013). USACE also imposes permit conditions for sand and gravel operations that prohibit dredging in secondary channels and dike fields potentially inhabited by FPM (Service 2014b).

In the St. Francis River drainage, channel dredging is used to clean out ditches and channels in order to maintain designed flow capacity (USACE 2018). There is no sand and gravel mining within the St. Francis Basin. Several studies have shown that FPM populations within this drainage not only survive channel clean out operations, but rapidly reoccupy post-work channel habitats (e.g., Harris 1997, 2001, 2009; Harris *et al.* 2009, Harris *et al. in litt.* 2013, USACE 2018). For example, prior to the 2001 maintenance dredging of Stateline Outlet Ditch, the FPM population in the

project area was estimated at more than 3,000 individuals (Harris 2001). An attempt to minimize the effect of the project involved collecting and relocating more than 2,000 FPM, about 60 percent of the estimated pre-dredging population, prior to the cleanout (Miller *et al.* 2003). Following removal of the FPM and the ditch cleanout, a 2005 post-dredging survey estimated the FPM population size in Stateline Outlet Ditch at more than double (6,000 individuals) the pre-dredge population (Harris *et al.* 2009). Further investigations of the short and long-term effects of ditch cleanouts on FPM in the St. Francis River system have resulted in similar observations (Service 2018; USACE 2018). Even so, USACE (2018) has developed and implemented channel cleanout BMPs, including project design and specifications to minimize the impact of ditch cleanouts on FPM and other mussel species, and continues to investigate effects through pre- and post-cleanout monitoring where FPM is present.

The detrimental effects of channelization on freshwater mussels have been well established (e.g., Hartfield 1993, Neves *et al.* 1997). As noted previously, however, monitoring of the short and long-term effects of ditch cleanouts in the St. Francis River system has shown some degree of FPM survival as well as rapid population recruitment and recovery (Service 2018). While FPM has been described as an opportunistic species (Haag 2012), it is currently unknown to what degree the response to ditch cleanouts is due to survival of individuals by vertical movement in the substrate, robust recruitment due to post-dredge conditions favorable to the host fish, or a combination of these or some other factors.

USACE navigation dredging in the Ohio River is primarily confined to areas of high deposition rates where FPM are not likely to occur. In dredged reaches where mussels do occur, USACE maps, avoids, and monitors mussel beds. Additionally, in some areas dredge disposal material is routinely monitored for the presence of FPM and other mussels (e.g., Fischer 2011).

Apart from dredging BMPs, the FPM range expansion within the St. Francis, Mississippi, and Ohio River systems may also be related to the stabilization and occupation of areas not subject to dredging (e.g., channel margins or secondary channels of the Ohio and Mississippi Rivers), reduced dredge frequency (all three river systems), or dredging methods (St. Francis River system) allowing adaptation of either or both the FPM and its host fish (freshwater drum) to existing conditions.

Illegal Discharges or Spills

FPM may be locally vulnerable to spills or illegal discharges. For example, in 2007, an illegal discharge of glycerin on fields and subsequent runoff into Belle Fountain Ditch, Missouri, killed more than 80 FPM, as

well as other mussel and fish species, along 7 miles of the stream (Roberts *in litt.* 2007, Davidson 2007). Such episodes are rare, and impacts are relatively localized. Mussel and fish kills in the St. Francis River drainage due to natural (e.g., late summer dissolved oxygen depletion) or anthropogenic causes are generally rapidly identified, investigated, and when appropriate, mitigated (e.g., Davidson *in litt.* 2016).

Non-point Source Pollution

Non-point source pollution (stormwater runoff that includes complex mixtures of pesticides, fecal coliform bacteria, metals, suspended solids, and pharmaceuticals) may have negative impacts on mussel populations in areas of concentrated agriculture and urbanization and has been identified as a concern in the Wabash River (e.g., Tiemann et al. 2008) and the St. Francis River (Service 1989) drainages. Non-point source pollution may also contribute to late summer oxygen depletion in shallow streams resulting in localized fish and mussel kills in the St. Francis River drainage (e.g., Davidson *in litt.* 2016). However, the increase in FPM abundance and range over the past two decades within areas that are highly impacted by non-point agricultural runoff and sediments suggests non-point source pollutants are not currently a major impediment to FPM survival (Hartfield, pers. observation, 2003-2019).

Summary: Since the 2012 5-year review, impoundment and hydropower projects with potentially adverse effects on the FPM have been completed with minimal impact to the species, while hydrokinetic development in the Lower Mississippi River has been abandoned. Potential threats have been further reduced by development and implementation of USACE programs protective of FPM and its habitats in the St. Francis, Mississippi, and Ohio River drainages. The species' increase in abundance and range, including within channelized ditches highly affected by agricultural runoff and in navigable river channels subject to dredging, shows resiliency to non-point source pollution and channel maintenance activities. While the FPM remains locally vulnerable to illegal discharges, spills, and non-point source pollution, the expansion of its range provides redundancy in the face of such threats. Therefore, threats previously identified to FPM habitat and range have declined, and/or the species has become locally adapted to conditions across its range.

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

Overutilization is not a threat to the FPM.

c. Disease or predation:

Disease and predation are not known to be factors threatening the FPM.

d. Inadequacy of existing regulatory mechanisms:

Since the implementation of the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System in 1972, industrial discharges have been regulated and point source pollutants have significantly declined in the large river systems inhabited by FPM. While studies suggest that some pollutant standards may not be protective of all freshwater mussel species or life stages (e.g., Augspurger *et al.* 2007, entire), the FPM has experienced an increase in abundance and range within areas affected by point and/or non-point source discharges (Service 2012, USACE 2013, 2018). Therefore, current State and Federal regulations for pollutants may be generally protective of the FPM.

As noted under Factor a (above), maintenance dredging or cleanouts conducted under the Rivers and Harbors Act, or other Federal regulations, may adversely affect FPM populations. USACE (2013, 2018) has developed BMPs for dredging in the Mississippi River, and for channel cleanouts in the St. Francis drainage that minimize adverse effects to the species, and promote rapid recovery of affected populations.

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

The 2012 review noted the harmful effects to freshwater mussels due to the spread of the invasive zebra mussel (*Dreissena polymorpha*), including competition for food and habitat resources. FPM, however, has expanded in range and abundance concurrent with the spread of the zebra mussel, and there is no evidence of any impact of zebra mussel competition to the FPM.

There continues to be a concern that climate change may lead to increased frequency of severe storms and droughts (for example, Golladay *et al.* 2004; McLaughlin *et al.* 2002; Lubchencho and Carl 2012) with potential negative effects to populations of freshwater mussels. Mussel and fish kills occasionally occur locally within the St. Francis River drainage due to late summer dissolved oxygen depletion (e.g., Davidson *in litt.* 2016). However, substantial horizontal movement by FPM within the stream bottom has been documented that could be a potential benefit in surviving extreme drought or dissolved oxygen depletion events (Peck *et al.* 2014). Habitats currently occupied by the FPM include low gradient small streams and ditches (i.e., upper St. Francis drainage) to large rivers (e.g., Mississippi, Ohio, St. Francis Rivers). This expanded distribution throughout a variety of stream and river orders reduces the species

vulnerability to extinction from local stochastic threats, such as severe storms or droughts caused by climate change.

D. Synthesis

Since development and revision of the FPM recovery plan, the species has experienced a significant increase in abundance and range. Known range in the St. Francis River drainage has expanded from a 15-mile reach of the St. Francis and a few tributary site records to about 200 channel miles of the river, floodway, and 18 tributaries (Figure 1, Table 1). In the Ohio River drainage, range has expanded from a few site records of the lower Wabash and Ohio Rivers into a 160 mi reach of the Ohio, and 150 mi reach of the Wabash. The FPM is also now known from outside the documented historical range at multiple sites along more than 400 mi of the Lower Mississippi River. The species is locally common in the St. Francis River drainage, and the main channel and at least seven tributary populations have demonstrated viability through persistence and recruitment. The Ohio River population has demonstrated viability over time, and the FPM is now one of the most abundant mussel species in the Wabash River. The contribution of individual factors to this increase in range, abundance and viability is unknown; however, improved habitat conditions, adaptation to conditions, or the increase in mussel survey efforts since listing may all be important.

Our 5-factor analysis, above, has found no direct or imminent threats to any of the three drainage populations of FPM. The implementation and success of USACE management programs in the St. Francis and Lower Mississippi River supports FPM resiliency, representation, and redundancy. The incorporation of these programs into the respective Federal projects provides assurances that protective BMPs, as well as some degree of monitoring, will continue in the St. Francis and Lower Mississippi River should the species be delisted.

There is no formal USACE FPM management program in the Ohio River drainage. Even so, the species is now common in the lower Wabash River and it has expanded its range into the lower Ohio River and tributaries. Within the navigable Ohio River, FPM populations and habitats are currently identified and avoided by USACE maintenance activities when possible. If maintenance is required in areas known or suspected to be occupied by FPM, USACE monitors for take of the species (e.g., Fischer 2011). Some of the management and monitoring actions currently implemented by USACE could be formalized as BMPs to a degree that would continue to promote conservation of the FPM in the Ohio River should the species be delisted.

The increase in abundance and range of the FPM reflects a decrease in the risk of range and habitat curtailment (Factor a) and provides redundancy which reduces the species vulnerability to stochastic events (Factor e). The St. Francis, Ohio, and Mississippi River drainages have been extensively modified to various degrees by channelization, dredging, dike and revetment construction, and/or

impoundment. The recruitment and persistence of FPM throughout this variety of modified and engineered river and stream reaches demonstrates population and species resilience to habitat modification, as well as the adequacy of regulatory mechanisms to protect the species (Factor d). Current distribution within three major drainages, along with drainage subpopulations occupying a variety of natural and anthropogenic habitats, also demonstrates an increase in ecological representation of the species over historical levels.

In summary, the best available information indicates that the fat pocketbook mussel no longer meets the definition of an endangered or threatened species under the Act and should be proposed for delisting.

III. RESULTS

A. Recommended Classification: Delist due to recovery.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- 1) Conduct surveys in cooperation with Federal, State, and private partners to confirm and update current distribution and status of drainage populations.
- 2) Develop and formalize a USACE FPM conservation program in the Ohio River that supports continued consideration of habitat needs following delisting.
- 3) Work with the States and USACE to develop a FPM post-delisting monitoring plan for the St. Francis, Ohio, and Mississippi River drainage populations.
- 4) Continue to work through Federal, State, and private partnerships to implement and monitor FPM conservation strategies within each drainage population.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of FAT POCKETBOOK MUSSEL (*Potamius capax*)

Current classification: Endangered

Recommendation resulting from the 5-Year review:

☐ Downlist to Threatened

☐ Uplist to Endangered

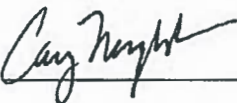
☒ Delist

☐ No change needed

Review conducted by: Paul Hartfield, Mississippi Ecological Services Field Office

FIELD OFFICE APPROVAL:

for **Lead Field Supervisor, U.S. Fish and Wildlife Service**

Approve  Date 12/2/19

REGIONAL OFFICE APPROVAL:

Acting **Regional Director, Fish and Wildlife Service, Southeast Region**

Approve  Date 12/17/19

ACTING Cooperating Regional Director, Fish and Wildlife Service, Midwest Region

☒ Concur ☐ Do Not Concur

Signature _____ Date _____

**APPENDIX A: Summary of peer review for the 5-year review of fat pocketbook
(*Potamilus capax*)**

A. Peer Review Method: The document was drafted by Paul Hartfield. Updated information on the species status and threats were provided to associated Service Ecological Services (ES) offices, State and Federal agency, and non-governmental partners to review for completeness and accuracy. A draft revised document, incorporating comments, was reviewed and revised internally by Cary Norquist, Mississippi ES Office. This version was sent to five outside peer reviewers, as coordinated by the Arkansas ES Office. These peer reviewers were chosen based on their qualifications and knowledge of the species and its habitat and management. Individual responses were received from three of the five peer reviewers. Solicited reviewers included State, Federal, University, and Museum biologists.

Peer Reviewers:

Kendall Moles, Arkansas Game and Fish Commission
Dr. John Harris, Arkansas State University
Steve McMurray, Missouri Department of Conservation
John M. Thron, U.S. Army Corps of Engineers, Memphis District
Kevin Cummings, Illinois Natural History Survey

B. Peer Review Charge: The following request was made of all peer reviewers:

On May 7, 2018, the U.S. Fish and Wildlife Service published a notice in the Federal Register (83 FR 20092) announcing a five-year review of the fat pocketbook mussel. The purpose of five-year reviews is to ensure that the classification of species as threatened or endangered is accurate and reflects the best available information.

Following Service current policy and guidelines on the process to conduct independent peer review, we are assisting our Mississippi Ecological Services Field Office to complete peer review of the science in the five-year review for this mussel. You have demonstrated experience with this species, mussels in general, or these habitat types. Therefore, in order to ensure that the best available information has been used to conduct this five-year review, we now request your peer review of the attached document.

Specifically we ask for comments on:

- Have we assembled the best available scientific and commercial information?
- Is our analysis of this information correct and properly applied?
- Can you identify any additional new information on the fat pocketbook mussel that has not been considered in this review?

Please note that we are not seeking your opinion of the legal status of this species, but rather that the best available data and analyses were considered in reassessing its status.

As part of the peer review process, we must evaluate the potential for conflicts of interest with the subject species or the action. We therefore ask that you fill out the attached Conflict of Interest form and return it with any notes, comments, or questions that you are willing to provide as your peer review.

We appreciate your interest in furthering the conservation of rare plants and animals by becoming directly involved in the review process of our Nation's threatened and endangered species. Your review and comments will become a part of the administrative record for this species, and you can be certain that your information, comments, and recommendations will receive serious consideration.

C. Summary of Peer Review Comments:

We received responses from three of the five peer reviewers. One reviewer responded that the review contained the best scientific and commercial information currently available on FPM, and that the analysis of the information presented was properly applied. Two of the responding reviewers noted that several citations in the text were not included under the References, and one of these also recommended several minor edits in the text. One reviewer provided minor revisions under Table 2.

D. Response to Peer Review Comments:

The References section was corrected; all edits and revisions were incorporated as appropriate.