

DRAFT GUIDELINES

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Upper Mississippi River Mussel Sampling Guidelines
For Activities Requiring Federal Permits
US Fish and Wildlife Service
Rock Island Field Office
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Background and Need - The listing of the Higgins eye mussel (*Lampsilis higginsii*) as a federally endangered species in 1976, resulted in the need to conduct freshwater mussel surveys prior to construction of river development activities. Early investigations focused on the “presence/absence” of Higgins’ eye at a given location and sampling protocols varied. Recent technological advances such as personal computers and geographic positioning systems have greatly improved mussel survey capability.

Upper Mississippi River (UMR) mussel (Bivalvia: Unionidae and Margaritifidae) populations have declined significantly since the invasion of the zebra mussel in the early 1990s. It is estimated that 43% of the 300 species of freshwater mussels in North America are in danger of extinction. Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, and Ohio list more than half of their 78 known mussel species as endangered, threatened, or requiring special concern. In order to restore and protect this declining faunal group, managers require accurate mussel data to make decisions affecting development actions. Consistency in survey protocols is necessary to ascertain population trends within specific communities as well as system wide.

In order to assess potential project effects upon a mussel community, managers need data about species composition, reproduction, abundance, age, etc. This information facilitates: (1) an assessment of that community’s local importance and (2) a determination of potential impacts on that community. Inconsistent and poorly designed sampling protocols hinder biologists’ ability to make these assessments. Standardized sampling guidelines improve decision making and establish a clear standard for all surveyors to meet. Such a standard also contributes to the development of a mussel community quality index useful for water resource planning.

Most agency sampling guidelines have been designed for wadeable streams, not large rivers. Guidelines for the Ohio River have been drafted, but are undergoing revision. The Minnesota DNR also has sampling guidelines that are being revised. Consultants specializing in UMR surveys also have their own sampling guidelines. Most of these guidelines employ techniques described in Strayer and Smith (2003) and adapted to UMR conditions.

Applicability- These guidelines apply to all activities requiring CWA Section 404 permits within the Rock Island District Corps of Engineers, Mississippi River miles 300.0 to 614.0.

¹ These guidelines are adapted from techniques and protocols currently employed by the Minnesota DNR, Ecological Specialists Inc. and from recommendations provided by the US Fish and Wildlife Service, Upper Midwest Sciences Center, and state DNR biologists.

When Is A Survey Required? – Generally, a survey is required for any project location along the river main stem, side channels, and sloughs. Isolated backwaters (e.g. lakes and ponds) do not require a survey in most situations. Locations such as boat harbors, marinas, docks, etc. that are regularly dredged (every 5 years) do not generally require a survey, provided the footprint remains the same. In addition to actions which place fill (e.g. rock, pilings, anchors) in the river, surveys are generally requested for activities where the river bottom could be impacted by boats (either directly by grounding or indirectly from propeller generated turbulence), and activities such as bulk commodity loading where spillage can cover the river bottom. In practice, the need for a survey is determined by agency biologists.

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The sampling objectives for site-specific mussel investigations are to determine: (1) the presence/absence of state and or federally threatened and endangered species, and (2) the distribution, abundance, density, and community characteristics of all mussels within and adjacent to the proposed impact area.

Surveyor qualifications – Investigators must demonstrate experience in mussel collection in large rivers and identification of species specific to the Upper Mississippi River system. In most situations, investigators will require divers familiar with large river hazards to collect mussels and other data. All surveyors/contractors must secure the appropriate state and federal permits.

Mussel Handling Guidelines- The following guidelines are recommended by the US Fish and Wildlife Service for handling endangered species and should be followed when handling all mussels. See also Cope and Waller (1995).

1. Work will not be conducted when air temperatures are at or below 32 degrees Fahrenheit, nor when water temperatures are at or below 40 degrees Fahrenheit.
2. All threatened or endangered species will be replaced by hand into the substrate in a natural position (posterior end protruding above the bottom and pointing upstream)
3. Specimens will be held in mesh bags suspended in the water or held in containers of water that is changed every hour (every half hour when air temperatures are at or above 87 degrees Fahrenheit) and replaced with water freshly taken from where they were collected.
4. Specimens will be returned unharmed within three hours following collection to a location near the initial capture site.
5. Live specimens that cannot be identified at the survey site will be photographed for identification purposes and returned to the substrate.
6. All live specimens of state and federal T & E species will be etched with a unique number, photographed, measured (length and height) and, if possible, sexed and aged. No intrusive activities are allowed unless stated in state or federal permit.

Habitat of Special Concern – Sometime in 2012, the spectaclecase mussel (*Cumberlandia monodonta*) could be listed as federally endangered. *C. monodonta* tends to aggregate under slab rock, boulders, or in cracks of bedrock, but can also be found in cobble/boulder and artificial substrates (e.g. rip-rap, near bridge piers). Where this substrate type is found, the survey must include a specific effort to search it

for mussels. All bridge piers, bank revetments, and mooring cells/pilings, should have their own dedicated search.

State and Federal Sampling Permits – All surveyors are required to secure the necessary state and federal permits prior to initiating surveys. Federal permits can be obtained by writing to: Regional Coordinator - Endangered Species Permits/Grants, U.S. Fish and Wildlife Service, 5600 American Blvd. West, Suite 990, Bloomington, Minnesota 55437-1458.

Techniques & Equipment - When the Higgins eye pearly mussel was listed, investigators commonly employed the crowfoot brail to delineate potential mussel communities. With the arrival of the zebra mussel in the 1990's the effectiveness of brails in locating mussel assemblages was reduced. While a brail is still useful to help determine mussel presence or absence, it is not a suitable substitute for quantitative sampling.

In most UMR situations, divers are required for mussel collection. An exception is locations where the entire sampling location is less than 3 ft. deep and allows wading/pollywogging and deployment of a ¼ m quadrat sampler (See Figure 1).



Figure 1 -Quarter meter quadrat sampler - Minnesota DNR photo

Substrate and Sediment Descriptions - Substrate characterization is important, but sieve analyses are generally not required. Visual/tactile texture observations (based on the Wentworth scale) are sufficient (e.g. percent silt, sand, silty-sand, clay, gravel, cobble, etc.). Substrate descriptions should also include the presence of relict shell, fresh dead shell, and zebra mussels. The number of live zebra mussels on living shells should also be estimated (e.g. 0, 1-10, 11-50, >50).

GPS Coordinates -Coordinates for collected samples (quadrats, transect start and end) must be recorded on all data sheets and provided with reports in electronic format suitable for use in a GIS application. WGS84 should be used as the reference datum for all GPS coordinates. Electronic files containing coordinates and any data related to those coordinates must be provided with latitude and longitude coordinates in separate columns.

Data entry forms- A sample datasheet for surveys is attached.

Level I Survey

The primary objective of a Level I survey is to: (1) determine if there is a significant freshwater mussel community present in the project vicinity and (2) if so, map areas where any mussels are found. If a mussel community has been previously identified at the location of interest, the investigator may wish to immediately conduct a Level II survey. A Level I survey is not required prior to conducting a Level II survey.

Size of survey area - The area surveyed should include the entire footprint (including vessel travel paths) of any proposed action as well as a buffer zone. Area outside of the project footprint should be searched until no more mussels are found, or for 25 m upstream, 50m downstream, and laterally to navigation channel, whichever occurs first.

The survey area should be divided into 2,000 square meter plots. Each plot should be searched for a



minimum of 20 minutes to collect as many mussels as possible. Substrate characteristics should be noted for each plot.

All plots shall be searched by feel, wading in shallow water, and using SCUBA in deeper water, methodically covering the survey area. All mussels found will be identified to species with one example of each species found within a survey photographed. All mussels handled will be returned to

the substrate. Specimens of live endangered or

threatened mussels must be returned to the substrate by hand, placed on their side, and allowed to burrow on their own. Where the substrate is very compacted cobble, a hole just large enough to receive the animal to a depth of $\frac{3}{4}$ of its length should be excavated and the mussel placed into it with the posterior end (siphons) up. Other species may be returned to the substrate from the water surface.

Level I Report Requirements –

All mussel survey reports should be provided to the US Fish and Wildlife Service, Rock Island Field Office, 1511-47th Avenue, Moline Illinois, 61265, The US Army Corps of Engineers, Regulatory Branch, PO Box 2004, Clock Tower Building, Rock Island, Illinois 61201-2004 and the appropriate state agency in Illinois, Iowa, Wisconsin, or Missouri.

Level I survey reports should include the following:

1. Description of methods used
2. Map or aerial photo clearly identifying the location of each search area and proposed project footprint (See Figure 2)

3. Composition of substrate, depth, and other physical conditions within each search area
4. List and number of live, relict mussel, and fresh dead² species found within each survey area. Age (< 5 or >5 years) should be estimated for each live mussel collected.
5. Total number of mussels encountered per 20 minute search in each 2,000 sq. m. plot
6. One photograph of each specimen of any federal or state listed species found
7. GPS coordinates for each sample location (note: coordinates should be taken from the center of each plot)
8. Any state or federally listed species must be marked with a unique identifier. The report shall also record age, sex (if possible from external observation) and length.

NOTE: If a federally listed mussel species is encountered during a Level I or Level II Survey, the surveyor must notify the Rock Island Field Office of the U.S. Fish and Wildlife Service at 309/757-5800. For a current list of species listed as threatened or endangered under the Endangered Species Act, see http://www.fws.gov/midwest/endangered/lists/cty_indx.html.

Level II Survey

When is a Level II Survey Required? – The necessity of conducting a Level II survey is at the discretion of each state or federal agency. This may be based on a review of the Level I report or results of other recent mussel surveys near the proposed project site. The objective for a Level II survey is to collect detailed information about mussel community characteristics and distribution. Mussel distribution within a community can be “patchy” with respect to density and species distribution. Hence, accurate GPS coordinates concerning sample locations/boundaries is needed. This information is critical in assessing (and avoiding) potential substrate impacts from structures such as bridge piers, dock pilings or mooring anchors. Such information is also essential if future monitoring or mitigation is required.

Level II mussel surveys will employ a combination of qualitative, semi-quantitative, and quantitative sampling sufficiently robust to: (1) determine the composition and density of mussels within and adjacent to the impact area, (2) map the distribution of the mussel assemblage in the project area, and (3) determine if state or federally listed individuals are present in the project area. The distribution of effort among quantitative, semi-quantitative and qualitative effort may vary according to aspects of the proposed project and/or the significance of the mussel resource encountered.

² Fresh dead shells have both valves attached; have a flexible hinge line, and shiny nacre.

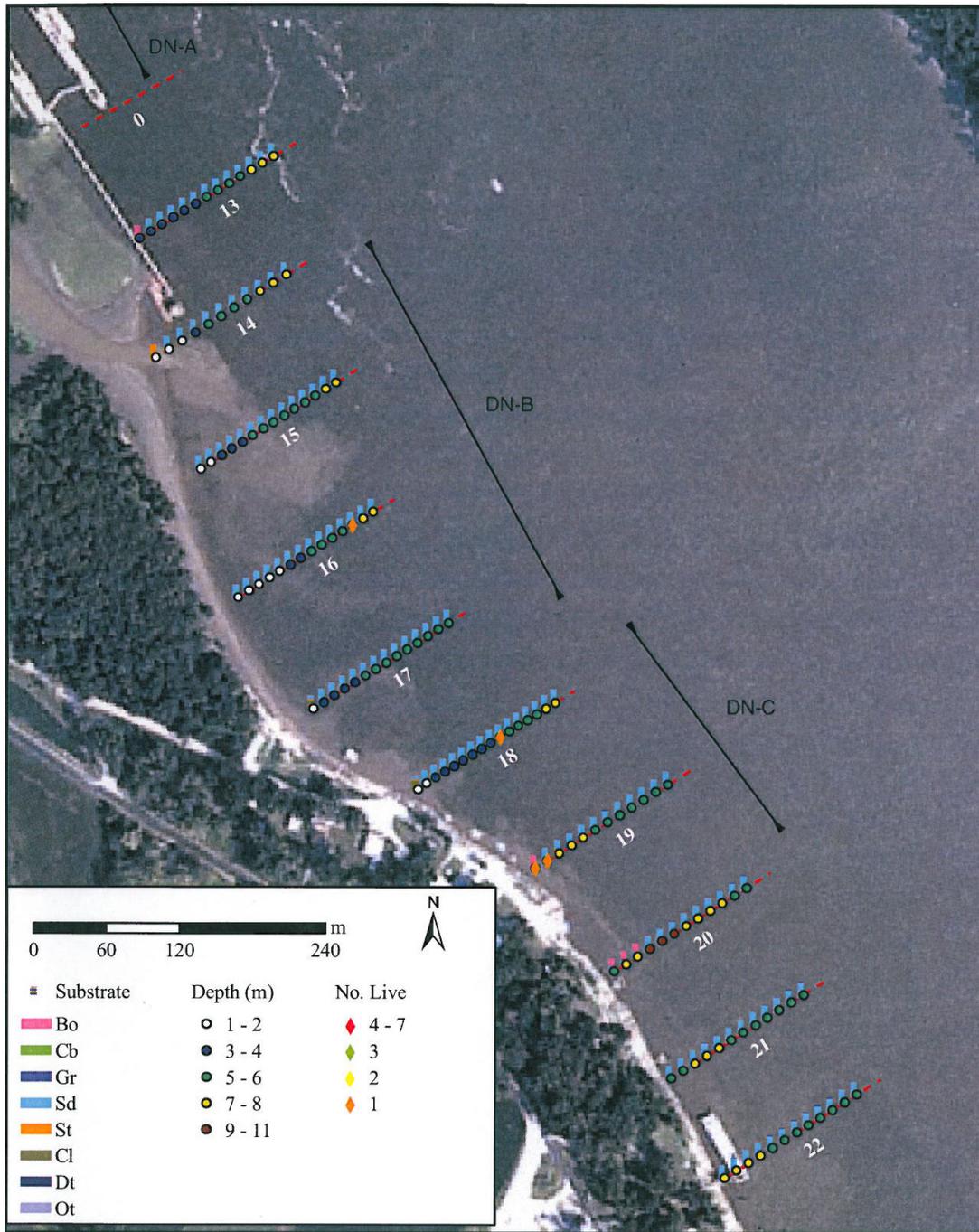


Figure 3 – Typical transect design for Level II mussel survey (Courtesy Heidi Dunn, Ecological Specialists Inc.)

Qualitative

In a Level II survey, a qualitative assessment must be employed (in addition to a quantitative one) in order to document the presence of as many species as possible. For impact locations where a broad expanse may be affected (e.g. dredge cut) several samples throughout the area need to be collected. The number of samples should be sufficient to present a credible representation of species richness. Determining the number of species present at a study site with a high degree of certainty can require such a large number of samples that it is cost prohibitive. However, the number of species in a

community can often be estimated using a species area curve (cumulative species vs. cumulative individual, see Watters 1992).

If no Unionids are found, at least one 5 minute qualitative sample must be collected in each potential impact area (actual area where substrate will be disturbed by construction) to document mussel absence. A good rule of thumb is to collect at least six 5-min qualitative samples past the last sample when a new species (inflection point of a species area curve) is collected.

At each qualitative sample location, a minimum five minute search will be conducted where the diver reports depth and substrate (percent bedrock, boulder, cobble, gravel, sand, silt, clay, vegetation, zebra mussels) as well as collecting as many mussels as possible. The GPS location for each sample is recorded. Unionids from each sample are identified, classified, aged, and counted. Fresh dead shells must also be counted.

SEMI-QUANTITATIVE

Most permit actions and mussel assemblages occur near shorelines. One sampling design (See Figure 3) uses transects perpendicular the shoreline at 100 meter minimum intervals. This design is useful for determining mussel bed (or patch) boundaries. However, when high mussel densities (greater than 10/sq m) are encountered, spacing should be reduced to 25-50m in order to map density contours within large beds. Transects should extend to the navigation channel or 25 meters beyond the impact zone border. The diver will search the substrate for mussels within 1m on one side of the transect line by sweeping his or her hands along the bottom disturbing the top three inches of substrate, thereby exposing the mussels for collection, moving small rocks and logs, and searching along edges of large rocks and logs. Each 10m section of transect should be treated as a separate sample. The diver will search at least 1min per 10m section if substrate is very deep silt or very loose sand and when no Unionids are present. The diver will spend at least 3min per transect section if habitat is suitable for Unionids and/or Unionids are present. The diver will place the freshwater mussels in a mesh bag, which will be transferred to the boat. Depth measurement and substrate description (percent bedrock, boulder, cobble, gravel, sand, silt, clay, vegetation, zebra mussels) are recorded at 10m intervals (bank=0). Unionids from each transect shall be identified, aged by counting annuli, and counted. Mussel distribution, along with substrate and depth information will be mapped to determine limits of a Unionid bed or at least suitable habitat (heterogeneous mixture of substrate, some flow at low stage, not subject to scouring at high river stages).

Quantitative

In a Level II survey, quantitative samples are necessary in order to obtain a credible estimate of density, species relative abundance, and age structure for the calculation of any metrics. Such estimates are needed to determine the quality of the mussel bed near and within any direct impact area, and to quantify how many mussels may be impacted. Density and abundance data is necessary in order to

estimate how many mussels may require relocation and/or calculate incidental take for federally listed species. Samples should be randomly distributed within the mussel bed area (determined during semi-quantitative sampling) or impact area, depending on how the data will be used. Smith (2006)

At each location, the diver will randomly place a 0.25m² quadrat on the river bottom.

Typically, the diver should hold position until GPS coordinates are recorded.

The diver may be asked to stop for depth measurement and describe substrate (percent bedrock, boulder, cobble, gravel, sand, silt, clay, vegetation, zebra mussels).

The quadrat will be placed such that the mesh bag is floating freely downstream of the quadrat.

All river bottom material will be excavated to approximately 10cm into the mesh bag attached to the quadrat.

The quadrat will be transferred to the surface for processing.

On the surface, the bag will be dumped into a nested 12mm and 6mm sieve. Unionids will be carefully separated from debris (be sure to look for tiny juveniles on other mussels or rocks, or byssal threads hanging on the mesh). All Unionids will be identified, measured (length in mm), and aged (external annuli count). State and federal species collected must all be marked with a unique identifying number which should be recorded in the data sheets.

Level II Report Requirements:

Level II Report Investigation results must be presented in report format including: (1) Project description, (2) methods and procedure used for the survey, (3) results, (4) Discussion, (5) Appendices. Mussel data can be presented in table formatting showing species abundance, composition, density, age, and length frequency. Results should present a thorough description of substrate composition throughout the study area including bathymetric information.

All transect surveys should be illustrated on a figure (map/photo) overlain on areas of proposed construction or possible impact. Locations where state or federal were collected must also be indicated. Aggregations of high density should be discernible either from the transect data or shading on the figure. Copies of all data sheets must be included in an appendix. Coordinates for collected samples must be recorded on all data sheets and provided with reports in an electronic format suitable for use in a Geographic Information System application. WGS84 should be used as the reference datum for all GPS coordinates. Electronic files containing coordinates and any data attributed with those coordinates must provide latitude and longitude coordinates in separate columns or fields. If the study was conducted within a *Lampsilis higginsii* Essential Habitat Area (see <http://www.fws.gov/midwest/endangered/clams/higginsey/hepmeha.html>) or if federally listed species were found and sample locations were randomly selected (simple random sampling, multiple random start, etc.), provide a GIS polygon layer (e.g., shapefile) that describes the location, shape, and extent of each area within which samples were randomly located. Age (no. external annuli) and length and height measurements (mm) of must be reported at least for all specimens of federal or state listed

species. The report must also contain the estimated densities (#/m²) and standard error of all species found alive. Density data must be presented separately for each study area if there was more than one – e.g., if the overall project area was divided into two or more study areas in which samples were separately randomized.

Summary

The above recommendations are intended to result in the minimum necessary effort required to: (1) identify and describe any significant mussel assemblages potentially affected by development activities, and (2) provide information necessary to develop mitigation measures (if required) and complete required agency regulatory procedures. The Fish and Wildlife Service Rock Island Field Office can provide technical assistance to review mussel sampling designs in advance of any investigations for US Army Corps of Engineer Clean Water Act Permits.

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Project # _____ of _____ State _____ River _____ Bank _____ Date _____
 River Mile(s) _____ Collection method _____ Effort (m² or min) _____ Collectors _____
 Comments _____

Repl- cate	Bag/ bucket	Distance from bank (min. max)	SPECIES	# Indiv. L/FD/WD/S F	AGE/LENGTH	Reprod. condition	Zebras/ unionid	Zebras/ 1/4m ²	Depth	Substrate						NOTES	GPS/DepthFinder		
										Be	Bo	Cb	Gr	Sd	St			Cl	Oth
1																			
2																			
3																			
4																			
5																			
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DATA SUMMARY
 No. Species _____ T&E _____ ENVIRONMENTAL CONDITIONS
 CPUE _____ Water Temp: _____
 Density _____ Air Temp: _____
 _____ Flow: _____
 (Site Draw Reverse side)