

Interim Core Map Documentation for the Scaleshell Mussel

December 17, 2024

Developed by US Environmental Protection Agency, Office of Pesticide Programs

Species Summary

The scaleshell mussel (*Leptodea leptodon*; Entity ID #345) is an endangered aquatic invertebrate. The U.S. Fish and Wildlife Service (FWS) has not designated a critical habitat for the scaleshell mussel. This species occurs in medium to large rivers with low to medium gradients. The scaleshell mussel inhabits a variety of substrate types but is primarily found in stable riffles and runs with slow to moderate current velocity. Additional information about this species is provided in **Appendix 1**. This species is currently included in the Vulnerable Species Action Plan.

Description of Core Map

The core map for the scaleshell mussel is based on biological information. Specifically, it is based on named occupied waterbodies noted in FWS' 2021 Five-Year Review and rivers identified as suitable habitat in FWS' 2010 Recovery Plan. Waterbodies representing stream/river and canal/ditches were also included in the core map to preserve connectivity between the identified rivers. The core map includes these named medium and large rivers found in four states: Oklahoma, Arkansas, Missouri, and South Dakota. These areas are found within the current species range last updated on 10/10/2024. **Figure 1** depicts the interim core map for scaleshell mussel, note the Missouri River is the boarder between South Dakota and Nebraska and is considered to be South Dakota in the FWS reports. Landcover categories within the core map area are included in **Table 1**. Landcover is predominantly open water, agriculture, and forestry.

The core map developed for the scaleshell mussel is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the scaleshell mussel. This core map incorporates information from FWS' 2021 Five-Year Review and 2010 Recovery plan; however, the core map has not been formally reviewed by FWS species experts. This interim core map may be revised in the future to incorporate expert feedback from FWS. This interim core map has an "average" best professional judgment classification because judgment is used to confirm that the selected NHDPlus waterbody segments are consists with the named known location information identified from FWS documents. However, this does not require much interpretation of complex datasets. This core map does not replace or revise any range or designated critical habitat developed by FWS for this species.

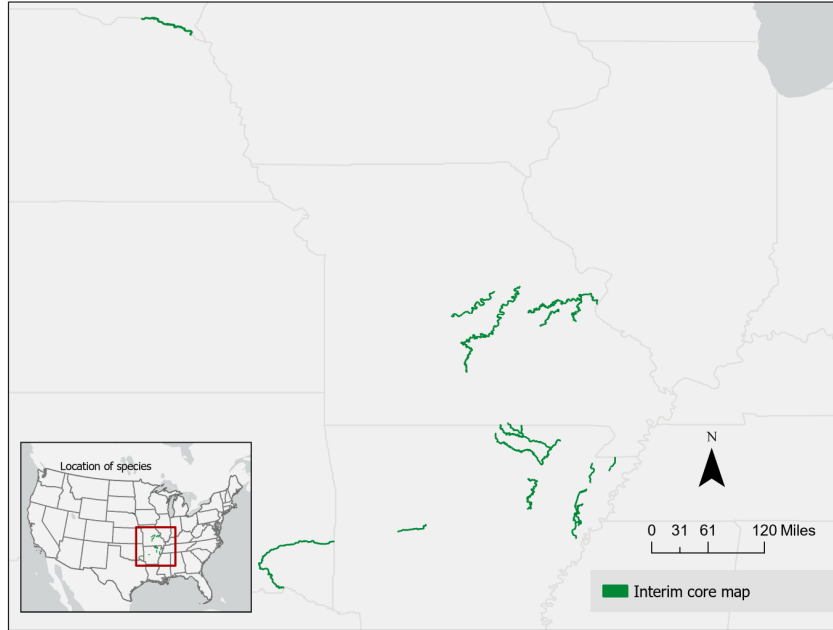


Figure 1. Scaleshell mussel interim core map.

Table 1. Percentage of Interim Core Map Represented by NLCD¹ Land Covers and Associated Example Pesticide Use Sites/Types.

Example pesticide use sites/types	NLCD Landcover (Value)	% of core map represented by landcover	% of core map represented by example pesticide use
Forestry	Deciduous Forest (41)	13	14
	Evergreen Forest (42)	0	
	Mixed Forest (43)	1	
Agriculture	Pasture/Hay (81)	2	4
	Cultivated Crops (82)	2	
Mosquito adulticide, residential	Open space, developed (21)	0	0
	Developed, Low intensity (22)	0	
	Developed, Medium intensity (23)	0	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	8	76
	Emergent Herbaceous Wetlands (95)	3	
	Open water (11)	64	
	Grassland/herbaceous (71)	1	
	Scrub/shrub (52)	0	
	Barren land (rock/sand/clay; 31)	5	

¹ Dewitz, J., 2023, National Land Cover Database (NLCD) 2021 Products: U.S. Geological Survey data release, <https://doi.org/10.5066/P9JZ7AO3>

Total Acres	Interim Core Map Acres	~385,500
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Evaluation of Known Location Information

There are four datasets with known location information:

- Descriptions of locations provided by FWS.
- Occurrence locations in iNaturalist;
- Occurrence locations in NatureServe;
- Occurrence locations in GBIF; and,

EPA evaluated these four sets of data before selecting the core map type and developing the core map. FWS included a summary of occupied rivers in both the 2021 5-Year Review and the 2022 malathion BiOp, see **Table 2** for a list of occupied rivers. FWS’ 2021 Five Year Review detailed the known locations and extant populations based on last known observation of this species. These named rivers formed the basis of the core map. As of October 2024, iNaturalist had 4 research grade observations for this species found in the same general location as the named river locations. Three of the iNaturalist observations are outside of the 10/10/24 range file but within the positional accuracy distance of a named river found within the range. GBIF included a number of human reference observations; however, none of them are georeferenced and could not be used to support core map development. Many of these human observations noted in GBIF are from NatureServe. As of October 2024, the only available georeferenced points from GBIF are for preserved specimens and not observations. Occurrences included in NatureServe are in the same vicinity as the named location from FWS. The NatureServe data also includes one area from 2005 that captures the Saint Francis River described in the Recovery Plan (2010) as suitable, but not included as an occupied river in the 5-Year Review. Due to the resolution of the data, it is not possible to determine if this occurrence represents “Stateline Outlet and Ditch #3” or the St. Francis River. However, this occurrence near the Saint Francis River further supports its inclusion in the core map. **Appendix 1** includes more information on the available known location information.

Approach Used to Create Core Map

The core map was developed using the “Process EPA Uses to Develop Core Maps for Draft Pesticide Use Limitation Areas for Species Listed by the U.S. Fish & Wildlife Service (FWS) and their Designated Critical Habitats”² (referred to as “the process”). This core map was developed by EPA using the 4 steps described in the process document:

1. Compile available information for a species;
2. Identify core map type;
3. Develop the core map for the species; and
4. Document the core map.

For step 1, EPA compiled available information for the scaleshell mussel from FWS, as well as observation information available from various publicly available sources (including iNaturalist, NatureServe, and GBIF). **Appendix 1** provides the compiled information for the scaleshell mussel. Influential information that impacted the development of the core map includes:

² Dated 2024, available online at: <https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas>

- In the 2021 Five-Year Review, FWS provided a list of populations and corresponding waterbody names where the species is known to exist since 1990 (extant), which served as the basis for the core map. The same list of rivers was included for this species in the 2022 malathion biological opinion.
- In the 2010 Recovery Plan, FWS identified the St. Francis River as suitable habitat for the scaleshell mussel.

For step 2, EPA used the compiled information to identify the core map type. The extant populations and corresponding waterbodies identified by FWS were located within the species range and could be mapped using the National Hydrography Dataset (NHD) Plus. Based on this information, EPA selected the biological information core map type, which consists of occupied waterbodies identified in the FWS 5-Year Review and the St. Francis River identified in the Recovery Plan (2010), see **Table 2** below. The range of the species was not selected as the core map because it contains currently unoccupied waterbodies and terrestrial habitat areas where this species does not live. This species does not have critical habitat.

For step 3, EPA used the best available data sources to generate the core map. All GIS data sources used for the scaleshell are discussed in EPA’s process document, with the primary dataset being the NHDPlus version 2.1. For this core map, EPA used the known locations in the form of named rivers and streams for the scaleshell mussel as identified by FWS in the 2021 Five Year Review. The waterbodies used to represent the known locations were clipped to the species range, because all extant populations are located within the species range based on the FWS 5-Year Review. The St. Francis River identified as suitable habitat in the Recovery Plan is also included in the core map. **Appendix 2** provides more details on the GIS data and analyses used to generate the interim core map.

Table 2. Waterbodies used to build the core map based on the known extant populations (from 1990-present) identified by FWS in the 2021 Five-Year Review and rivers identified as suitable habitat in the 2010 Recovery Plan.

Major Watershed	Stream Populations	State	Counties	Most Recent Record	Name in NHD Plus (GNIS_NAME)
Meramec River Basin	Meramec River mainstem	Missouri	Crawford, Jefferson	2008	Meramec River
		Missouri	St. Louis	2019	
	Big River tributary to Meramec River	Missouri	Jefferson	2013	Big River
	Bourbeuse River tributary to Meramec River	Missouri	Jefferson, St. Louis	2007	Bourbeuse River
Missouri		Franklin	2019		
Missouri River Basin	Missouri River mainstem	South Dakota, Missouri	Yankton (SD), Gasconade (MO)	2005	Missouri River
	Gasconade River tributary to Missouri River	Missouri	Gasconade, Laclede, Maries, Osage, Wright	2007	Gasconade River
		Missouri	Pulaski	2019	
	Osage River tributary to Missouri River	Missouri	Osage	Osage	2001
Missouri		Cole		2013	

Major Watershed	Stream Populations	State	Counties	Most Recent Record	Name in NHD Plus (GNIS_NAME)
White River Basin	White River mainstem	Arkansas	Benton, Jackson	1999	White River
	Black River tributary to White River		Lawrence, Sharp	No date (assumed after 1990)	Black river
	Spring River tributary to White River		Lawrence, Randolph, Sharp	1991	Spring River
	South Fork Spring River		Fulton	1990	South Fork Spring River
	Myatt Creek tributary to Spring River		Fulton	1996	Myatt Creek
	Strawberry River tributary to Spring River		Lawrence, Sharp	2017	Strawberry River
Arkansas River Basin	South Fourche LaFave River	Arkansas	Perry	2019	South Fourche LaFave River
Red River Basin	Kiamichi River	Oklahoma	Choctaw, Pushmataha	2004/2005	Kiamichi River
St. Francis River Basin	Stateline Outlet and Ditch #3 (tributary to St. Francis River)	Arkansas	Mississippi	2005	Canal/Ditch (see Appendix 1 for details on selection process)
	Saint Francis River	Arkansas	N/A	Suitable area identified in the 2010 Recovery Plan	Saint Francis River

Discussion of Approaches and Data that were Considered but not Included in Core Map

EPA considered mapping the specific habitat characteristics within the occupied rivers used by the mussel, such as stream size, gradient and occupied river miles (available in the 2010 Recovery Plan). However, to maintain connectivity between occupied sites, EPA retained the full length of the named stream and rivers described in the FWS recovery documents. The resulting core map captures more area compared to the suitable habitat based on stream size, gradient, or occupied river miles but is protective of areas the species may occupy between sites and suitable habitat based on connectivity.

Appendix 1. Information compiled for species during Step 1

1. Recent FWS documents

- Final Recovery Plan for the Scaleshell Mussel (2010). (https://ecos.fws.gov/docs/recovery_plan/100407_v2.pdf)

- Five-Year Review (2010). (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1718.pdf)
- Five-Year Review (2021). (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3246.pdf)
- Biological and Conference Opinion on the Registration of Malathion Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act. U.S. Fish and Wildlife Service, Ecological Services Program, Headquarters 2022: <https://www.fws.gov/media/biological-and-conference-opinion-registration-malathion>

2. Background information

Status: Federally listed as endangered in 2001

Resiliency, redundancy, and representation (the 3Rs)

Resiliency – the scaleshell has low resiliency. Many known locations have only one reported individual and those locations are a large distance apart.

Redundancy – the scaleshell has medium redundancy. Part of the Recovery Plan requires four distinct stable populations in four separate stream reaches. Currently there are two stream populations that exist in separate watersheds with four local populations.

Representation – the scaleshell has low representation. This species is dependent on very specific physical stream characteristics. It is also a parasitic obligate on the freshwater drum during a juvenile life stage. These characteristics make the species difficult to adapt to change.

Habitat, Life History, and Ecology

Habitat: The scaleshell occurs in medium to large rivers with low to medium gradients. It inhabits a variety of substrate types but is primarily found in stable riffles and runs with slow to moderate current velocity. The scaleshell is also usually found in stable channels where a diversity of other mussel species are concentrated (i.e., mussel bed). This is typical for many other mussel species as suitable stream habitat for freshwater mussels naturally occurs in relatively small patches separated by longer reaches of unsuitable habitat. More specific physical, chemical, and biological habitat requirements of the scaleshell are unknown, particularly of the juvenile stage. The scaleshell appears to be dependent solely upon freshwater drum (*Aplodinotus grunniens*) to complete its life cycle. Drum are common in larger streams throughout the range of the scaleshell. Drum live most of their lives on or near the bottom and are usually found in large pools. Knowledge on the distribution, abundance, habitat use, and behavior of freshwater drum is needed to manage scaleshell populations and determine suitable habitat for the species (Malathion BiOp Appendix C, 2022; Species Recovery Plan, 2010).

Diet: Juvenile mussels are believed to employ foot (pedal) feeding to some degree for the first several months of their lives, feeding on depositional materials in interstitial water, including bacteria, algae, and detritus. Adults are suspension feeders, using their gills to remove suspended particles in the water column. Adult diet is believed to include detritus, phytoplankton, zooplankton, diatoms, bacteria, and other microorganisms. Recent evidence suggests that detritus and bacteria may be an important food source (Recovery Plan, 2010).

Taxonomy

Aquatic invertebrate, mussel

Relevant Pesticide Use Sites

Agriculture and livestock areas (Recovery Plan, 2010)

Relevant Recovery Criteria and Actions

Objective: Ensure the long-term viability of the scaleshell by stabilizing and protecting existing populations and restore degraded habitat and watershed in areas of historical range.

Criteria: Scaleshell will be considered for downlisting to threatened status and removal from the protection of the Endangered Species Act when:

1. Each stream population must exist in a separate watershed so that a single stochastic event, such as a toxic spill or disease outbreak, will not affect more than one of the four stream populations.
2. At a minimum, one stream population must be located in the Upper Mississippi River Basin, four in the Middle Mississippi River Basin (two of these must exist east of the Mississippi River), and three in the Lower Mississippi River Basin.
3. Population viability will be defined when Action 3.4.2 (Research Population Dynamics of the Scaleshell) is completed.
4. Threats to local populations in Criterion 1 have been identified and addressed per the measurable criteria developed in Action 2.3.
these must exist east of the Mississippi River), and three in the Lower Mississippi River Basin.

Recovery Actions: Watershed restoration will be aimed at addressing the various causes of habitat degradation including sedimentation; point and non-point pollution sources; substrate destabilization; land, bank, and channel erosion; and eutrophication. Examples of watershed improvements to alleviate these threats include, but are not limited to the following: improving wastewater treatment plants, reestablishing protective riparian corridors to reduce sedimentation; stabilizing stream banks; reducing sheet run-off; using no-till agricultural methods; controlling nutrient enrichment by carefully planning heavy livestock use areas; excluding cattle from streams by erecting fences and providing alternative water supplies; development of gravel mining guidelines; and implementing voluntary best management practices to control run-off for a variety of agricultural, silvicultural, and construction activities (Recovery Plan, 2010).

Recommendations for Future Actions/Actions Needed

- Stabilize existing populations through artificial propagation to prevent extirpation.
- Formation of partnerships and utilization of existing programs to protect remaining populations, restore habitat, and improve surface lands.
- Improve understanding of the biology and ecology of the scaleshell.
- Further delineate the current status and distribution of the scaleshell.
- Restore degraded habitat in areas of historical range; reintroduce the scaleshell into portions of its former range.
- Initiate various educational and public outreach actions to heighten awareness of the scaleshell as an endangered species and solicit help with recovery actions. -Track recovery and conduct periodic evaluations with respect to recovery criteria.

3. Description of Species Range

The scaleshell mussel's range was last updated on 10-10-2024. The species historical range included Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Minnesota, Missouri, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin. Current FWS range includes watershed-level areas in Arkansas, Missouri, Nebraska, Oklahoma, and South Dakota. The FWS-defined range is large (>5 million acres) and appears to be based on HUC8/HUC12 (8- and 12-digit Hydrologic Unit Codes) watershed boundaries. The species range is depicted in **Figure A1-1**.

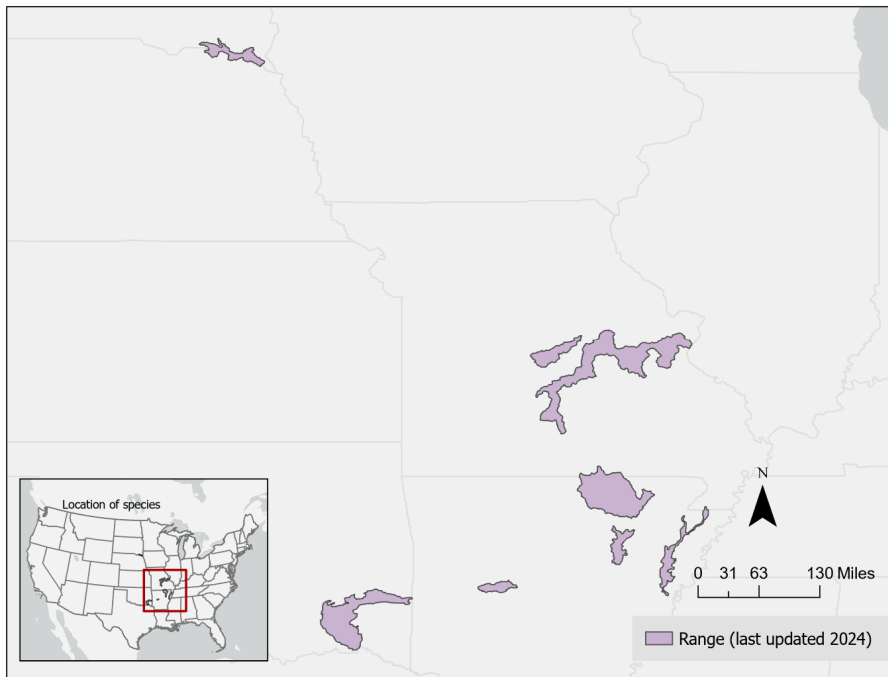


Figure A1-1. FWS range from ECOS last updated on 10/10/24.

<https://ecos.fws.gov/ecp/species/5881>

4. Critical Habitat

The Scaleshell mussel does not have designated critical habitat.

5. Known Locations

- The FWS describes the known occupied rivers in both the 2021 5-year review and malathion BiOp.
 - **Table 2**, found in the main species summary document above, outlines the known occupied streams/rivers from the 2021 5-Year Review with observations from 1990-present.
 - The 2022 malathion BiOp notes that the scaleshell is believed to be extirpated from Minnesota, Iowa, Wisconsin, and all states east of the Mississippi River. Currently, FWS reports that the scaleshell can only be consistently located, although very rare, in three Missouri streams including the Meramec, Bourbeuse, and Gasconade rivers. It has been reported from 15 additional streams in the last 25 years, but only has been represented by a small number or a single specimen (live or dead) collected during one or more extensive mussel surveys of these rivers. These streams include the Big, Big Piney, Osage, and Missouri rivers in Missouri; Missouri River in South Dakota; Myatt Creek, St. Francis, White, Spring, South Fork Spring, Strawberry, South Fourche LaFave, Cossatot,

Saline (a tributary of the Little River), and the Little Missouri rivers in Arkansas; and Kiamichi River in Oklahoma. In all, in the last 25 years, the scaleshell has been reported from 18 of the 56 rivers where it historically occurred (2022 Malathion BiOp, Appendix C).

- The river/stream locations outlined in the 2021 5-Year Review include a few additional tributaries in addition to the ones named in BiOp. The 5-Year Review (2021) also indicates the last observance for the Big Piney River, mentioned in the malathion BiOp, is from 1981. For this reason, this location was excluded from the core map.
- iNaturalist has [4 research grade occurrences](#) as of October 10, 2024 dated between July 2002 and September 2024. These points are within the positional accuracy distance of a named river found in the FWS 5-Year Review (**Figure A1-2**).

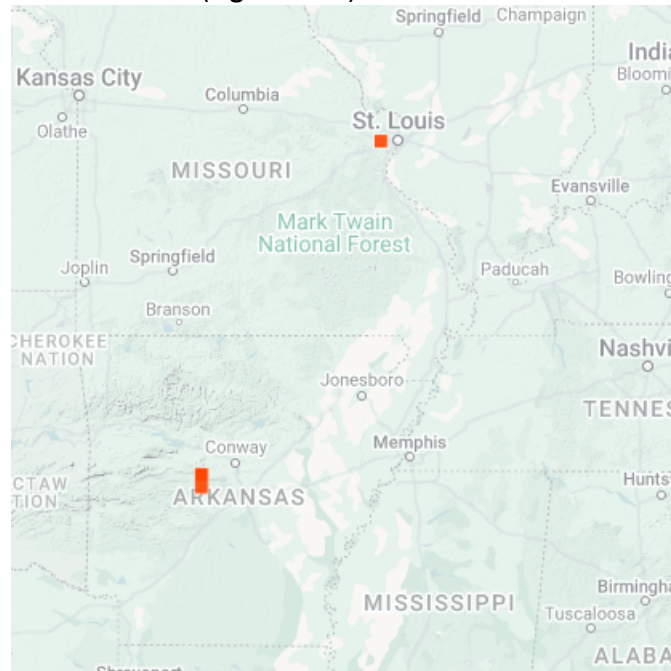


Figure A1-2. iNaturalist research grade occurrences for the scaleshell mussel (red polygons).

- GBIF does not include recent (post 1990) georeferenced [human observation occurrences](#) as of October 2024. Recent human observation occurrences from NatureServe are noted in GBIF but coordinates are not available. Georeferenced occurrences for 6 preserved specimens are available but not applicable for the development of the core map.
- NatureServe Explorer³ includes occurrences found in Oklahoma, Arkansas, Missouri, South Dakota and Illinois, see the map below. The Illinois location is found outside of the current range. In the 5-Year Review FWS acknowledges this location but notes additional surveys failed to identify additional specimens. The occurrences on the border between Arkansas and Kansas are also outside of the current range, but one has no date and the second is from 1983. For these reasons the additional areas outside of the range were not included during core map development (**Figure A1-3**).

³ <https://explorer.natureserve.org/pro/Welcome>

- The remaining recent occurrence (1990-present) found in Oklahoma, Arkansas, Missouri, and South Dakota are representative of the streams/rivers named by FWS in the 2021 5-Year Review or the river with suitable habitat described in the 2010 Recovery Plan.

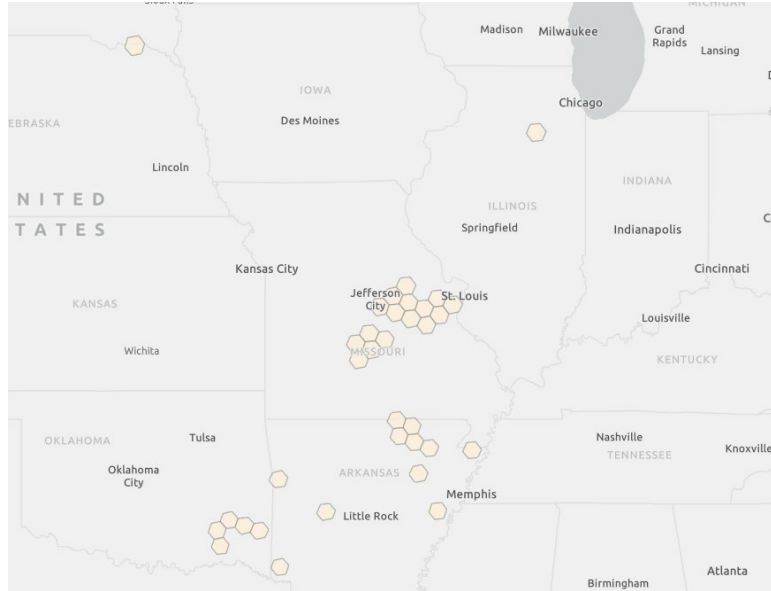


Figure A1-3. Occurrences of the scaleshell mussel publicly available from NatureServe. The occurrences are represented as yellow hexagons.

Appendix 2. GIS Data Review and Method to Develop Core Map (Step 3)

The core map type for this species is based on biological information, including known locations (named, occupied rivers/streams) reported in the FWS 5-year review and 2010 Recovery Plan and rivers identified as suitable habitat. This section details the data and steps used to create the core map for the scaleshell based on this biological information.

1. References and Software

- Range: <https://ecos.fws.gov/ecp/species/5881>
- National Hydrography Dataset Plus (NHDplus) Version 2.1: <https://epa.maps.arcgis.com/home/item.html?id=4bd9b6892530404abfe13645fcb5099a>
- Software used: ArcGIS Pro version 3.2

2. Datasets Used in Core Map Development

2.1. Range

The range was last updated on 10/10/2024. The file was downloaded from the FWS ECOS page on 10/16/2024) then added to a map in ArcGISPro, and the layer was renamed to “Scaleshell Mussel Range”

2.2. NHDPlus Version 2.1

Layers used include Flowline and Waterbodies.

2.3. Locations Identified by FWS

According to the 2010 Recovery Plan, 2021 5-Year review, and 2022 malathion BiOp, this species has been found in the following watersheds since 1990: Illinois River Basin, Meramec River Basin, Missouri River Basin, White River Basin, Arkansas River Basin, Red River Basin, and St. Francis River Basin. **Table A2-1** provides a summary of the streams with populations last recorded since 1990 (summarized from Table 1 in the 2021 5-Year Review). This information corresponds with the named rivers found in the 2022 malathion BiOp.

To develop the core map, EPA used the named rivers with records from 1990-Present from the 5-Year Review and rivers described as suitable habitat in the Recovery Plan, limited by the current species range. By limiting the core map to the species range, 4 rivers named in the 2021 5-Year Review were excluded; the Illinois River, the Mulberry River, the Little Missouri River tributary to Ouachita River and Ouachita River. The observation date for the Mulberry River, the Little Missouri River tributary to Ouachita River and Ouachita River were either unknown or from the mid-1990s. The observation for the Illinois River is from 2013, but the 5-Year River notes only a single specimen was observed even after additional surveying. FWS excluded these areas when updating the range for the species in October of 2024. For these reasons EPA was comfortable limiting the core map to areas within its current range.

Table A2-1. Summarized table of recorded observation from the 2021 FWS 5-Year Review.

Major Watershed	Stream Populations	State	Counties	Most Recent Record
Illinois River Basin	Illinois River mainstem	Illinois	Grundy	2013 ¹
Meramec River Basin	Meramec River mainstem	Missouri	Crawford, Jefferson	2008
		Missouri	St. Louis	2019
	Big River tributary to Meramec River	Missouri	Jefferson	2013
	Bourbeuse River tributary to Meramec River	Missouri	Jefferson, St. Louis	2007
Missouri		Franklin	2019	
Missouri River Basin	Missouri River mainstem	South Dakota, Missouri	Yankton (SD), Gasconade (MO)	2005
	Gasconade River tributary to Missouri River	Missouri	Gasconade, Laclede, Maries, Osage, Wright	2007
		Missouri	Pulaski	2019
	Osage River tributary to Missouri River	Missouri	Osage	2001
Missouri		Cole	2013	
White River Basin	White River mainstem	Arkansas	Benton, Jackson	1999
	Black River tributary to White River		Lawrence, Sharp	No date (assumed after 1990)
	Spring River tributary to White River		Lawrence, Randolph, Sharp	1991

	South Fork Spring River		Fulton	1990
	Myatt Creek tributary to Spring River		Fulton	1996
	Strawberry River tributary to Spring River		Lawrence, Sharp	2017
Arkansas River Basin	South Fourche LaFave River	Arkansas	Perry	2019
	Mulberry River	Arkansas	unknown	No date ²
Red River Basin	Kiamichi River	Oklahoma	Choctaw, Pushmataha	2004/2005
	Ouachita River	Arkansas	Clark	No date (may be pre-1990) ²
	Little Missouri River tributary to Ouachita River	Arkansas	Clark	1995 ³
St. Francis River Basin	Stateline Outlet and Ditch #3 (tributary to St. Francis River)	Arkansas	Mississippi	2005
	Saint Francis River	Arkansas	N/A	Suitable area identified in the 2010 Recovery Plan

¹ This area was not represented in the 10/10/2024 range update by FWS. This observation of one live specimen was reported by an Illinois Natural History Survey biologist (5-Year Review, 2021). Prior to this observation, the mussel was considered extirpated from all historical streams east of the Mississippi River (5-Year Review, 2021). Subsequent surveys after 2013 failed to find additional evidence of this species (5-Year Review, 2021). Given this information, this portion of the Illinois river was not included in the core map.

² The Mulberry River in western Arkansas starting in the Ozarks and the Ouachita River in Clark County, Arkansas are not represented within the 10/10/2024 range update by FWS. Because the dates of these observations are not known and these areas were not included in the updated range, these two waterbodies were not included in the core map.

³ The Little Missouri River in Clark County, Arkansas is not represented within the 10/10/2024 range update by FWS. Although the scaleshell mussel was detected in this waterbody in 1995, this waterbody was not included in the core map because it was not included in FWS's range file.

2.4. Selecting Named Waterbodies from the NHDPlus and Core Map Development

- 1) First, the NHDplus version 2.1 layers⁴ were added to a map in ArcGIS Pro. This includes three layers: Flowlines, Waterbodies, and Sinks. The locations name in the FWS 5-Year Review are streams/rivers, so the focus was on the "Flowline" layer.

This layer was clipped to the extent of the range because all named known locations are found within the range (**Figure A2-1**).

⁴ <https://epa.maps.arcgis.com/home/item.html?id=4bd9b6892530404abfe13645fcb5099a>

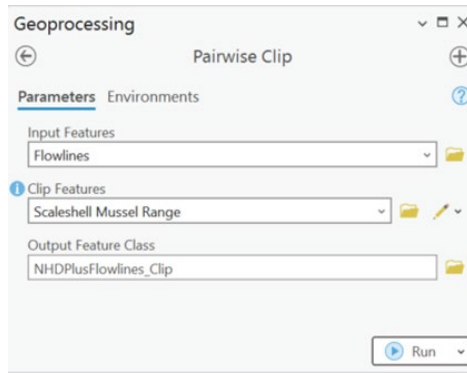


Figure A2-1. Screenshot of pairwise clip step.

- 2) “Select By Attributes” (**Figure A2-2**) was used based on using the ‘Feature Name from the Geographic Name Information System’ or GNIS_NAME column (See **Table A2-1** for river names from the NHD).

The resulting selection of 1,687 features from “NHDPlusFlowlines_Clip” represents most, but not all, of the named rivers/waterbodies. The Stateline Outlet and Ditch #3 tributary to the St. Francis River (Mississippi County, AR) are missing.

Note: As indicated in the footnotes for the **Table A2-1**, the Illinois River, Mulberry River, and Ouachita River were not included because these areas are not within the current range. The last known observations for these locations are from the mid-90s or earlier if a date is available. These areas were also excluded by FWS for the range.

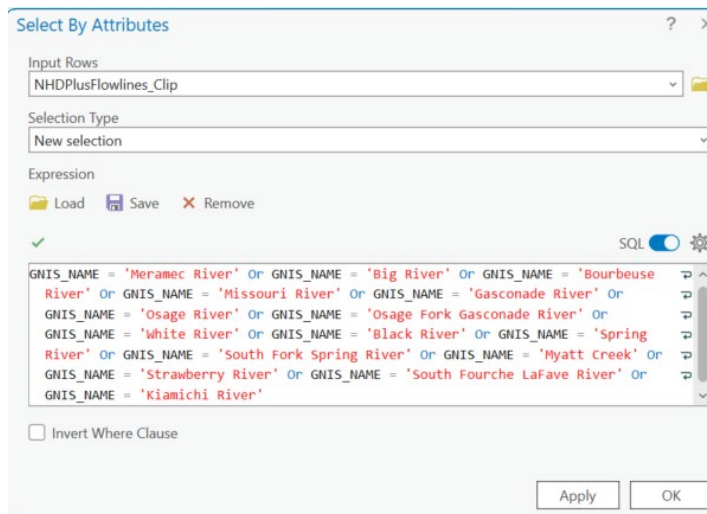


Figure A2-2. Screenshot of “Select by Attributes” step.

- 3) To add Stateline Outlet and Ditch #3, EPA reviewed the location description found in the FWS 5-Year Review.
 - a) “A fresh-dead specimen was collected in 2005 from the convergence of Big Lake Relief (aka Stateline Outlet Ditch) and Ditch #3 (outflow below Big Lake National Wildlife Refuge structure) in northeast Arkansas (Christian 2006).”

- b) Labeled by name on the reference base map in ArcGIS Pro but only labeled as “Canal/Ditch” in the NHDPlus layer, this location could not be extracted using the “Select by Attribute Tool” on the Feature Name from the Geographic Name Information System column.

These waterways were added to the selected feature from step 2 using “Select By Circle.” See **Figure A2-3**.

Common Identifiers (COMID) for the additional features: 771022, 770934, 771128, 771118, 771124, 770884, 770994, 770900, 770964, 771022

- c) After adding the Stateline Outlet and Ditch #3 locations, the selection included 1,697 flowlines, accounting for all named known locations found in the 5-Year Review.

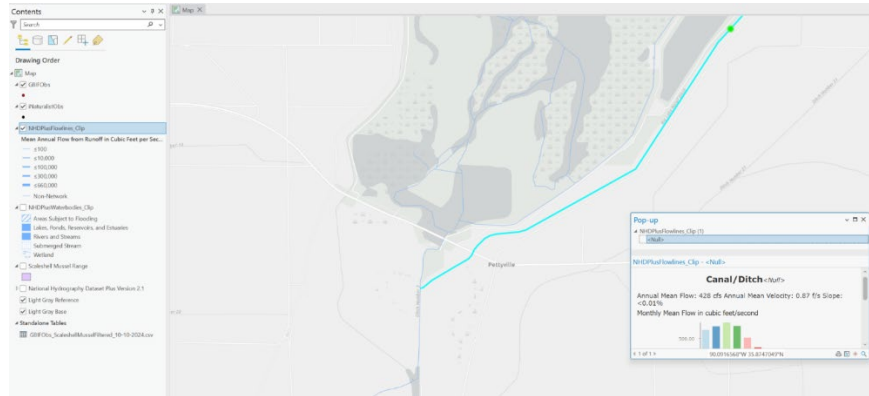


Figure A2-3. Screenshot of applying “Select by Circle.”

- 4) A large portion of the range in eastern Arkansas (in Craighead, Poinsett, Cross, Lee, and St. Francis counties) was not represented in the selected waterbodies after accounting for the named location from the 5-Year Review. These missing areas generally represent the St. Francis River watershed and are captured in **Figure A2-4**.

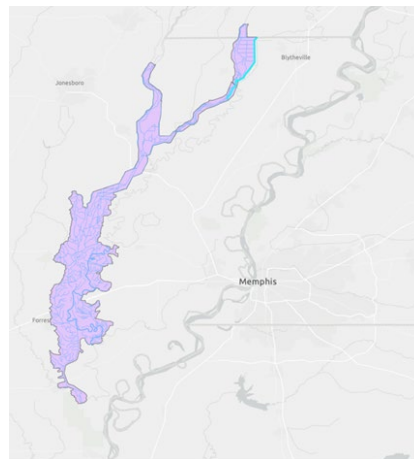


Figure A2-4. The St. Francis River watershed.

- a) In the Recovery Plan (2010), FWS states that within the St. Francis River Drainage, “77 km (48 mi.) of habitat [in the St. Francis River were identified as] generally suitable for mussels:

Wappapello Dam to Mingo Ditch, Missouri; Parkin to Madison, Arkansas; and Marianna to the confluence with the Mississippi River at Helena, Arkansas.”

- b) Given the 10/10/2024 range includes this large watershed area, and the St. Francis River is expected to offer suitable habitat based on the Recovery Plan, the St. Francis River was added to the selected features using “Select By Attributes” and to add to previously selected features, for a total of 1,770 selected features.
 - i) ‘Feature Name from the Geographic Name Information System’ or GNIS_NAME: St. Francis River
- 5) After visual inspection, several gaps existed between river segments, disrupting connectivity. To preserve connectivity 10 additional features were added to the selected flowlines. These additions included “Artificial Paths”, “Canal/Ditch”, or “Stream/River.”
 - a) Common Identifiers (COMID): 3679216, 3679268, 3679270, 3679256, 3679252, 3679254, 771728, 771138, 771122, 771604
- 6) The resulting 1,780 selected flowline features were exported to a new feature class called NHDPlus_SelectedRivers (**Figure A2-5**).

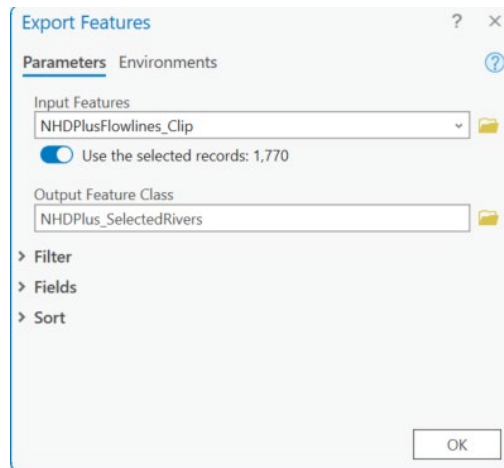


Figure A2-5. Screenshot showing that the selected flowlines were exported.

- 7) NHDplus waterbodies that intersect with the selected flowlines were extracted to further preserve connectivity between river flowlines.
 - a) First, the NHD waterbodies layer was clipped to the scaleshell range using the “Pairwise Clip” tool.
 - b) Next, waterbodies within 100 meters of the NHDPlus_SelectedRivers layer were identified using ‘Select By Location’ (**Figure A2-6**). The 100 meters distance was used to include waterbodies that were nearby but did not contain a flowline; resulting in 132 selected features. This selection is further refined in the following steps.

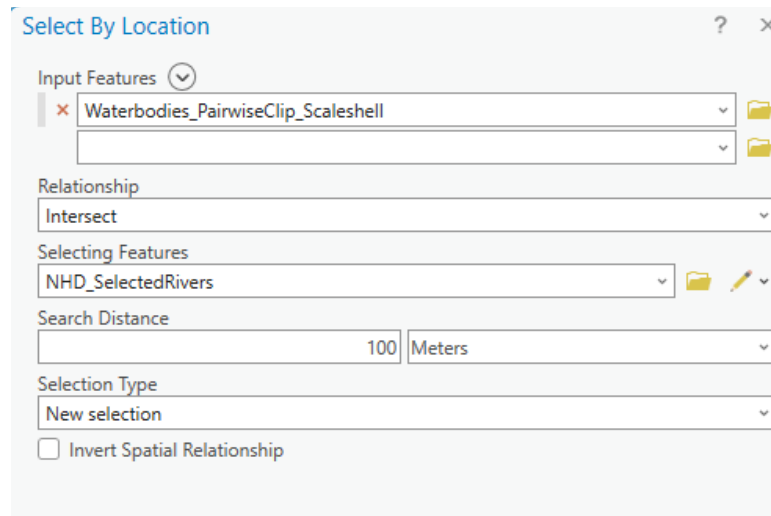


Figure A2-6. Screenshot of the “Select by Location” tool.

- c) Waterbodies classified as 'Inundation Area', 'Lake/Pond', 'Reservoir', 'Submerged Stream', or 'Swamp/Marsh' for the Feature Type (FTYPE) were removed from the selection using “Select By Attributes” (**Figure A2-7**). The remaining feature types included 86 Steam/Rivers and 2 Canals/Ditches.

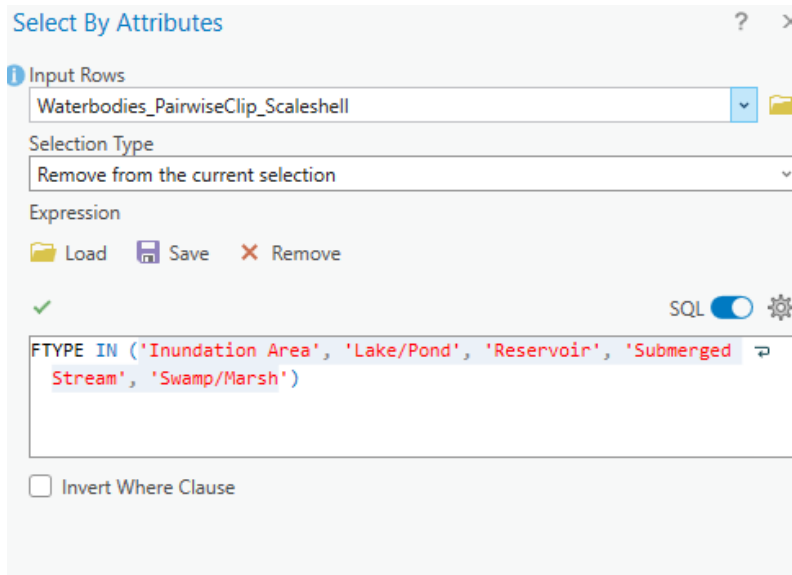


Figure A2-7. Screenshot of the “Select by Attributes” tool.

- d) After visual inspection, 2 waterbodies that included non-occupied streams were removed using the “Select by Attributes” tool; resulting in 85 selected waterbodies.
- i) Common Identifier numbers (COMIDs): 120049897 (2 features), 120049447
- e) These selected waterbody features were exported to a new feature class named NHD_SelectedWaterbodies (**Figure A2-8**).

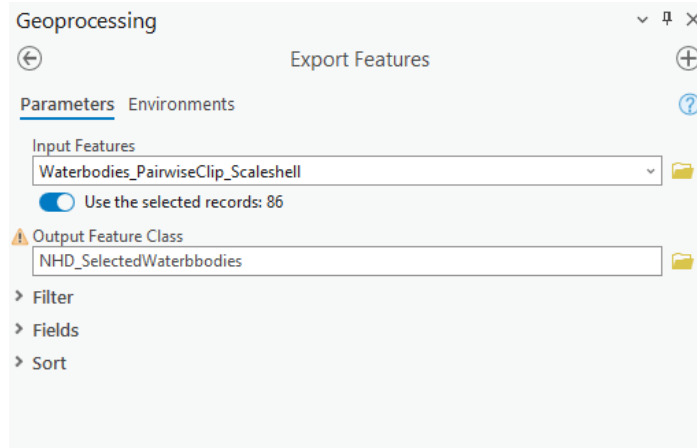


Figure A2-8. Screenshot showing that selected waterbodies were exported to a new feature class.

- 8) To merge the selected flowline and selected waterbodies for the scaleshell, a small buffer of 15 meters was added to the selected flowlines using “Pairwise Buffer” (Figure A2-9). These flowlines were also dissolved into a single feature during this process.

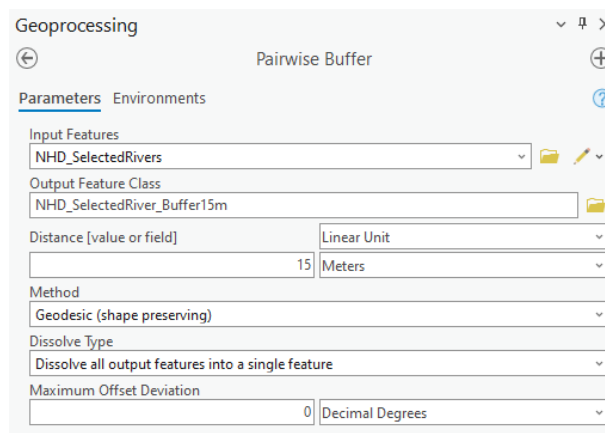


Figure A2-9. Screenshot of the “Pairwise Buffer” tool.

- 9) Next, the buffered flowlines and the selected waterbodies were merged using “Merge” (Figure A2-10).

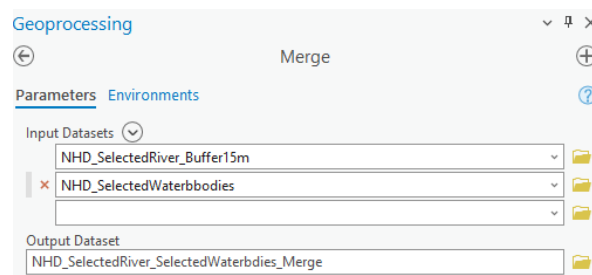


Figure A2-10. Screenshot of the “Merge” tool.

10) Finally, the core map was generated by dissolving the polygons into a single feature using “Pairwise Dissolve” (Figure A2-11).

a) Core map name: Scaleshell_Coremap

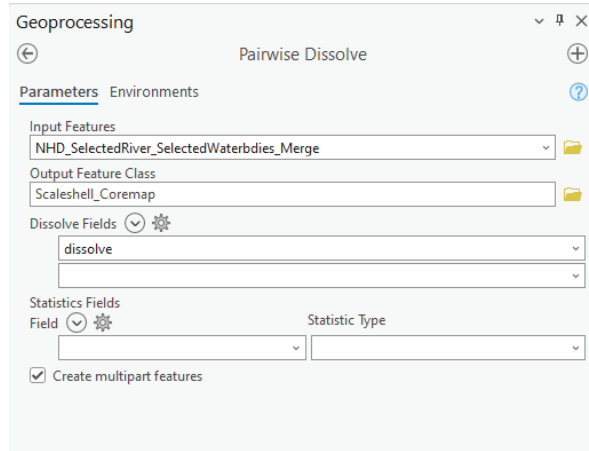


Figure A2-11. Screenshot of the Pairwise Dissolve tool, the final step of the core map creation process.