GUIDELINES FOR SAMPLING FRESHWATER MUSSELS IN INDIANA

Wildlife Section
Division of Fish & Wildlife
Indiana Department of Natural Resources

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The following guidelines are intended to provide accuracy and consistency for the mussel surveys completed in the waters of Indiana for the purposes of environmental review, while protecting the state's mussel resource.

General guidelines that apply to all mussel surveys:

- The **impact area** is defined as the entire area where in-channel work will occur.
- The **study area** includes the impact area, as well as an area upstream and downstream from the impact area boundaries. These distances are determined by multiplying the average stream width for the impact area by 2 (for upstream) and by 4 (for downstream); a minimum of 50 meters upstream and 100 meters downstream from the impact area boundaries is required for all surveys.
- Those persons conducting mussel surveys in Indiana must have an adequate knowledge of Midwestern mussel communities and be able to correctly identify live individuals of Indiana's mussel fauna (Table 1).
- Those persons conducting mussel surveys must be able to obtain an Indiana Scientific Purposes License (contact Operations Section Staff Specialist at: lpetercheff@dnr.IN.gov or 317-233-6527) as well as a Federal Fish and Wildlife Permit (if required for survey location).
- Water flows must be at normal levels before mussel surveys can be completed. Surveys can only be completed when discharge for the closest USGS gage (http://waterwatch.usgs.gov/new/index.php?m=real&r=in&w=map) is at or below its median daily streamflow value for the dates of the survey. Depending on the time of year, certain surveys may not be dependent on this criteria; requests to sample at higher discharges should be forwarded to the Nongame Aquatic Biologist (contact information below).
- Surveys can only be completed between May 1-October 15; these restraints could be modified for unusually high spring/fall water temperatures. Surveys can not be conducted when air temperatures are at or below 32°F.
- All live mussels collected during surveys must be identified to species, enumerated and measured (height and length in millimeters).
- Proper handling of live mussels (including keeping mussels in flow-through river bags etc.) must be utilized to minimize negative impacts during handling. All live mussels collected during survey efforts must be returned to the study area from which they came. When water temperatures are above 50°F, live mussels can be simply placed back on the substrate surface; when water temperatures are below 50°F, live mussels must be replanted into the substrate by hand.
- At least one valve for each species collected during surveying must be vouchered for verification purposes. No live mussels are to be sacrificed for this purpose. For species only found live within the study area, high-quality digital images of both valves and beak should be substituted.
- Vouchered shell material and digital images must be provided to the Nongame Aquatic Biologist for verification. Shell material of significance will be deposited in the Indiana State Museum.

- Upon completion of the mussel survey, a final report must be prepared that includes all of the following:
    - a complete list of all mussel species (including exotics) collected (live or dead) during survey activities within the study area with indication of best condition of shell material (live, fresh dead, weathered dead or subfossil) encountered
    - measurement information for all live mussels
    - a detailed description of the methods and effort used to complete the survey (as defined by these guidelines)
    - the exact location (using GPS coordinates) of any live federal/state endangered mussels (Table 1) collected during survey activities.
    - a detailed map of the study and impact areas, delineating substrate types and water depths throughout the study area
    - information on the water temperature, air temperature and water clarity for the dates of surveying
    - pictures clearly identifying the impact area and study area
- A copy of the final report must be provided to the following Indiana Department of Natural Resources staff: 1) Operations Staff Specialist (as required by the Scientific Purposes License), 2) Environmental Biologist requesting the survey, and 3) Nongame Aquatic Biologist.

Guidelines specific for Nonwadeable and Wadeable stream reaches:

NONWADEABLE:

- **Nonwadeable** reaches are defined as those where greater than 25% of the bottom of the study area cannot be adequately sampled without the use of diving methods.
- The following reaches are considered nonwadeable regardless of reach characteristics:
    1) entire Ohio River
    2) St. Joseph River in St. Joseph and Elkhart counties
    3) Maumee River in Allen County
    4) Wabash River from the Ohio River upstream to Huntington Reservoir
    5) White River upstream to the confluence of the East Fork and West Fork
    6) West Fork White River from confluence with White River upstream to the Johnson/Morgan county line
    7) East Fork White River from confluence with the White River upstream to Columbus (Bartholomew County)
- All nonwadeable reaches will require surveys to be completed by diving.
- Quantitative surveys using transects perpendicular to stream flow will be required.
- The distance between transects will be determined by dividing the average stream width within the impact area by two. The maximum distance between transects will be 100 meters.
- The number of transects will be determined by dividing the distance between transects into the total length of the study area, with at least one transect encompassing each of the upstream and downstream boundaries of the study area.
- Along each transect, at 10 evenly-spaced increments, mussels will be collected from 2-1/4 m^2 quadrats. All substrate to a depth of 15-20 cm must be excavated, bagged and processed stream-side.

- All transect endpoints and location of quadrats along the transects must be identified using GPS coordinates. A detailed map depicting the study area boundaries and location of transects/quadrats must be included in the final report.
- A detailed map depicting the mussel density per quadrat within the study area must be included in the final report.
- More intensive surveying within the areas of highest mussel densities within the study area determined by the initial transect sampling may be required in reaches that possibly harbor federal/state endangered mussel species.
- For all nonwadeable sites, additional qualitative sampling must be conducted in shallow areas, if present, within the project area. This would include areas around exposed sand/gravel bars, backwaters, side-channels, etc. These should be sampled using techniques described under the 'wadeable' portion of these protocols.
- Ohio River sampling may require special sampling protocols currently being developed by the Ohio River Valley Ecosystem Mollusk Subgroup. The Nongame Aquatic Biologist should be contacted for the most current version of these protocols (see below for contact information).

WADEABLE:

- **Wadeable** reaches are defined as those where greater than 75% of the bottom of the entire study area can be adequately sampled without the use of diving methods.
- Qualitative sampling methods are sufficient for wadeable stream reaches.
- The entire study area, including all habitats, must be visually (if possible) and physically searched for live mussels and dead shell material.
- Physical search techniques must be attempted in order to collect small individuals, small species and species that tend to bury deeper in the substrate. This could include searching through the substrate with hands, shoed-feet or gently pulled specialized rakes.
- All exposed areas and stream banks within the study area must be searched for dead shell material.
- Person-hours spent sampling must be included in the final report.
- Even though transect sampling is not required during surveys of wadeable reaches, maps depicting the areas of highest mussel concentrations and describing the substrate types throughout the study area must be included in the final report.

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TABLE 1: NATIVE FRESHWATER MUSSELS OF INDIANA:

	GENUS	SPECIES	COMMON NAME	STATUS
1	*Actinonaias*	*ligamentina*	MUCKET	
2	*Alasmidonta*	*marginata*	ELKTOE	
3	*Alasmidonta*	*viridis*	SLIPPERSHELL MUSSEL	
4	*Amblema*	*plicata*	THREERIDGE	
5	*Anodonta*	*suborbiculata*	FLAT FLOATER	
6	*Anodontoides*	*ferussacianus*	CYLINDRICAL PAPERSHELL	
7	*Arcidens*	*confragosus*	ROCK POCKETBOOK	
8	*Cumberlandia*	*monodonta*	SPECTACLECASE	extirpated
9	*Cyclonaias*	*tuberculata*	PURPLE WARTYBACK	
10	*Cyprogenia*	*stegaria*	FANSHELL	federal endangered
11	*Ellipsaria*	*lineolata*	BUTTERFLY	
12	*Elliptio*	*crassidens*	ELEPHANTEAR	
13	*Elliptio*	*dilatata*	SPIKE	
14	*Epioblasma*	*flexuosa*	LEAFSHELL	extirpated
15	*Epioblasma*	*obliquata obliquata*	CATSPAW	extirpated
16	*Epioblasma*	*obliquata perobliqua*	WHITE CATSPAW	federal endangered
17	*Epioblasma*	*personata*	ROUND COMBSHELL	extirpated
18	*Epioblasma*	*propinqua*	TENNESSEE RIFFLESHELL	extirpated
19	*Epioblasma*	*sampsonii*	WABASH RIFFLESHELL	extirpated
20	*Epioblasma*	*torulosa rangiana*	NORTHERN RIFFLESHELL	federal endangered
21	*Epioblasma*	*torulosa torulosa*	TUBERCLED BLOSSOM	federal endangered
22	*Epioblasma*	*triquetra*	SNUFFBOX	federal endangered
23	*Fusconaia*	*ebena*	EBONYSHELL	
24	*Fusconaia*	*flava*	WABASH PIGTOE	
25	*Fusconaia*	*subrotunda*	LONGSOLID	state endangered
26	*Hemistena*	*lata*	CRACKING PEARLYMUSSEL	extirpated
27	*Lampsilis*	*abrupta*	PINK MUCKET	federal endangered
28	*Lampsilis*	*cardium*	PLAIN POCKETBOOK	
29	*Lampsilis*	*fasciola*	WAVYRAYED LAMPMUSSEL	special concern
30	*Lampsilis*	*ovata*	POCKETBOOK	
31	*Lampsilis*	*siliquoidea*	FATMUCKET	
32	*Lampsilis*	*teres*	YELLOW SANDSHELL	
33	*Lasmigona*	*complanata*	WHITE HEELSPLITTER	
34	*Lasmigona*	*compressa*	CREEK HEELSPLITTER	
35	*Lasmigona*	*costata*	FLUTEDSHELL	
36	*Leptodea*	*fragilis*	FRAGILE PAPERSHELL	
37	*Leptodea*	*leptodon*	SCALESHELL	extirpated
38	*Ligumia*	*recta*	BLACK SANDSHELL	
39	*Ligumia*	*subrostrata*	PONDMUSSEL	
40	*Megalonaias*	*nervosa*	WASHBOARD	
41	*Obliquaria*	*reflexa*	THREEHORN WARTYBACK	
42	*Obovaria*	*olivaria*	HICKORYNUT	
43	*Obovaria*	*retusa*	RING PINK	extirpated
44	*Obovaria*	*subrotunda*	ROUND HICKORYNUT	state endangered

45	*Plethobasus*	*cicatricosus*	WHITE WARTYBACK	federal endangered
46	*Plethobasus*	*cooperianus*	ORANGEFOOT PIMPLEBACK	federal endangered
47	*Plethobasus*	*cyphyus*	SHEEPNOSE	federal endangered
48	*Pleurobema*	*clava*	CLUBSHELL	federal endangered
49	*Pleurobema*	*cordatum*	OHIO PIGTOE	special concern
50	*Pleurobema*	*plenum*	ROUGH PIGTOE	federal endangered
51	*Pleurobema*	*rubrum*	PYRAMID PIGTOE	state endangered
52	*Pleurobema*	*sintoxia*	ROUND PIGTOE	
53	*Potamilus*	*alatus*	PINK HEELSPLITTER	
54	*Potamilus*	*capax*	FAT POCKETBOOK	federal endangered
55	*Potamilus*	*ohiensis*	PINK PAPERSHELL	
56	*Ptychobranchus*	*fasciolaris*	KIDNEYSHELL	special concern
57	*Pyganodon*	*grandis*	GIANT FLOATER	
58	*Quadrula*	*cylindrica cylindrica*	RABBITSFOOT	state end/fed threatened
59	*Quadrula*	*fragosa*	WINGED MAPLELEAF	extirpated
60	*Quadrula*	*metanevra*	MONKEYFACE	
61	*Quadrula*	*nodulata*	WARTYBACK	
62	*Quadrula*	*pustulosa pustulosa*	PIMPLEBACK	
63	*Quadrula*	*quadrula*	MAPLELEAF	
64	*Simpsonaias*	*ambigua*	SALAMANDER MUSSEL	special concern
65	*Strophitus*	*undulatus*	CREEPER	
66	*Toxolasma*	*lividum*	PURPLE LILLIPUT	special concern
67	*Toxolasma*	*parvum*	LILLIPUT	
68	*Toxolasma*	*texasense*	TEXAS LILLIPUT	
69	*Tritogonia*	*verrucosa*	PISTOLGRIP	
70	*Truncilla*	*donaciformis*	FAWNSFOOT	
71	*Truncilla*	*truncata*	DEERTOE	
72	*Uniomerus*	*tetralasmus*	PONDHORN	
73	*Utterbackia*	*imbecillis*	PAPER PONDSHELL	
74	*Venustaconcha*	*ellipsiformis*	ELLIPSE	special concern
75	*Villosa*	*fabalis*	RAYED BEAN	federal endangered
76	*Villosa*	*iris*	RAINBOW	
77	*Villosa*	*lienosa*	LITTLE SPECTACLECASE	special concern