

CONSERVATION PLAN FOR THE ENDANGERED FAT POCKETBOOK MUSSEL IN THE ST. FRANCIS RIVER BASIN

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Section 7(a)(1) of the Endangered Species Act (ESA) requires all Federal agencies to use their authorities as appropriate to carry out programs for the conservation (i.e., recovery) of endangered and threatened species. For more than a decade the U.S. Army Corps of Engineers (USACE) Memphis District (MVM) has worked with the U.S. Fish & Wildlife Service (USFWS), state resource agencies, and other parties to resolve issues associated with construction and maintenance activities in the St. Francis River Basin and suspected potential impacts to the endangered fat pocketbook mussel (FPM). This has been accomplished in large part by collaborative efforts over the past 15 years to identify and resolve information gaps and research needs, and applying this information to develop a better understanding of local and Basin-wide patterns of FPM response to MVM construction and operations and maintenance (O&M) actions.

Herein, the USACE-MVM outlines programmatic mechanisms by which the St. Francis Basin projects can be conducted to ensure the conservation of FPM and its ecosystem. This program has been developed under informal and formal consultation with the USFWS under sections 7(a)(1) and 7(a)(2) of the ESA. This conservation program also complies with USACE Environmental Operating Principles, and the Civil Works Ecosystem Restoration Policy (ER 1165-2-501).

USACE-MVM St. Francis Basin Construction and Maintenance Program

The St. Francis Basin Project was authorized by the Flood Control Act of 15 May 1928 and amended by the Acts of 15 June 1936, 18 August 1941, 24 July 1946, 17 May 1950, 27 October 1965 and 13 August 1968. The St. Francis Basin Project is located in southeastern Missouri and northeastern Arkansas. The project limits extend from the hills southwest of Cape Girardeau, Missouri, near Wappapello Lake, to the confluence of the St. Francis and Mississippi Rivers, about 10 miles above Helena, Arkansas. The basin covers an area of approximately 8,400 square miles. The basin is about 215 miles in length and 53 miles in width.

Construction, operation and maintenance of the authorized flood control channel improvements are the overall responsibility of the Federal Government. The goal of channel maintenance is to ensure that the channels retain their original design capacity and function. Many drainage channels deteriorate as a result of poor maintenance. Drainage channels filled with silt, debris and other obstructions generally indicate the lack of a continuing maintenance program. Ditches and watercourses often become obstructed by silt bars, accumulations of brush, logs or other debris, and by jutting banks covered with clumps of bushes and trees, all of which reduce their carrying capacity.

Depending upon the conditions of the channel (length, amount of sediment and vegetation, etc.), maintenance excavation may be minor or major. Major maintenance excavation of a channel is generally initiated when the channel deterioration results in a significant loss of the authorized level of protection or another project purpose is jeopardized. Erosion of lateral ditches often results in sedimentation in authorized channels of the St. Francis Basin Project. If the resulting sediment deposition/shoals become unacceptable stream obstructions or otherwise threaten the proper function of the project, the Federal Government may take steps to control the erosion of lateral ditches.

As a general rule, it is assumed that channel maintenance will be required in reaches of each of the channels within the basin every 15-20 years. However, variations do occur, and some channels require more frequent cleanouts while others may not require maintenance for several decades. Land use upstream and adjacent to the channel often dictates cleanout requirements.

Status of the Fat Pocketbook Mussel:

The status of FPM was most recently summarized in a 5-Year Review by USFWS (2012). Most historical records for the fat pocketbook were from the upper Mississippi River (above St. Louis), the Wabash River (Ohio River drainage) in Indiana, and the St. Francis River in Arkansas. When listed under the ESA (1976), the fat pocketbook mussel was considered extirpated from the Mississippi and Ohio River drainages, and viable in only a short reach of the St. Francis River in Arkansas. The USFWS 1989 Recovery Plan identified a recovery objective to reclassify the fat pocketbook mussel from endangered to threatened status, and provided two criteria for meeting this objective: 1) Protecting the St. Francis drainage population from habitat modification; and, 2) Locating or establishing at least two additional viable populations within two other river systems within the historical range of the species.

Over the past four decades, the fat pocketbook has recolonized or been discovered in 200 miles of the St. Francis River and 25 stream or ditch channels in Arkansas and Missouri; a 163 mile reach of the Ohio River and approximately 100 miles of the lower Wabash River and tributaries in Kentucky, Illinois and Indiana, as well as the lower reaches the Cumberland River, Kentucky, and Tennessee Rivers; and along a 300 mile reach of the Lower Mississippi River. Although some of these fat pocketbook mussel populations are localized and small, most have shown evidence of recruitment, and there is evidence of population recruitment and expansion in all of the occupied drainages (St. Francis, Ohio, Wabash, Mississippi). FPM remains extirpated from the upper Mississippi River drainage (USFWS 2012). While there is little doubt that some portion of the increase in abundance and range of FPM over the past few decades is due to higher visibility and increased monitoring efforts due to its Federal status, other factors which may have contributed on both a local and range-wide perspective include geomorphic stabilization of river and stream channels following 20th century modifications, improved water quality due to Federal and State regulations, improved water and habitat quality due to development of agricultural and forestry Best Management Practices (BMPs), reductions in pesticide and herbicide toxicity, and improvements in pesticide and herbicide application protocols.

Research and monitoring programs throughout the range indicate that FPM population segments can be locally or temporarily affected by navigation dredging (Ohio and Mississippi rivers), channel cleanout (St. Francis River system), or other activities (e.g., fleeting areas, loading/unloading facilities, hydropower, and pollution.). However, these programs also show that the species has persisted or expanded its range and numbers in areas where such activities periodically occur. The 5-Year Review concluded that the expanded distribution, evidence of recruitment, and persistence of FPM provided evidence that threats to the species have been reduced, recovery potential has increased, and that reclassification from endangered to threatened may be considered pending further evaluation of recruitment, and documentation of management strategies and BMPs for the species.

Status of the Species in the St. Francis River Drainage

Within the St. Francis River drainage, FPM is known to occur in river channel segments and 25 streams and ditches (AGFC 1981, 1984, 1986, 2001; Clark 1985; Ahlstedt and Jenkinson 1987; Barnhart 1997; Harris 2002; Ecological Specialists 2005; Peck et al. 2007; USACE 2009, 2012, 2013, 2014). Recent surveys have revealed information regarding population size of FPM in several stream reaches within the St. Francis Basin (Harris 2001; Harris 2002; Ecological Specialists 2005; Harris, unpublished data; USACE 2012; USACE 2014). Most inhabited streams contain widely scattered or very locally dense FPM populations; however high densities throughout long reaches of stream have been documented from a few locations. For example, a 5,600 m reach of Stateline Outlet Ditch is estimated to contain $6,783 \pm 1,553$ individuals, and a 6,116 m reach of Rivervale Outlet Ditch is estimated to contain $1,868 \pm 558$ (USACE 2012). There is no explanation for these large populations, although hypotheses include the dependability of water flows and depths, the widespread availability of preferred substrates (Watters 2000), increased suitability for host fishes, a combination of these factors, and/or other unknown factors. Data from these and other studies document that, although highly modified, the St. Francis River Basin contains the most widespread and abundant populations of the fat pocketbook in the United States.

Insights from Research and Monitoring

Consultation for endangered and threatened species under section 7(a)(2) requires the identification and implementation of reasonable and prudent measures (RPMs) to reduce take incidental to Federal activities. Many past consultations regarding ditch maintenance activities in streams inhabited by FPM included RPMs requiring translocation of affected populations to suitable habitat elsewhere in the St. Francis River watershed, or in a few cases, propagation and release of juvenile mussels.

Translocations of FPM have had variable success. An attempted reintroduction of St. Francis Floodway FPM to the Mississippi River in southeastern Missouri was unsuccessful, with an estimated survival of only 10% after three years (Koch 1993), and with no live marked mussels found after five years (Moore 1995). In 2002, over 2,000 fat pocketbook mussels were moved from Stateline Outlet Ditch in northeastern Arkansas to several sites in the St. Francis River channel and Ditch 29. Subsequent monitoring through 2007 at the St. Francis River channel

relocation sites either failed to detect any marked individuals or primarily detected dead individuals (94%) (Miller et al 2003; USACE 2009); however, monitoring of Ditch 29 relocation showed high survival (90%) (USACE 2009). Mussels moved from Ditch 10 to Stateline Outlet Ditch also had a high rate of survival after two years (86%) (Ecological Specialists 2005; USACE 2009). The discrepancies between relocation efforts remain unexplained; however, concerns were raised regarding the methods of translocation and care of the individual organisms that were moved to the St. Francis River sites, while Ditch 29 was adjacent to Stateline Outlet Ditch and post translocation actions by USACE and USFWS staff likely increased the survival rate of those mussels translocated to Ditch 29.

In addition to uncertainties regarding the effectiveness of translocation, recent studies and observations suggest high resilience and/or recovery potential for FPM within O&M project sites. Harris (1997) found that FPM comprised greater than 13% of the live and recently dead mussels in the St. Francis Floodway four to seven years after maintenance dredging. While most FPM concentrations tended to be in areas unintentionally missed by the dragline, some dredged sites also supported high concentrations. Similar results occurred following Stateline Outlet Ditch maintenance dredging in 2001. The original population estimate was $3,072 \pm 121$ (Harris 2001). Although a robust attempt was made to translocate all FPM from the area prior to the maintenance dredging, the post-project estimated population was $6,783 \pm 1,553$, an increase of more than 70% over pre-project and pre-removal population size (Harris, unpublished data).

In 2009 a quantitative mussel survey was conducted in Rivervale Outlet Ditch due to an identified need for a channel cleanout. Based upon the results of this survey and in consultation with the Service, an experimental design was developed that would leave mussels in place during the proposed channel cleanout of the ditch and monitor FPM response dynamics (USFWS 2009) post cleanout. Pre-project monitoring estimated FPM population size within the project footprint as 550 ± 280 individuals (CCR Environmental and Harris 2009). One year following the cleanout the post-project quantitative survey revealed an estimated population of $1,868 \pm 558$, an increase of around 350% over pre-project conditions (USACE 2012). A similar experiment to quantify population size and demographics before and after maintenance dredging is currently in progress by USACE in Straight Slough (USFWS 2014).

During both the Stateline and Rivervale cleanouts, the USACE identified and implemented measures to minimize dredging and impacts to FPM. These included conducting channel elevation surveys prior to the cleanouts and avoiding areas meeting design grade; conducting operations from only one bank (one-sided cleanout); minimizing impacts to the no work side of the channel, and off-site equipment staging areas. Monitoring results show an increase in recruitment of FPM (<90 mm) following dredging at both project sites (Figure 1); both sites also experienced an increase in adult FPM (>90 mm); however, the increase in adults was more pronounced at Rivervale where no mussels were translocated. Whether the response observed in these projects was a result of not completely removing all individuals pre-project, incomplete removal of material by contractors, vertical upward movement of individuals post-project, robust post-project recruitment, or a combination of these or other unknown factors, is not fully understood at this time.

Length Cohorts – *Potamilus capax*

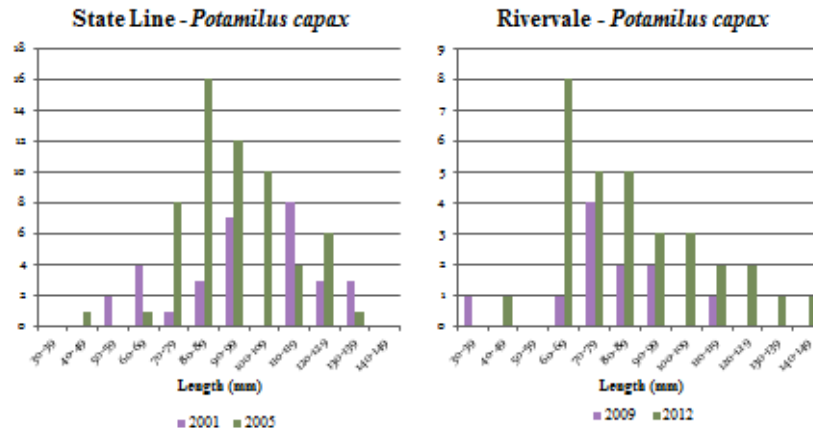


Figure 1: Length Cohorts of FPM at State Line Ditch and Rivervale Outlet Ditch pre- (purple) and post- (green) project (Harris 2014).

These results indicate that leaving FPM in place during O&M activities in the St. Francis River drainage improves site recovery of the species, and may be preferable to translocation. Translocating mussels from one stream to another also has the potential to result in negative effects to native FPM through the potential of reducing genetic diversity via inbreeding depression (Service 2004). Heterozygous bivalve individuals are known to have higher survivorship, greater resistance to stress, and faster growth rates (Launey and Hedgecock 2001). Additionally, there is no guarantee that mussels translocated to nearby ditches or streams will not again need to be moved when new maintenance operations are planned.

Conservation Plan Outline

Over the past century, the St. Francis River system and watershed has been largely modified and converted from a bottomland hardwood drainage ecosystem into an agricultural drainage system. USACE is congressionally mandated to work with local drainage districts to maintain drainage and flow through this network. Although modification has been drainage-wide and on a landscape level, the drainage network continues to function as a riverine aquatic ecosystem supporting numerous native species, including the endangered fat pocketbook mussel, and provide other important ecosystem services. The goal of this USACE-MVM conservation plan is to contribute to the conservation of the fat pocketbook mussel through management of the network of ditches and floodways in the St. Francis River Basin. The objectives are to utilize and continue to develop ecological and engineering data to increase our understanding of FPM and the ecosystem; to identify, implement, and when appropriate modify reasonable, prudent, and cost-effective channel maintenance, management, and monitoring practices that maintain or improve channel habitat values for the fat pocketbook and other native species; to work with the

drainage districts and other partners in developing and applying data and Best Management Practices, and to establish a management program that can continue to benefit the FPM, its ecosystem, and associated species regardless of the status of the species under the ESA. This conservation plan complies with procedures and mandates under section 7(a)(1) of the ESA, USACE Environmental Operation Principles, and the Civil Works Ecosystem Restoration Policy (USACE ER 1165-2-501).

Based upon recent observations and measurements of FPM response to O&M projects in the St. Francis River Basin (see *Insights from Research and Monitoring*, above), MVM will rely upon the following O&M BMPs and Stand Operating Procedures (SOPs) to cost-effectively manage FPM and its habitats.

Construction and Maintenance BMPs and SOPs:

Translocation of FPM prior to O&M actions has been standard procedure in areas with moderate to high densities of mussels. Translocation is expensive, time consuming, has had mixed and limited success, and has the potential of detrimental genetic effects (see *Insights from Research and Monitoring*, above). Therefore, translocation will no longer be conducted unless new information developed in the future and coordinated with USFWS and state resource agencies provides justification. Due to the relatively high abundance of FPM at some locations within the drainage, translocation remains an option should reintroduction opportunities develop in the future to extend the population range and abundance baseline within the St. Francis system (see *Conservation Collaboration*, below).

1. Appropriate erosion control measures (silt-fencing, replanting, etc.) will be implemented within and adjacent to all construction and maintenance (O&M) sites.
2. Staging areas for crew, equipment, and materials will be established where water will not drain directly into ditches or streams. Storage of fuel, oil, and other chemicals will remain within the staging areas or another confined area to avoid accidental spills into ditch and stream systems.
3. Wherever possible, ditch cleanouts will be conducted from only one side of a channel.
4. Project design and specifications will consider pre-project habitat condition and importance.
 - a. Areas naturally meeting design specifications will not be dredged.
 - b. Areas with high densities of mussels (identified during pre-construction monitoring, see below) will be avoided, when possible.
5. Prior to all O&M projects, project specifications, operational BMPs, and details related to those specifications and practices, will be explained directly to construction crews by a USACE biologist to ensure that projects are completed accordingly.
6. USACE will modify O&M BMPs as necessary and appropriate in consideration of new information developed from FPM monitoring and/or research.

Monitoring SOPs:

Monitoring is necessary to document compliance with the ESA and other environmental regulations, and to document management success and/or need for BMP modification. In the recent past, MVM has conducted an intensive quantitative survey methodology to determine decline and amount of decline in FPM. In practice, increases in FPM have been observed at project sites (see *Insights from Research and Monitoring*, above). In consultation with USFWS, we have determined that objectives of monitoring should be the ability to detect persistence and/or decrease or increase in relative abundance of FPM and population structure (i.e., demographics as implied by length cohorts) at project sites. These objectives may be cost-effectively achieved by a Catch per Unit Effort (CPUE) monitoring design, which shall be employed as described below. Intensive quantitative survey methodology may be utilized in future site-specific research projects identified through coordination with conservation partners.

1. Prior to design, O&M project sites will be surveyed (CPUE) for unionid mussels and habitat conditions. Areas of high mussel density or diversity, or supporting FPM will be recorded for design consideration. Shell length of all live FPM encountered during surveys will be measured.
2. Project sites where FPM were encountered will be surveyed for unionid mussels and habitat conditions between 12 and 24 months following project completion according to pre-project survey design. Survey reports will document qualitative changes in species occurrence, diversity, relative abundance, CPUE, and FPM demographics.
3. As opportunity and funding allows, project sites may also be surveyed 5+ years post construction or maintenance, to document long-term channel and species response.

Coordination:

1. USFWS and appropriate state agencies will be notified during design and construction of any O&M project.
2. USFWS and appropriate state agencies will be informed of all pre- and post- project surveys, invited to assist and participate, and provided with all survey reports.
3. USACE will document any deviations from O&M BMPs and provide notice to USFWS and appropriate state agencies along with reasons or justification for such deviations.

Conservation Collaboration:

1. USACE will work collaboratively with drainage districts, other agencies, and NGOs to identify and implement conservation opportunities for FPM and its habitats within the St. Francis River system, as authorities, budget, and opportunities allow. These may include, but are not limited to, flow restoration, habitat stabilization, reintroduction, and management related research needs (e.g., fish host distribution and passage, FPM life history and recruitment, etc.).
2. USACE will meet periodically with drainage districts, USFWS, state agencies, and NGO partners to consider new information derived from monitoring and/or research

for application to FPM status, distribution, and management in the St. Francis River drainage.

Agency conservation programs developed under section 7(a)(1) of the Endangered Species Act are intended to assist federal agencies and their potential partners in planning and implementing actions to protect and recover endangered or threatened species affected by the agencies activities. These conservation measures are a guide for meeting the goal and objectives outlined above, and do not obligate any party, including the USACE or drainage districts to undertake specific actions at specific times. Implementation or timing of specific actions outlined above may be contingent upon opportunity and annual appropriations and other budgetary constraints.

Effects Analysis

Since the FPM was listed as endangered under the ESA, the number of identified St. Francis River drainage populations has increased dramatically, there has been no documented decline in FPM numbers or distribution, and the species appears to be resilient to current conditions within much of the MVM project area. FPM continue to occupy representative natural habitats, as well as highly modified habitats within the drainage (Figure 2).

MVM has developed BMPs supported by research and monitoring to minimize impacts that may result from O&M activities under consultation with USFWS and appropriate state agencies. All of these BMPs have been at least partially implemented for more than a decade, and have become incorporated into standard operating procedure by USACE-MVM. Management related research and other discretionary conservation opportunities identified by this Program provide the potential of increasing the FPM distributional and population size baselines within the drainage, further contributing to the conservation of FPM. The Conservation Program outlined above also incorporates many useful elements of adaptive management into the St. Francis River Floodway Project. For example, information gathered through pre- and post-construction monitoring has been, and may continue to be used to refine channel cleanout methods and to document FPM response to cleanouts.

Based upon this assessment and with implementation of this FPM Conservation Program for the St. Francis River Drainage, conservation of the species within the drainage is insured for the foreseeable future. Additionally, the FPM Conservation Program outlined above contributes to the first recovery criterion for downlisting FPM to threatened status, i.e., *Protecting the St. Francis drainage population from habitat modification* (USFWS 1989).

Therefore, MVM is in full compliance with section 7(a)(1) of the ESA, USACE Environmental Operation Principles, and the Civil Works Ecosystem Restoration Policy. Additionally, development of this Conservation Program and development of partnerships with USFWS and state resource agencies over the past decade are expected to facilitate MVM O&M actions, through reducing delays, as well as monitoring and relocation costs. It is anticipated that at least some proportion of these savings will be available to implement future discretionary conservation efforts for FPM under the MVM Program.

Figure 1. Survey sites with the fat pocketbook in the St. Francis River basin.

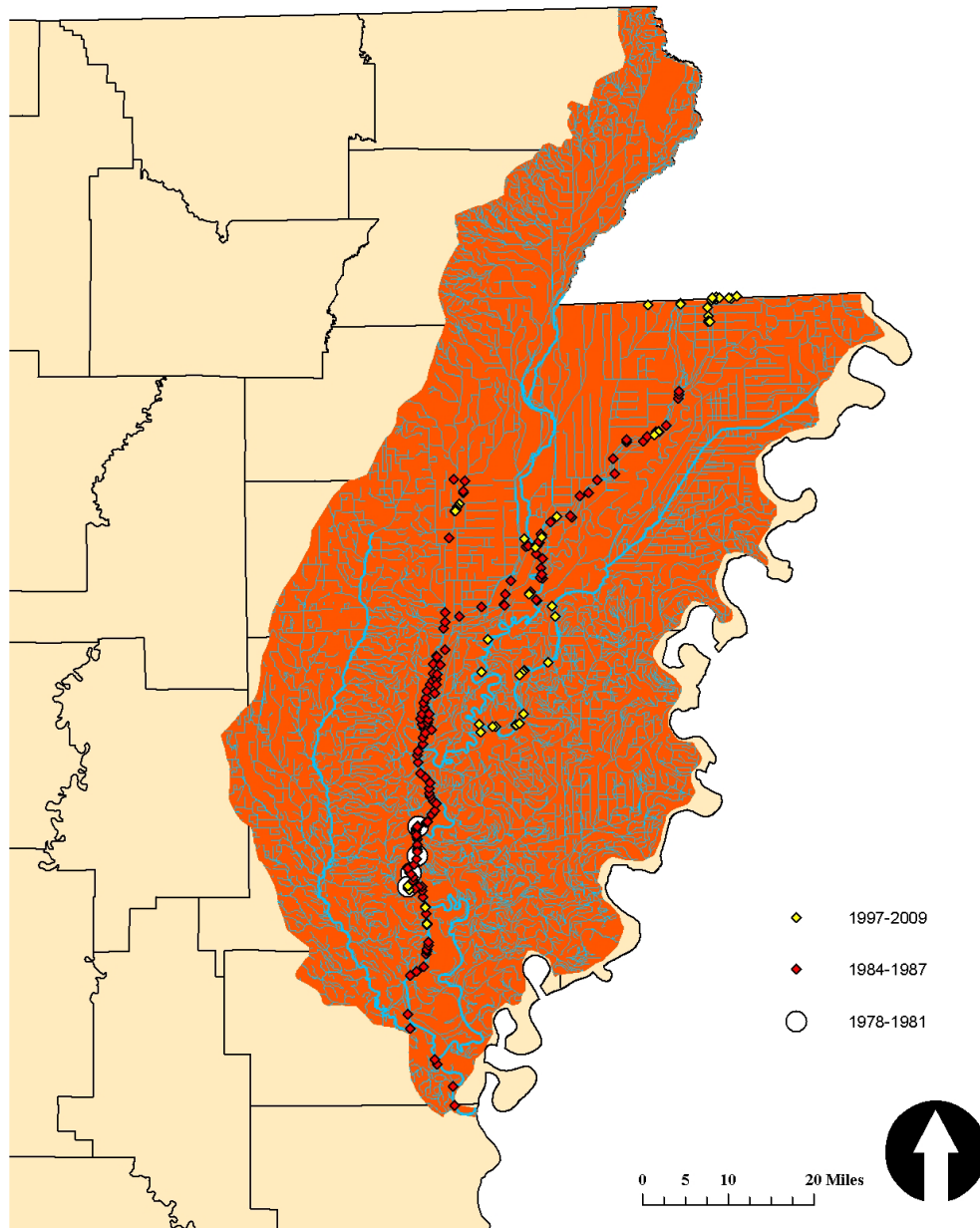


Figure 2: Distribution of FPM in the St. Francis River Drainage.

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