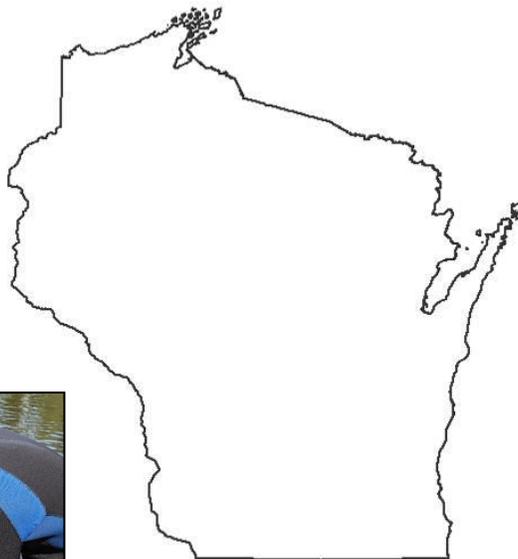


# Wisconsin Mussel Monitoring Program Training Manual



# WISCONSIN MUSSEL MONITORING PROGRAM

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Ver. May 2018

For more information about the Wisconsin Mussel Monitoring Program or iNaturalist, contact: [Jesse Weininger \(608\) 397-0198](mailto:Jesse.Weininger@dnr.wisconsin.gov)  
To find out where the nearest shell drop-off is located or for more information, contact: [Lisie Kitchel \(608\) 266-5248](mailto:Lisie.Kitchel@dnr.wisconsin.gov)

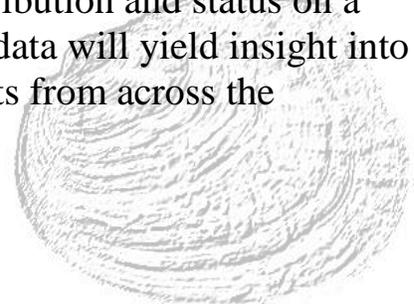


## INTRODUCTION

Freshwater mussels (also referred to as clams or unionids) reach their greatest diversity in North America where some 300 species occur. However, surveys conducted over the past several decades have documented significant declines in freshwater mussel populations. Many populations have been locally extirpated (removed completely) and others are failing to reproduce. Primary factors responsible include extensive habitat modification and destruction, commercial exploitation, water contamination, and competition with exotic species. Malacologists (mollusk specialists) estimate that nearly 70% of these species are presently threatened, endangered, or extinct. Of the 52 mussel species that occur within Wisconsin's lakes, rivers, and streams, 24 mussels are listed as threatened, endangered, or special concern and several species are considered species with informational needs.

Despite their importance, limited work has been done to comprehensively inventory and monitor freshwater mussels and large informational gaps remain within Wisconsin's impressive 84,000 river miles and 15,000 lakes. Current management efforts tend to focus on areas with the highest species diversity, large rivers, or where previous surveys took place, such as Harold Mathiak's statewide effort in the 1970's. Other mussel surveys take place at localized project areas at bridge crossings or dams. Therefore, the goal of the Wisconsin Mussel Monitoring Program is to gain a *statewide* perspective on mussel populations and inventory where individual mussel species occur. This program has been modeled after the Texas Mussel Watch project\*, which was established in 1992, and has been successful in examining over 1300 sites in all the major drainage basins in that state.

With the help of citizen scientists in Wisconsin, these efforts will provide much needed up-to-date information on mussel distribution and status on a statewide level. In addition, the volunteer collected data will yield insight into water quality, while also shaping conservation efforts from across the Midwest.



## FRESHWATER MUSSEL ANATOMY AND IDENTIFICATION

The most conspicuous part of a mussel is its shell, the two symmetrical valves held together with a ligament that creates a protective covering for the soft boneless animal inside. The ligament exerts a constant pressure on the valves and opens them as the adductor muscles relax, e.g. when the mussel is taking in water. The area of the umbo (see Figure A) is where the growth begins in the juvenile mussel. Concentric lines extending out to the edge of the shell indicate annual growth but may also form in response to a variety of temporary unfavorable environmental conditions such as a fall in water level, low oxygen supplies, or a lack of food. Consequently, although growth lines can be used for determining the age of a shell, they are not always a reliable method.

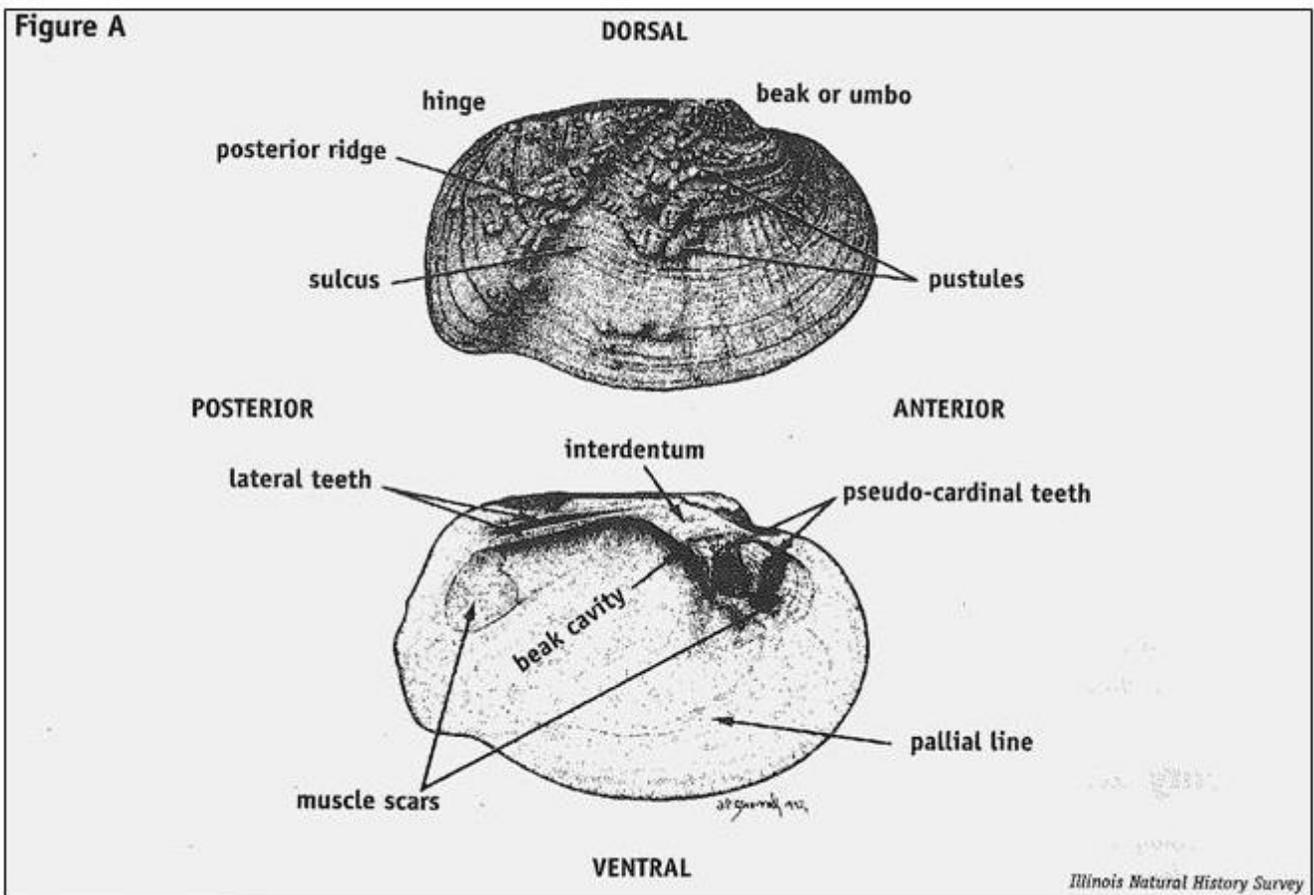
The shell features are used to differentiate species or sub-species. However, freshwater mussels are extremely variable in colorations, shape, and size, both within and between species. No specimen is likely to exactly fit the descriptions that follow.

The **dorsal** edge or top of the shell has the **hinge** and the **beak** or **umbo**, a raised area on each valve above the hinge. The **ventral** edge is opposite the hinged side and is where the valves separate. The **posterior** of the shell protrudes from the stream bottom and is often coated with algae. In some species, females have more rounded and swollen posterior shells than do the males. The **anterior** side of the shell is closest to the umbo.

On the outside of the shell, various features are used for identification: the **epidermis** (periostracum) or surface layer, the sculpture of the umbo, the presence or absence of a **sulcus** or depression from the beak to the ventral margin, the characteristics of the posterior ridge running from the umbo to the **posterior ridge** of the shell, and the arrangement of **pustules** or other features on the surface. Inside the shell depth of the **beak cavity** and color of the **nacre** or hard pearly internal layer can be distinctive. The **lateral teeth** near the hinge and the **pseudocardinal teeth** on the opposite side of the beak cavity are important identifying features (see Figure A).

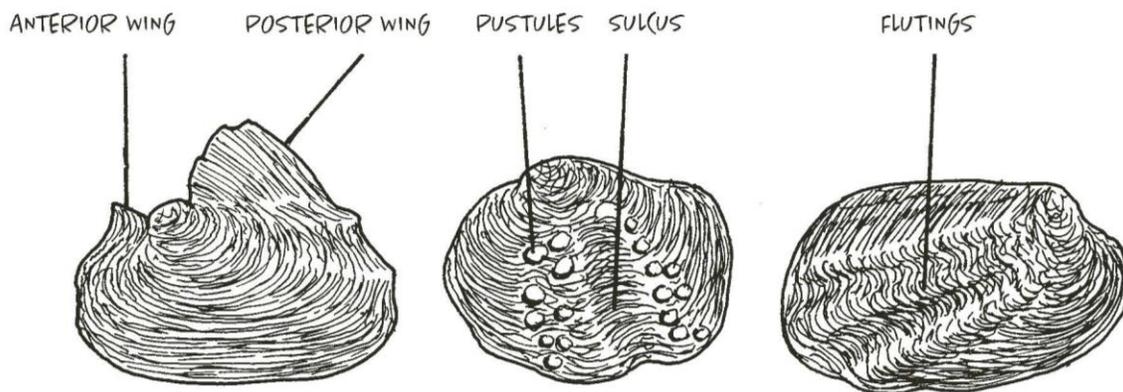
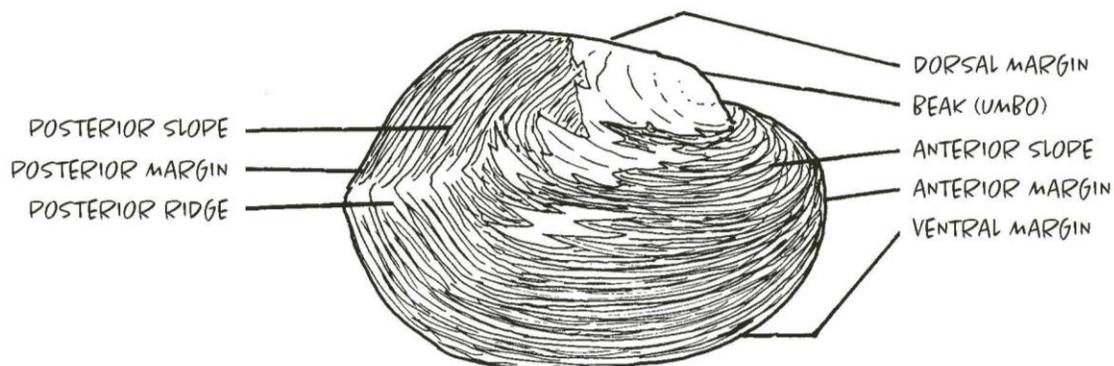
## WISCONSIN MUSSEL MONITORING PROGRAM

The body of the mussel consists of a thickened, central mass that is attached to the valves near the hinge. The forward or bottom part of the body forms the muscular foot. On each side of the foot lie the thin double gills and outside these is the **mantle**, the thin sheets of tissue that adhere to the inner surfaces of the shell. At the posterior end of the body are two tubes or **siphons**, which bring water in (the incurrent siphon) and expel it (the excurrent siphon). The nervous system is very simple and mussels are unable to see, hear, or smell. Nevertheless, the edges of the mantle are sensitive to changes in light intensity and mussels are sensitive to both touch and changes in equilibrium, as well as chemical stimuli.

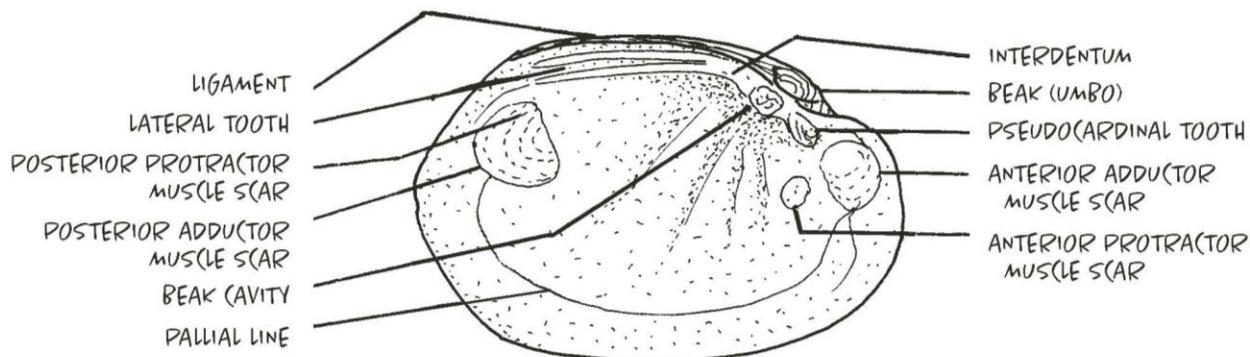


# WISCONSIN MUSSEL MONITORING PROGRAM

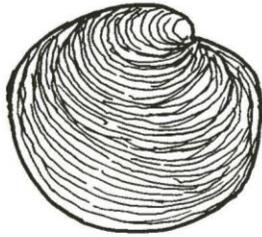
## EXTERNAL SHELL FEATURES



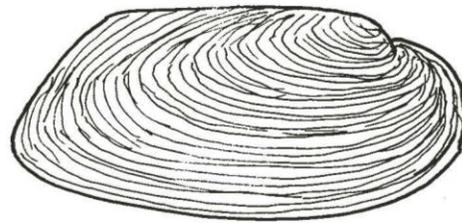
## INTERNAL SHELL FEATURES



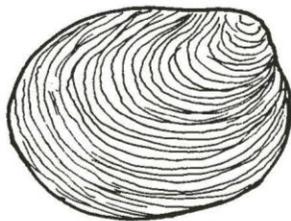
**SHELL SHAPE**



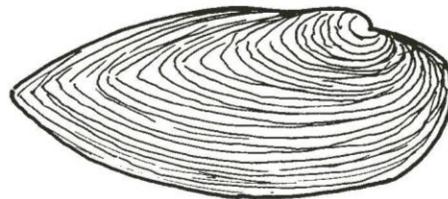
ROUND



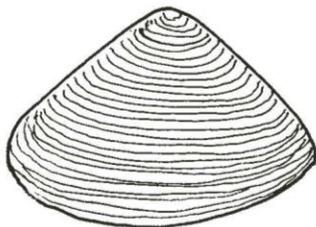
RHOMBOIDAL



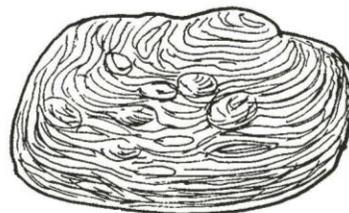
OVAL



ELLIPTICAL



TRIANGULAR

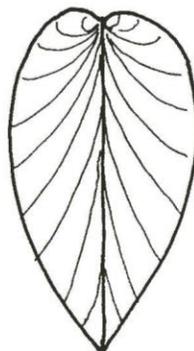


QUADRATE

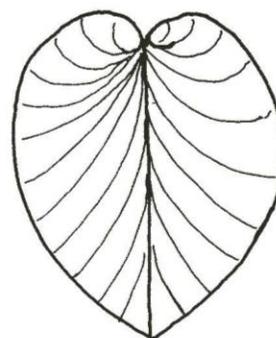
**SHELL WIDTH**



COMPRESSED



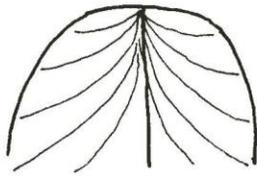
NORMAL



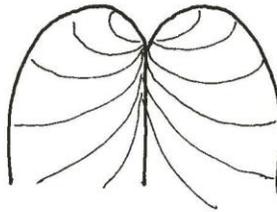
INFLATED

# WISCONSIN MUSSEL MONITORING PROGRAM

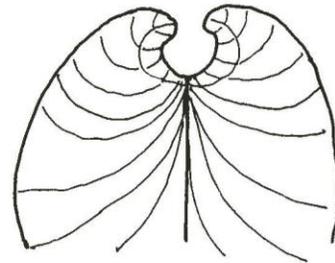
## BEAK MORPHOLOGY



BEAKS NOT ABOVE  
HINGE LINE



BEAKS ABOVE  
HINGE LINE

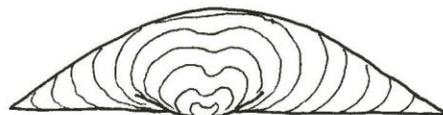


BEAKS ELEVATED  
AND HOOKED

## BEAK SCULPTURE

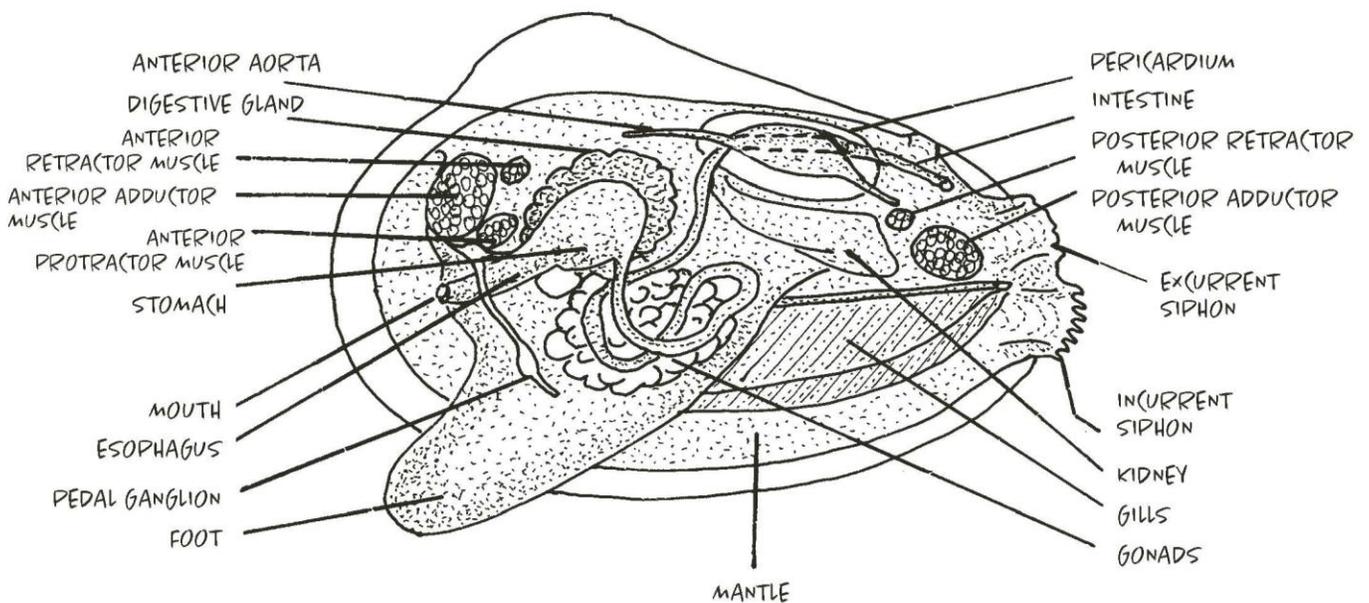


SINGLE LOOPED



DOUBLE LOOPED

## INTERNAL SOFT TISSUE ANATOMY



## FRESHWATER MUSSEL LIFE CYCLE

Most North American freshwater mussels species are sexually dimorphic (one species is known to be hermaphroditic). Female mussels can produce 100,000 to 3 million eggs in a given spawning season. Eggs pass from the ovaries to specialized portions of the gills that function as marsupia or brood pouches. Males release sperm into the water, where they are dispersed by water currents. A mature female may fortuitously draw a portion of these through the incurrent siphon to fertilize her eggs. Successful spawning, therefore, requires that a sufficient number of mature males and females be in proximity to each other. The fertilized eggs develop into small larvae called glochidia. They may be attacked by bacteria and protozoa, and mortality is often heavy during this time. Superficially, the glochidia resemble adult mussels, with two shells, but only 0.05-0.35 mm in diameter. They possess only a single central muscle for snapping and the embryonic stages of a mouth, intestines, a heart, and a foot.

When water temperature and photoperiod reach the proper environmental conditions, the female releases the mature glochidia into the water (see Figure B). Glochidia are not free-swimming. The current carries them or they may sink to the bottom where they remain with their valves gaping open. In order to survive, they must attach to a host, usually a fish. Fish pick up glochidia by taking in water that contains them, brushing against the bottom and stirring up the sediment with fin movements, or in response to tricks that various species use to lure a potential host. The hooked mussel species usually attach to the fins or soft body surfaces, the hookless species to the gills. Wherever they attach needs to be vascularized as they need the fish blood to fully develop.

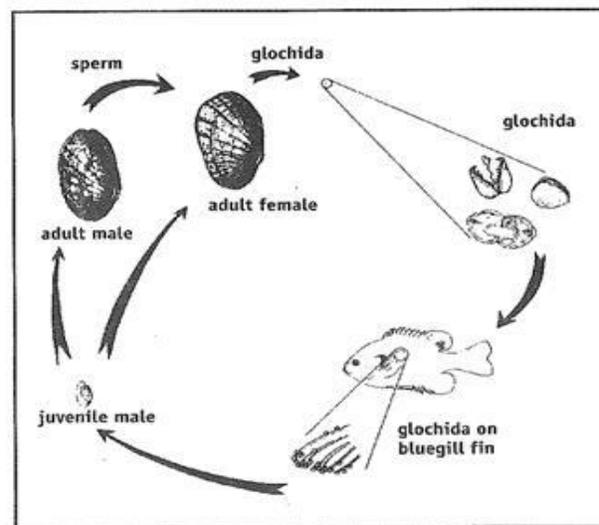


Figure B. Typical life cycle depicting the various stages. The life cycle for most species of naiades is very similar to that depicted here.

## WISCONSIN MUSSEL MONITORING PROGRAM

Larval mussels undergo an internal metamorphosis during this mandatory parasitic period on a fish. Within several hours of attachment, the tissue of the fish grows over each glochidium, completely encasing it in a small cyst. During this period, the glochidia digest and absorb the host tissue that was enclosed between their valves at the time of attachment and absorb nutrients from the host's blood to support the metamorphosis as their adult organ systems form. The period of attachment varies from 10 to 30 days, and some species overwinter on the fish. The length of time depends on the host, water temperature, and time spent in the female brood pouch.

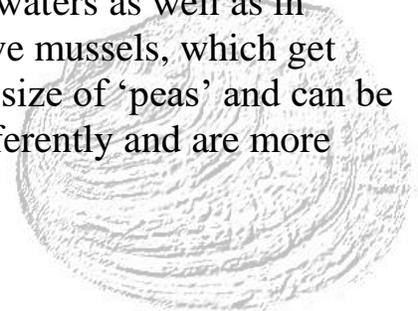
A number of species are host specific, and use only one species of fish, while many are capable of infecting similar types of fish or multiple fish species. The Salamander mussel (*Simpsonaias ambigua*) is the only mussel known to use the mudpuppy, an aquatic salamander, rather than a fish. Many mussel species with a predatory host fish have developed "fish lures" to entice the host to attack the lure resulting in the release of thousands of glochidia in to the host's mouth and over the body. Other species release glochidia in masses called conglutinates that vary in size, shape, and color according to species to attract the fish by looking like insects or prey items. Some species put "all their eggs in one basket" by releasing the entire conglutinal mass in a strand of mucus that sways in the water similar to an angler fishing. Some still don't have a know host. Due to this critical link in the lifecycle of freshwater mussels, declines in host fish populations can have devastating consequences.

Upon completion of this parasitic stage and development of their internal organs, the young mussels break through the tissue of the host fish and fall to the bottom. If they are fortunate enough to land on suitable substrate, they begin independent lives as juveniles. Their adult shells begin to appear beneath their glochidial shells. Many juveniles fall prey to worms, crustaceans, and other bottom feeding organisms during the first few months. Those that survive reach maturity in two to eight years, depending on the species. The longer lived, thick shelled species generally take longer to reach maturity. Few embryos survive into adulthood but the high losses are compensated for long life span. Although a few of the thin-shelled species may live five to ten years, the thick shelled species may live twenty or forty years or much longer.

## FRESHWATER MUSSEL ACTIVITY AND HABITAT

Mussels spend their entire juvenile and adult lives either partially or completely buried in bottom sediments. Mussels show very little variation in their diets; all species feed primarily on detritus and plankton. For very young juveniles, ingestion of fine sediments and the bacteria growing on them appears to be particularly important. Although some species are known to move several feet per hour in response to adverse environmental changes such as falling water levels, most individuals rarely move more than a few hundred yards in a lifetime. Rather than migrating to deeper waters in the winter, most mussels are believed to simply burrow more deeply into the bottom of their summer habitat. Consequently, their lives are directly subjected to the conditions of the substrate in which they live and to the conditions of the water passing over them. Long distance dispersal is accomplished by the movement of glochidia-infested hose fish and occasionally by birds carrying juveniles overland in mud or debris on their legs and feet. Predators include mink, raccoons, waterfowl, turtles, fish, and primarily, the muskrat. Humans are implicated as well, chiefly for the use of shells in the manufacture of buttons and in the cultured pearl industry, and sometimes for bait or person consumption.

Mussels can be found in many aquatic habitats, including ponds, lakes, flowages, impoundments, rivers and streams. The greatest diversity and highest abundance occurs in rivers and streams which provide flowing water for food and respiration, and a diversity of host fish. The diversity in ponds and lakes is usually quite low since only a few species tolerate non-flowing waters, however mussels can be quite abundant in some lakes. Flowages and impoundments will have a greater diversity in areas where there is still some flow from the original river, but not as much as in rivers or streams. Fingernails clams can also be found in all of these waters as well as in wetlands, but are small bivalve cousins of our native mussels, which get much bigger. Fingernail or pea clams are more the size of 'peas' and can be confused with juvenile mussels, but are shaped differently and are more symmetric.



## HARVEST REGULATIONS IN WISCONSIN

*\*The word "clam" is a general legal definition used in Wisconsin's clamming law that refers to native freshwater mussels.*

This information is a summary of Wisconsin's clamming statutes and administrative rules. Refer to Section 29.537, Wisconsin Statutes and Chapter NR 24, Wisconsin Administrative Code for the specific law and regulations that govern commercial and noncommercial clamming in Wisconsin.

See also Section 29.604, Wisconsin Statutes and Chapter NR 27, Wisconsin Administrative Code for requirements pertaining to threatened and endangered species.

These rules apply to all inland and boundary waters of Wisconsin.

### **Commercial Clamming\* – Closed**

All Wisconsin waters have been closed to commercial clamming.

### **Pearl Hunting - Illegal in Wisconsin Waters**

It is no longer legal to harvest live clams from the waters of the state.

### **Personal Clamming - Illegal in Wisconsin Waters**

It is no longer legal to take live clams from Wisconsin waters.

Under current rules, a person may take dead shell only on all public Wisconsin waters (except shells from the St. Croix and Namekagon Rivers or shells of threatened or endangered species).

### **Threatened or Endangered Mussel Species**

It is illegal to remove threatened or endangered clams from any Wisconsin water.

See Section 29.604, Wisconsin Statutes and Chapter NR 27, Wisconsin Administrative Code for requirements pertaining to threatened and endangered species.



**THREATENED OR ENDANGERED MUSSELS** (eff. 2014)

The Wisconsin Department of Natural Resources (DNR) Bureau of Natural Heritage Conservation maintains a list of state and federally listed mussel species that are legally protected as either threatened or endangered. There are penalties for taking, possessing, transporting or selling threatened or endangered species. The DNR also maintains a list of species of Special Concern. These species are of concern due to a change in abundance or distribution. The purpose of that category is to focus attention on these species before they become threatened or endangered.

**State Endangered      State Threatened**

Higgins' Eye Mussel**	Rock Pocketbook
Yellow Sandshell	Buckhorn (Pistolgrip)
Slough Sandshell	Wartyback
Spectaclecase**	Monkeyface
Purple Wartyback	Slippershell
Butterfly	Ellipse
Elephant Ear	Salamander mussel
Snuffbox**	
Ebony Shell	
Bullhead**	
Rainbow Shell	
Winged Mapleleaf**	

\*\* Also listed as Federal Endangered

**State Special Concern**

The list of Special Concern Species is not provided on this page due to its dynamic nature. The most current list may be found as part of the Working List on the DNR Bureau of Natural Heritage Conservation website. Species on the Special Concern list may vary over time as more information about a species is collected and may require listing, or may be removed from the Working List if it is found to be more abundant.



# WISCONSIN MUSSEL MONITORING PROGRAM

## NATIVE MUSSELS OF WISCONSIN (rev. 2014)

### Scientific name

*Actinonaias ligamentina*  
*Alasmidonta marginata*  
*Alasmidonta viridis*  
*Amblema plicata*  
*Anodonta suborbiculata*  
*Anodontoides ferussacianus*  
*Arcidens confragosus*  
*Cumberlandia monodonta*  
*Cyclonaias tuberculata*  
*Ellipsaria lineolata*  
*Elliptio complanata*  
*Elliptio crassidens*  
*Elliptio dilatata*  
*Epioblasma triquetra*  
*Fusconaia ebena*  
*Fusconaia flava*  
*Lampsilis cardium*  
*Lampsilis higginsii*  
*Lampsilis siliquoidea*  
*Lampsilis teres (anodontoides)*  
*Lampsilis teres (teres)*  
*Lasmigona complanata*  
*Lasmigona compressa*  
*Lasmigona costata*  
*Leptodea fragilis*  
*Ligumia recta*  
*Megalonaias nervosa*  
*Obliquaria reflexa*  
*Obovaria olivaria*  
*Plethobasus cyphus*  
*Potamilus alatus*  
*Potamilus capax*  
*Potamilus ohioensis*  
*Pyganodon cataracta*  
*Pyganodon grandis*  
*Quadrula metanevra*  
*Quadrula nodulata*  
*Quadrula pustulosa*  
*Quadrula quadrula*  
*Simpsonaias ambigua*  
*Strophitus undulatus*  
*Toxolasma parvus*  
*Tritogonia verrucosa*  
*Truncilla donaciformis*  
*Truncilla truncata*  
*Utterbackia imbecilis*  
*Venustaconcha ellipsiformis*  
*Villosa iris*

### Common name

Mucket  
 Elktoe  
 Slippershell  
 Threeridge  
 Flat Floater  
 Cylindrical Papershell  
 Rock Pocketbook  
 Spectaclecase  
 Purple Wartyback  
 Butterfly  
 Eastern Elliptio  
 Elephant-Ear  
 Spike  
 Snuffbox  
 Ebonyshell  
 Wabash Pigtoe  
 Plain Pocketbook  
 Higgins Eye  
 Fatmucket  
 Yellow Sandshell  
 Slough Sandshell  
 White Heelsplitter  
 Creek Heelsplitter  
 Flutedshell  
 Fragile Papershell  
 Black Sandshell  
 Washboard  
 Threehorn Wartyback  
 Hickorynut  
 Sheepnose (Bullhead)  
 Pink Heelsplitter  
 Fat Pocketbook  
 Pink Papershell  
 Lake Floater  
 Giant Floater  
 Monkeyface  
 Wartyback  
 Pimpleback  
 Mapleleaf  
 Salamander Mussel  
 Strange Floater  
 Lilliput  
 Pistolgrip (Buckhorn)  
 Fawnsfoot  
 Deertoe  
 Paper Pondshell  
 Ellipse  
 Rainbow



## RIVER/STREAM SAFETY CONSIDERATIONS

There are many hazards that may be encountered while surveying for mussels in wadable streams and/or rivers, please take the time to properly evaluate the site status for safety concerns. As always please respect property owners by leaving the site as you found it. Never take chances that could put you at risk of injury when surveying for freshwater mussels.

### On shore:

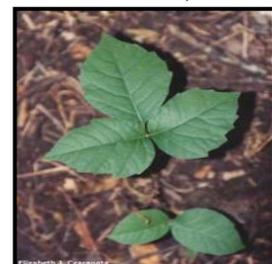
As you approach your survey site please be mindful of dermally toxic plants that can cause burns, allergic reactions, and blistering. Five common poisonous plants that should not be touched: Cow parsnip (*Heracleum lanatum*), Wild parsnip (*Pastinaca sativa*), Poison ivy (*Toxicodendron rydbergii*), Stinging nettle (*Urtica dioica*), and Wood nettle (*Laportea canadensis*).

- **Wild parsnip** (*Pastinaca sativa*): This plant is widespread along road sides, among prairies and in disturbed landscapes, mostly in sunny areas. Wild parsnip is an invasive species. The plant's stem is smooth and deeply ridged, and it has a distinct yellow, flat flower head that blooms from mid-June to July. Its sap contains psoralen, which causes severe rashes, blisters and discoloration on the skin, especially when the affected area is exposed to sunlight.



- **Poison ivy** (*Toxicodendron rydbergii*): A well-known native plant, it has distinct compound leaves with three leaflets, with the middle segment slightly larger in size. Poison ivy is commonly found in pastures and damp forests, and along roadsides and fences. Its sap contains a resinous oil called urushiol that causes inflammation, itching, rash and blisters on the skin.

✓ Photos: Wisconsin DNR



## WISCONSIN MUSSEL MONITORING PROGRAM

### *While in the water:*

Water levels may rise suddenly, especially during and/or after a rain event or if a water release occurs at a dam impoundment upstream.

Rivers/streams may often have strong currents that can create loose footing and large drop-offs.

Sharp objects such as rocks, downed wood, and man-made materials such as glass or metal may be encountered. Additionally, as zebra mussels become more abundant in our lakes and rivers, they may also affect survey areas within their sharp edges of the shells. It is recommended that surveyors protect their feet with a pair of shoes for water use (wading shoes, neoprene dive boots, or other footwear). Gloves are also recommended particularly when you are attempting to retrieve objects from the water.

- **Zebra Mussel** (*Dreissena polymorpha*): An invasive species that have inhabited Wisconsin waters and are displacing native species, disrupting ecosystems, and affecting citizens' livelihoods and quality of life. They hamper boating, swimming, fishing, hunting, hiking, and other recreation, and take an economic toll on commercial, agricultural, forestry, and aquacultural resources. Their sharp razorblade-like shell is known to cut swimmer's skin. Therefore, volunteers of the Wisconsin Mussel Monitoring Program are required to wear protective shoes and gloves at sites with known zebra mussel presence.



## VOLUNTEER MONITORING STRATEGY

### GENERAL VOLUNTEER COLLECTION METHODS

#### **How to sign up for a survey:**

Identify a location on interest (stream, county, or region) and contact the Program Coordinator to set up your assignment. It is recommended you take a mussel monitoring training before any fieldwork takes place. However, trainings are not always suitable with schedules or located within reasonable driving distances. Therefore, concessions are provided to those who'd still like to participate in the WMMP. Also, if you don't feel comfortable conducting a survey by yourself work with the Program Coordinator to find others in your area willing to team up. Having more people participate in a survey can be more enjoyable and can improve the likelihood that mussels are located.

#### **What to bring:**

Certain equipment will be necessary to conduct a successful mussel survey. Things you will need to bring on each survey:

1. Mussel monitoring reporting forms. You may also report observations on the program's iNaturalist project.
2. Clipboard and pencils
3. Camera (or smartphone)
4. GPS unit (or smartphone)
5. Bathyscope (or mask & snorkel)
6. Freshwater mussel field guides to help identify species
7. Waders (or clothes you don't mind getting wet)
8. Water, sunscreen, hat, towel, extra set of clothes, cell phone

#### **Other things to consider:**

Preparatory research: In some cases, finding mussels will not be easy. Often, mussels will be buried into the substrate, individuals will appear cryptic, or populations are small and easily overlooked. It's important, then, to do a little research prior to your survey. It may be necessary to see what species have been recorded near the target area and learn about the life histories of the possible species that may occur at your site. Some mussel species prefer fast moving waters with a coarse substrate, while some can be found in silty, slow moving pool habitats. Some species spend much of their lives at the substrate surface, filtering large amounts of water, while others may be completely buried and only observed if excavated. If you don't find any live or dead mussels during your survey, that's ok! This kind of information is just as important as finding populations. The important thing is that you are confident that you didn't find mussels because they are not there, not because you were underprepared, or overlooked individuals.

## WISCONSIN MUSSEL MONITORING PROGRAM

Handling mussels: Although mussels can tolerate a wide variety of short-term environmental conditions, they can be stressed by physical handling. Handling errors, such as roughly removing animals from the substrate, leaving animals out of water during hot and sunny days, or in warm and stagnant water, are minimized by the use of prepared volunteers. During identification, keep attained mussels cool and moist minimizing the amount of time spent out of the water. Once photographed or identified, return mussels to the same area where found. Place individual mussels on its side along the river bottom. Mussels can extend their foot well beyond the margins of the valves, so even if the mussel is accidentally placed upside-down, the individual will most likely reposition itself to a suitable position on the river bottom.

Disinfection: Cleaning should be performed every time equipment is moved between waters to avoid transporting invasive species and/or pathogens. Disinfect your equipment and gear by applying one of the following:

- Store dry for 5 consecutive days after cleaning with soap and water and/or high-pressure water;
- Washing with  $\sim 212^{\circ}$  F water (steam) or  $\geq 140^{\circ}$  F water;
- Applying a 500 ppm Chlorine (sodium hypochlorite) solution for 10-minute contact time (household bleach is generally 5.25% sodium hypochlorite) so mix 1.22oz or 2.44 tablespoons per gallon water.

Safety: Use common sense and judgment for your own personal safety. If you are going into the field alone tell someone at home of your plans before you leave. Remind those you are with to keep safety in mind and report potential unsafe conditions or practices to avoid accidents and injuries. If possible, bring a cell phone with you and have the number of the local county sheriff's department on hand. These can be found on each county's website.



# WISCONSIN MUSSEL MONITORING PROGRAM

## DATA COLLECTION GUIDELINES

Please use the most current monitoring forms (see page 23). You can also use iNaturalist (inaturalist.org) to record and submit data. See page 26 for more details. Also, please respond to every question. Write 'unknown' or use provided fields for NA or 'Don't know' if not known.

## GENERAL PROCEDURES

Our mussel sampling guidelines were designed for permanent wadable (most areas < 1.2 m deep) streams. Mussel sampling in wadable streams should optimally be conducted during mid to late summer (mid June - late September) when stream levels are near base flows and water temperatures are near maximums. Sampling during this time period when mussels are active will allow mussels disturbed during sampling to re-establish themselves in the substrate. Sampling outside of this optimum period may be necessary, but water temperature should be at least 40oF, to minimize thermal stress to mussels. In addition, summer sampling during peak water temps is more comfortable for collectors snorkeling or diving, allowing for longer sampling periods.

## DATA SHEET FIELDS

Date: (mm/dd/yyyy) Fill in the date when the mussel data were collected for the station.

Collectors: Person or persons collecting mussel data, list primary investigator first.

E-mail: Electronic address to be used for online communications.

Waterbody: The name of the stream as shown on the most recent USGS 7.5' topographic map. Make sure the spelling of the name is accurate and includes all parts of the stream name (e.g., "West Branch", "Middle Fork", "River", "Creek", etc.) to avoid confusion. Other commonly used names for the stream can be written here in parentheses.

Monitoring Site: Provided name of survey site on waterbody. Commonly named to nearest road or access point to starting location.

County: The name of the county in which the monitoring site is located.

State: The name of the state in which the monitoring site is located (Wisconsin).

Latitude & Longitude: GPS Latitude and Longitude of station downstream end starting location.

If using hand held GPS units use decimal degrees (e.g. N045.79330; W091.96815). It is important that geographic coordinates of the start of the station are recorded. If using iNaturalist to upload data, Latitude & Longitude are automatically uploaded when Location Services is turned "On" in your smartphone settings. If you do not have a GPS or smartphone device at the monitoring site, you can estimate the Latitude & Longitude using Google Maps.

Did you enter into iNaturalist? (Yes or No). If you checked yes, and entered all collected survey data into iNaturalist instead of using the paper datasheet, you do not need to fill out and send the paper copy.

Are juveniles mussel present? (Yes or No). A mussel less than 4 years old is considered a juvenile. Count the number of growth rings (annuli) on the shell properly age an individual. If you are not sure, take a photo, note the observation on the data sheet (or iNaturalist) and send to Program Coordinator.

Search Method: (Bathyscope, Mask & Snorkel, Hand or Visual, or Other). Did you use a viewing aid or did you look for mussels using visual or tactical searches?

Collection Method: (Casual Observation or Timed Survey). Casual observation does not follow a specific survey strategy. Timed surveys follow specified survey protocols, requiring a minimum of a two-hours search per site (page 21).

# WISCONSIN MUSSEL MONITORING PROGRAM

Average Water Depth: Record average depth within the entire search area, preferably in centimeters (1 in = 2.54 cm).

Water Depth Range: Record the minimum and maximize water depths you've experienced during searches, preferably in centimeters (1 in = 2.54 cm)

Substrate % Cover: Record the amount of substrate type present within the monitoring site.

Substrate is recorded as a percentage (nearest 5%). Substrate types should be recorded as follows:

- Detritus: Partially decayed organic matter such as leaves, sticks, dead macrophytes, etc.
- Clay: Very fine inorganic material; individual particles barely or not visible to the naked eye. Either dark brown or gray color. Feels gummy and sticky, slippery when underfoot.
- Silt: Fine inorganic material, typically dark brown in color. Feels greasy and muddy in hands. Loose; does not retain shape when compacted into a ball.
- Sand: Inorganic material smaller than fine gravel but coarser than silt. The material found on a beach. Maximum length of 0.062 mm - 1.9 mm.
- Gravel: Rocks with a maximum length of 2 mm - 6.4 cm (0.08 in - 2.5 in).
- Cobble: Rocks with a maximum length of 6.5 cm - 26 cm (2.51 in - 10 in).
- Boulder: Rocks with a maximum length of 26.1 cm - 4 m.
- Bedrock: Solid, uniform rock bottom.
- Vegetation: Visually estimate the % cover of emergent and submergent plants

## CASUAL OBSERVATION

A casual observation search is conducted to determine the presence of a mussel at a particular location. Initial searches have no survey strategy. Instead, we ask volunteers to document any living or dead mussels at any location. Searchers may walk along shorelines looking for shells or stranded live mussels, or look in shallow waters use waders, visual, or snorkeling strategy. Streambanks may also be examined to look for dead shells or midden piles, species not found alive, may be represented by dead shells.

## TIMED SURVEY

Qualitative (timed) searches are conducted to establish species lists, abundance, and richness estimates for mussels present at a site. The probability of detecting a mussel species during a timed search varies greatly depending upon mussel species, field conditions, collector experience, and length of time spent searching. Therefore, the WDNR requires an increased survey effort with increasing stream size. Qualitative searches are given for a given amount of sampling effort (person-hours). Search times are 1 hour for 2 searchers (2 person/hrs) for stream areas less than 15 meters in width and 2 hours for 2 searchers (4 person/hrs) on stream areas 15 meters in width or greater. The increase in sampling effort with stream size corresponds to the likelihood of more diverse mussel communities in larger rivers.

Areas of mixed loose gravel should be fanned occasionally to detect mussels hidden between the substrate. Record start time on Timed Search data sheet and begin looking for mussels. Mussels not identified should be clearly photographed or a voucher specimen collected for positive identification by a malacologist familiar with regional fauna.

# WISCONSIN MUSSEL MONITORING PROGRAM

## TIMED SURVEY PROTOCOL

Timed surveys are a useful way to gauge the current health of a mussel population at a site. Data collected here will be used to estimate species richness, abundances, and provide data for long-term monitoring to determine population change through time. The following procedures should be followed for timed mussel sampling:

- 1) Establish site start location. A suggested site will be provided by the Program Coordinator. Upon arrival to the field site, choose a starting location representative of the stream habitat and mark the location (Latitude & Longitude using GPS, smartphone, or mark on a map).
- 2) Estimate the stream width to determine how much time is necessary for a complete sample.
  - a. Search times are 1 hour for 2 searches (2 person/hrs) for streams less than 15 meters stream width and 2 hours for 2 searchers (4 person/hrs) on streams 15 meters and greater stream width.
  - b. If surveyors would like to complete a 2-hour timed search along a section of a large stream (example: Chippewa River or Rock River), contain your search to a width of 15 meters from the shoreline. Surveyors should provide an estimated area of the surveyed site.
- 3) Once in position, start the clock for the first 15-minute search.
  - a. Ideally, two persons each equipped with a bathyscope or mask-and-snorkel will search from downstream to upstream by walking back and forth across the survey area, beginning at the marked starting point.
- 4) Stop all searches when clock reaches 15 minutes.
- 5) At the end of each 15-minute search, count and record all live and dead mussels found, noting any mussels less than 4 years old.
  - a. Mussels can be aged by counting the lines on its shell, just like you can count tree rings on a tree.
- 6) Separate mussels by species, line-up, and take one group photo at the end of each 15-minute search to post onto iNaturalist or e-mail to the Program Coordinator.
  - o Photograph individual species if uncertain about the identification. Photograph the entire mussel (see page 25).
  - o Dead shells can be kept or sent-in for identification.
- 7) The survey is completed when the time limit has been reached (2 or 4 hours)
- 8) Record general habitat information for the surveyed site on the survey data sheet. Estimate and record length and width of river searched in meters. Estimate substrate (silt, sand, gravel, cobble, boulder, bedrock) by percentages (such as 10% sand, 40% gravel, 50% cobble), estimate amount of vegetation in the stream by percentage, and water depths. Note any unique habitat conditions (downed trees, islands, riffles) at the site and briefly sketch a map of the survey area. Datasheets are provided in the training manual (page 23) on the program website.

# WISCONSIN MUSSEL MONITORING PROGRAM

## Sampling Locations

1. Shallow-water areas
2. Exposed sand and gravel bars
3. River and lake bottoms during low-water periods (droughts, drawdowns, etc.) too deep to wade otherwise
4. Islands and streambanks for middens

## Sampling Methods – wading

1. Casual collection of specimens (no measure of time, area, or effort)
2. Timed Surveys (number per person-hour – e.g. 2 people searching for one hour = 2 person-hours)

Without proper authorization from Wisconsin DNR, volunteers should never use scuba or hookah diving, snorkeling, or other sampling gear like brails to obtain Wisconsin Mussel data. In special cases, these methods may be permissible, but only after review of the personnel involved and sites to be sampled.

## Data Collected

1. Species (if you have received the appropriate training to identify Wisconsin mussels)
2. Number (or number/time, number/area, number/effort)
3. Specimen condition (living, recently dead, etc., see other descriptions herein)
4. Invasive bivalve data (Asian clam presence, Zebra or Quagga mussel presence)
5. Other data (data sheets have a space for site-specific data as available). For example, data sheets have a space for water temperature. This is often useful data to have. If it is known, record it, but do not pass up an opportunity to collect data on mussels present because a thermometer was not available.

## Specimens Retained or Shipped to the Wisconsin Mussel Monitoring Program

Specimens being mailed to the Wisconsin Mussel Monitoring Program should be rinsed or washed free of soft tissues or other organic material and mud that may produce objectionable odors. Specimens should be sealed in plastic bags that are waterproof (note: most sandwich bags are not watertight, but ziplocks work well). Mussels from each site should be kept separate and the data sheet should be placed in another plastic bag inside the specimen bag. Following these directions will ensure that the data will not get damp or damaged due to water and that it will remain with the bagged specimens.

E-mail completed data sheet to: Jesse Weinzinger, Wisconsin DNR - NHC, [Jesse.Weinzinger@wisconsin.gov](mailto:Jesse.Weinzinger@wisconsin.gov)

### Conversion chart

Standard Units	Metric Units
1 inch	2.54 centimeters
1 foot	30.5 centimeters or 0.30 meter
1 yard	0.91 meter





# GUIDE TO PHOTOGRAPHING FRESHWATER MUSSELS



Fig. 1. Lateral exterior view.



Fig. 2. Dorsal view.

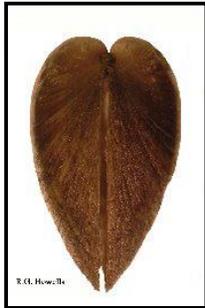


Fig. 3. Anterior view.

Freshwater mussels (clams) have been recognized as important, but rapidly declining, elements of aquatic ecosystems. Therefore, state legal protections in Wisconsin have further focused attention on this group. However, they can be notoriously difficult to identify. Fortunately, modern digital photography and electronic transfer of images can quickly and efficiently assist with identifications. Still, images must be shot in ways to help rather than hinder easy recognition of specimens in questions.

Lateral external (side) views may be the most common angle for species identification (Fig. 1). These can be used with living specimens of rare species. This view should show the shape of the shell, beak elevation, coloration, and external sculpture. In order to have a complete view of the side profile, it is important to have the hinge line facing up. Dorsal views (top) of a living specimen are important to indicate shell inflation and characteristics of beak sculpture (Fig 2). Anterior views (Fig. 3) may also show inflation as well as beak elevation and possible gaps between valves. If photographing dead specimens, interior views of each valve are necessary to show the hinge teeth, interdentum, muscle scars, pallial line, and nacre color, as well as beak elevation (Figs. 4 & 5). Specimen size can be stated or shown by inclusion of a ruler or background grid.

Except in a few special cases, proper identification should include two photographs; one side view and one top view. Additional photographs of anterior or interior views may provide more detail on certain identification characteristics, but these are not required. Laying a specimen on a flat surface, or positioned flat in-hand, and shooting directly down on it is often best. Photographs displaying a mussel from an acute angle can obscure shell shape, form, and other detail that may limit identification accuracy (Figs 6-8). Dark exteriors and stark white interiors often cause digital cameras to select intermediate exposures that produce low-quality images of both views. Modern digital cameras or smartphones can often give excellent results with available light or simple desk lights; expensive flash systems are rarely needed. Photo quality of 300 dpi may be needed in publications, but 75-150 dpi is often sufficient for identification. Photo size of 5-10 inches (longest axis) is often acceptable; there is no reason to send email photo attachments of 3-5 feet wide!

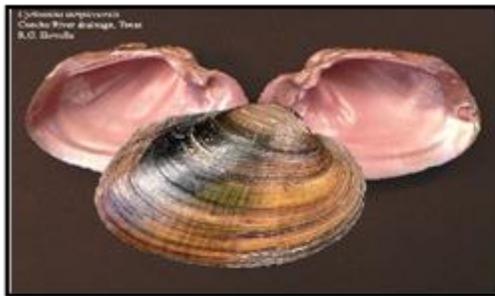


Fig. 4. Final photo style used by BioStudies is a composite of both interior valve views with an exterior valve overlaid, as well as anterior or dorsal views, or both.



Fig. 5. The Freshwater Mollusk Conservation Society has recommended images with one view of each valve.



# WISCONSIN MUSSEL MONITORING PROGRAM

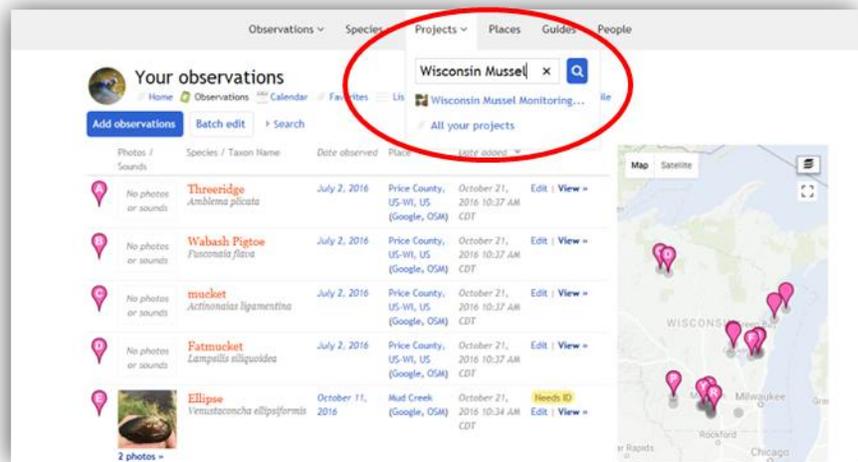
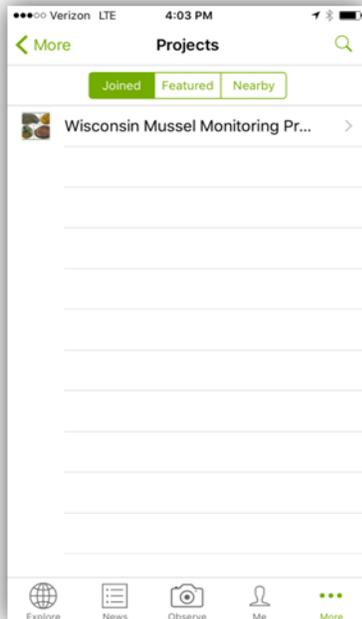
## USING iNATURALIST TO SUBMIT OBSERVATIONS TO THE WISCONSIN MUSSEL MONITORING PROGRAM

### 1. Set up an account on iNaturalist

It's free! Sign up [here](#).

### 2. Join the Wisconsin Mussel Monitoring Program

Once you have an account, and navigate to the project page, you can then start submitting observations using your PC or smartphone.



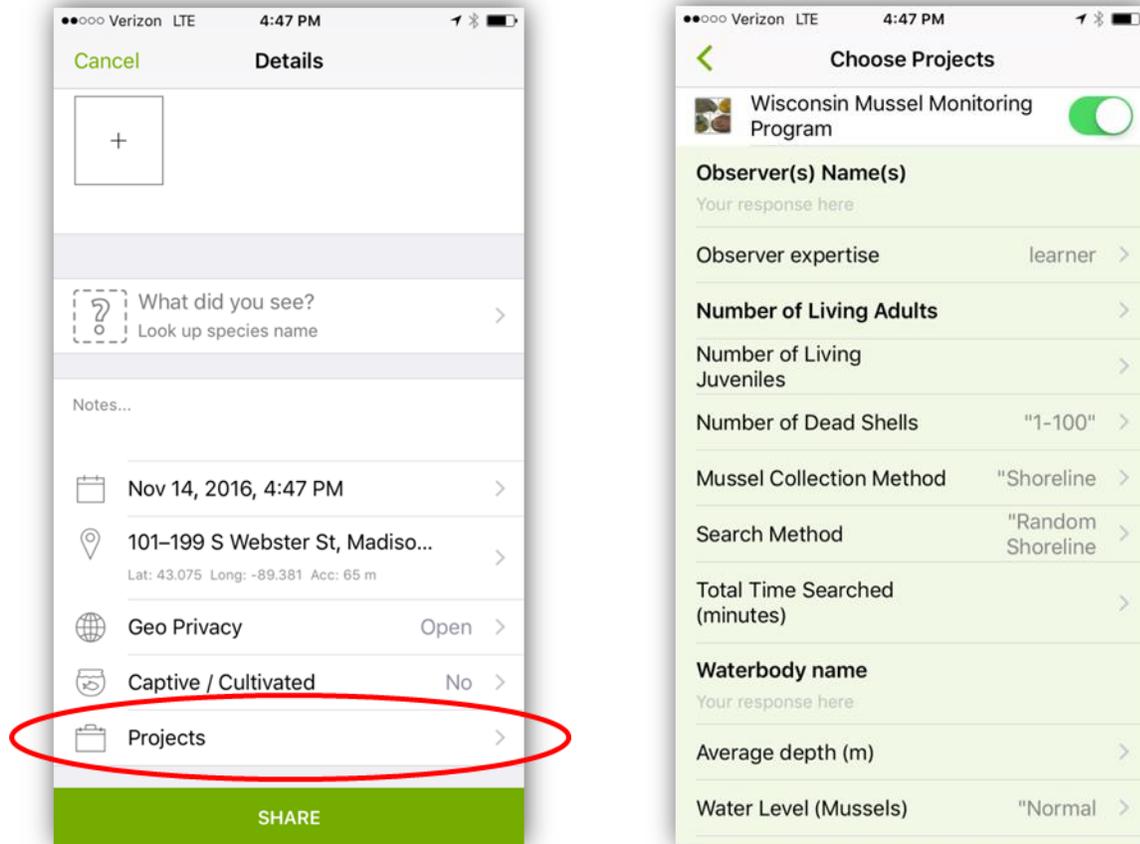
**Left:** Wisconsin Mussel Monitoring Program display on the iNaturalist project search screen using an iPhone.

**Right:** Project search bar on iNaturalist's website.

### 3. Add your observation to the Wisconsin Mussel Monitoring Program

**Using the mobile app:** Making an observation on iNaturalist is simple, the how-to is explained in [this tutorial](#). When you make an observation, there will be an opportunity to add it to a project. Click the Wisconsin Mussel Monitoring Program (WMMP) project, and you will be prompted to fill out additional fields. These fields correspond to the data collection sheet (e.g., number of living adults, number of dead shells, mussel collection method, etc.). Note: Some of these fields are mandatory. Your observation will not be added to the project if you do not fill out all the necessary fields, add a photo, or GPS coordinates

# WISCONSIN MUSSEL MONITORING PROGRAM

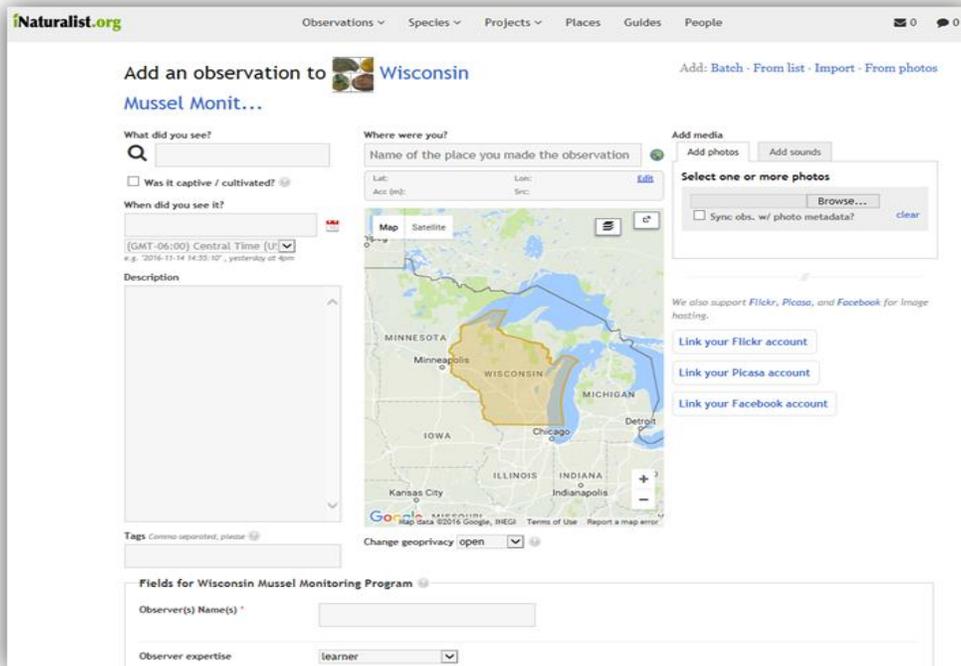
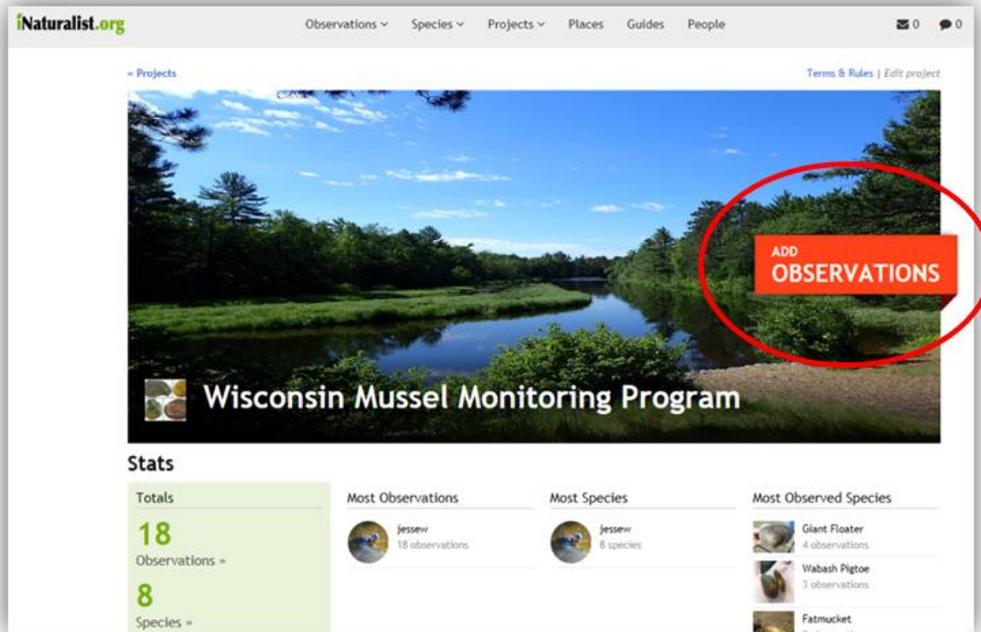


**Left:** The main page for submitting any observation to iNaturalist using an iPhone. You can touch “Projects” to add an observation to the WMMP.

**Right:** The data collection form for iNaturalist on the iPhone. When you are finished filling out the data collection form you can go back to the main page, obscure the location, and touch “Share”.

**Using the website on a PC:** If you want to submit your observations using your PC when you get back from the field that’s fine too. Sign in to iNaturalist and navigate to the WMMP project page. On the banner across the top of the page there is an option to “Add Observations.” Click and you will be brought to the project’s data submission form, which includes the data fields, a map and an option to upload a photo. Again, many of these fields are mandatory. If you don’t fill out certain data fields, upload a photo or put a point on a map, your observation will not be submitted.

# WISCONSIN MUSSEL MONITORING PROGRAM

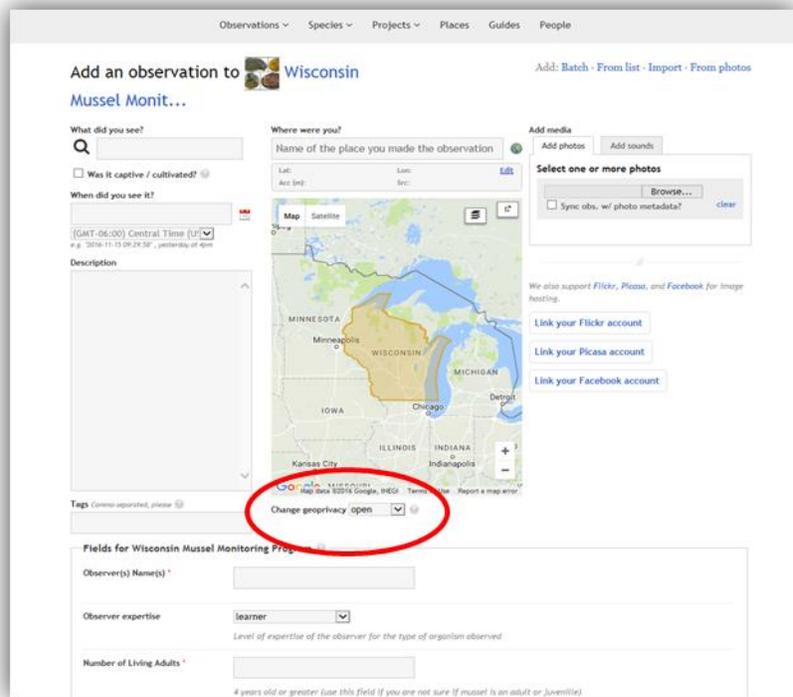


**Upper:** The Wisconsin Mussel Monitoring Program main page on iNaturalist for PC. Click the “Add Observations” in the banner to submit data. You can also see who is involved in the program, how many observations have been submitted, and where observations were made.

**Lower:** The data submission form on the iNaturalist website.

# WISCONSIN MUSSEL MONITORING PROGRAM

Obscuring the location of your observation (**VERY IMPORTANT!!!**): When you are marking the location of your observation (whether on the mobile app or PC) you will be given the opportunity to obscure the location. This is also called setting the “geoprivacy.” Obscuring the location of your observation means that you and the program coordinator can see the exact location, but everyone else will only be able to see to within 10km of its true location. Since the Wisconsin Mussel Monitoring Program is a public project, any observations you add to it can be viewed by the public, even if they do not have an account on iNaturalist. Therefore, it is recommended you obscure any observations you submit to the WMMP project so people outside the program cannot see their exact locations.



**Left:** Geoprivacy location on the iNaturalist mobile app. Please change the geoprivacy from "open" to "obscure" when recording a state listed mussel species.

**Right:** Geoprivacy location on the iNaturalist website for PC.

## FREQUENTLY ASKED QUESTIONS

You can find more help with using iNaturalist on their [help page](#).

1. Do I have to submit data via iNaturalist or can I continue using the old data collection techniques?
  - You can use either. The iNaturalist project was set up to give volunteers another option for data submission and as a way for program participants to see what each other are doing. However, if you don't have a smartphone or computer or would just prefer to submit data the old-fashioned way, that's ok too.

## WISCONSIN MUSSEL MONITORING PROGRAM

2. Do I need to obscure the location of all my observations whether they are of rare species or not?
  - You only need to obscure the location of rare species observations submitted to the Wisconsin Mussel Monitoring Program Project. So, if you observe a common plant or turtle or bird and want to add it to iNaturalist, you do not need to obscure the location.
3. What if I don't have a cell signal when I'm in the field?
  - You can still collect the data on your smartphone even if you don't have a cell signal. The data will be stored on your phone until you get somewhere with better service and the observation will be automatically uploaded then. You can log into the iNaturalist app when you get better cell service to confirm that the observation was uploaded.
4. I submitted data but I don't see it on the Wisconsin Mussel Monitoring Program page?
  - There are a couple things that may cause your observations to not get added to the project. First, make sure that you filled out all the mandatory data fields (these should have asterisks next to them), uploaded a photo and put a point on a map, marking the location of the observation. If you haven't met these requirements, your observation will not get added to the project. Also, there is sometimes a lag between when the observation is uploaded and when it shows up on the project main page. If it still doesn't show up on the main project page, there may be something wrong with the data itself.
5. The data collection fields on the mobile app are out of order and I can't read the entire heading for certain fields. What's going on?
  - If you are using the iNaturalist app for an Android phone, you may run into some problems with the data collection fields. The fields may appear out of order and some of the headings may run off the screen. You should still be able to see enough information to understand what data to enter into each field, but it may be worthwhile, if you have an Android phone, to look at the data collection form before you go into the field or carry a hard copy of one with you so you know what the field. You can also log into the project on the iNaturalist website to see the entire field headings. Rest assured, your observation will still be successfully submitted to the Wisconsin Mussel Monitoring Program project from an Android phone.
6. Can I edit my observation after it is submitted?
  - Yes. If you go to your observations page on the iNaturalist website or app, you can view an observation and edit any of the data fields, change the photograph or the location.
7. Who do I contact with questions about submitting observations to the Wisconsin Mussel Monitoring Program project?
  - The primary contact for the WMMP is Jesse Weinzinger. You can reach him at [jesse.weinzinger@wisconsin.gov](mailto:jesse.weinzinger@wisconsin.gov) or (608) 397-0198. For general questions relating to iNaturalist, contact [help@inaturalist.org](mailto:help@inaturalist.org)