Mussel Monitoring Program of Wisconsin

Volunteer Training Manual

WISCONSIN DEPT. OF NATURAL RESOURCES

Ecological Inventory and Monitoring

WISCONSIN TRAPPERS ASSOCIATION

Wisconsin's Citizen-Based Water Monitoring Network

Table of Contents

Ver. July 2014

MUSSEL MONITORING PROGRAM OF WISCONSIN

INTRODUCTION

Freshwater mussels (also referred to as clams or unionids) reach their greatest diversity in North America where over 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 and others are failing to reproduce. Primary factors responsible include extensive habitat modification and destruction, commercial exploitation, water contamination, and competition with invasive exotic species. Macalogists (mollusk specialists) estimate that nearly half of these species are presently threatened, endangered, or extinct. Of the 51 mussel species that occur within Wisconsin's lakes, rivers, and streams, 28 mussels are listed as threatened, endangered, special concern or species of greatest conservation need and are species with informational needs.

Despite their importance, very little work has been done to comprehensively inventory and monitor freshwater mussels in Wisconsin. Statewide efforts such as Harold Mathiak's in the 1970's, who surveyed 70 of 72 counties in Wisconsin, have not been replicated but has provided us locations from which to begin our surveys. Other mussel surveys have been conducted on distinct river basins or for specific species or project areas such as for bridges and dams. The goal of the Mussel Monitoring Program of Wisconsin 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 contributing to conservation efforts from across the Midwest.

*This training packet was modified from the original by Texas Parks and Wildlife to fit the needs of the Mussel Monitoring Program of Wisconsin.

FRESHWATER MUSSEL ANATOMY AND IDENTIFICATION

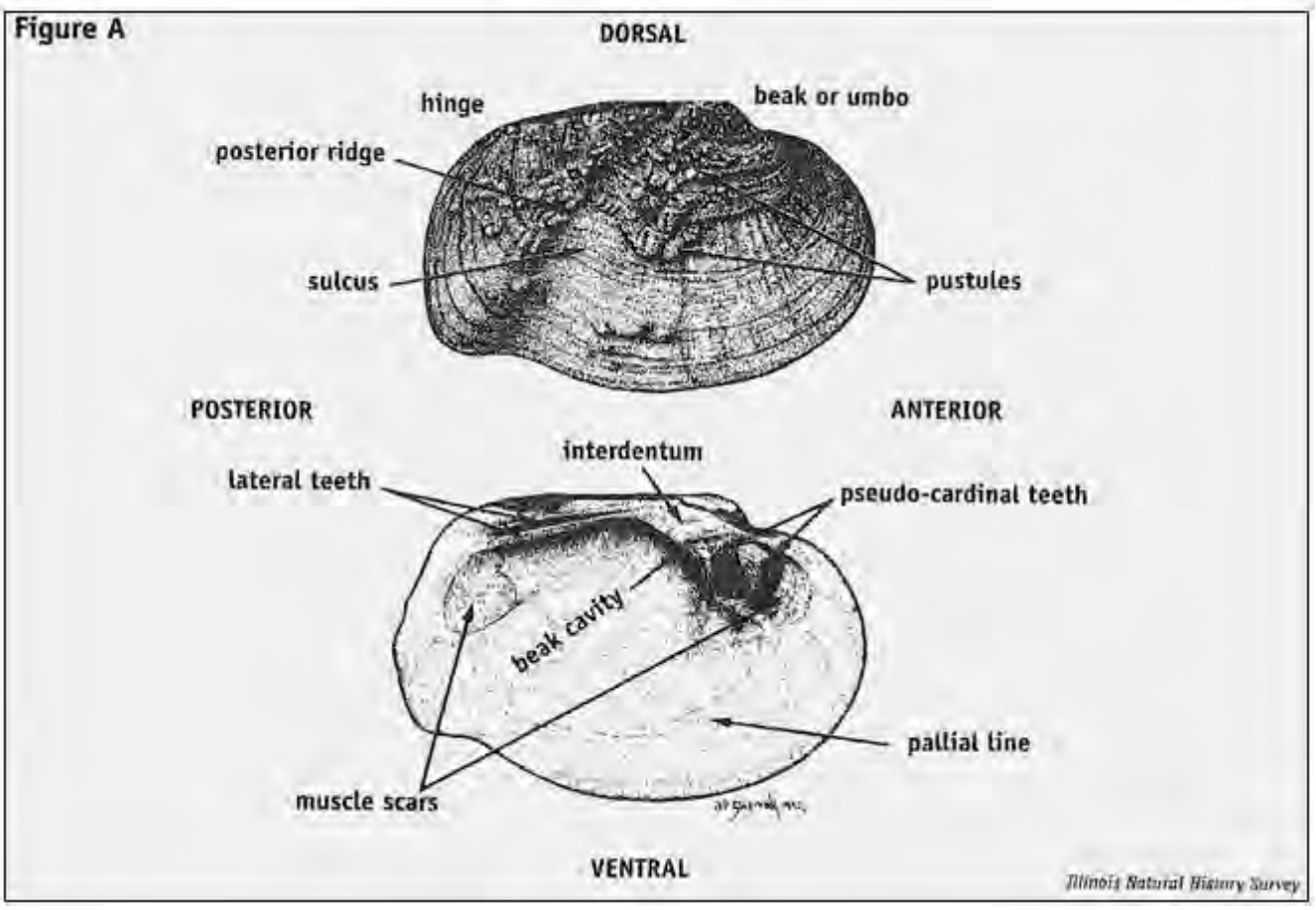
The most conspicuous part of a mussel is its shell, the two symmetrical valves held together with a ligament that creates a protective covering for the soft boneless animal inside. The ligament exerts a constant pressure on the valves and opens them as the adductor muscles relax, e.g. when the mussel 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 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 coloration, shape, and size, both within and between species. No specimen is likely to exactly fit the description or picture.

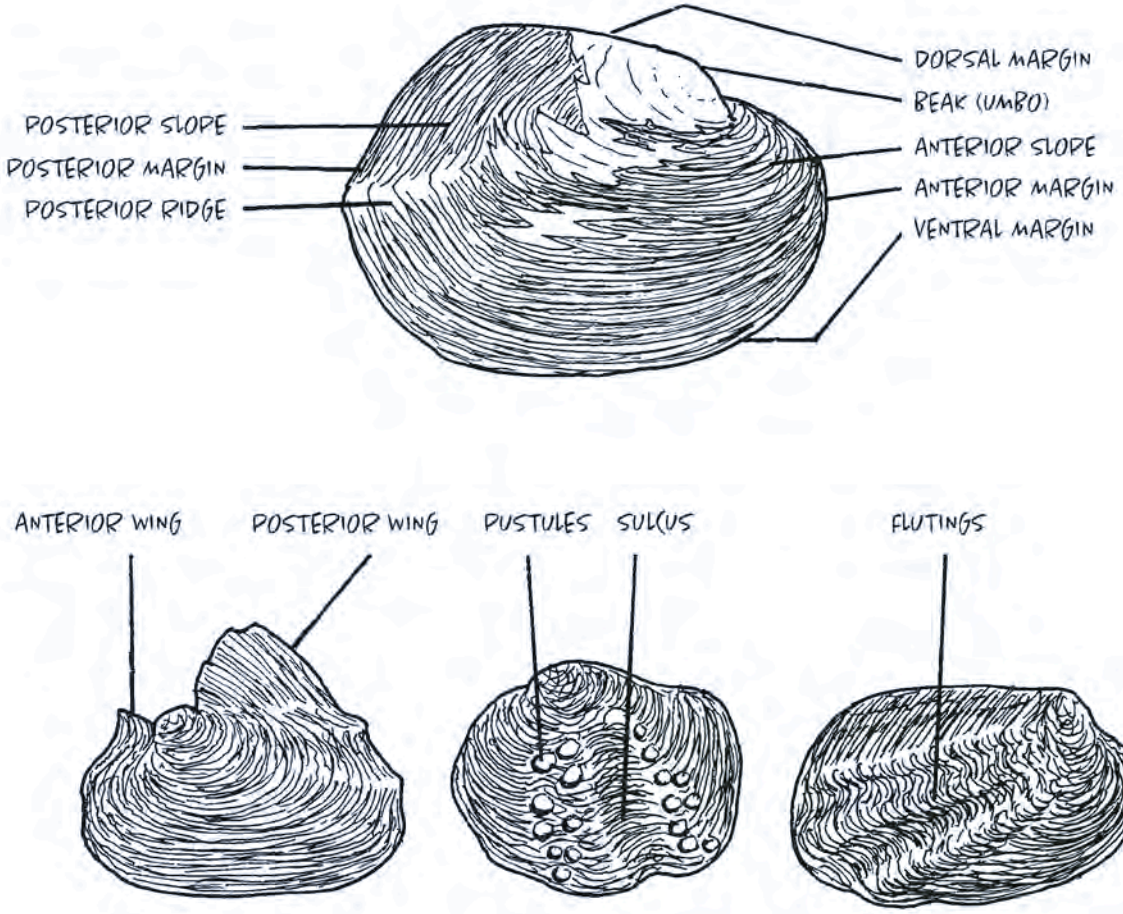
As indicated in Figure A, the dorsal edge or top of the shell has the hinge and the beak or umbo, a raised area on each valve above the hinge. The ventral edge is opposite the hinged side and is where the valves separate. The posterior of the shell protrudes from the stream bottom and is often coated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

On the outside of the shell, various features are used for identification: the epidermis (periostracum) or surface of the shell, 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 beak to the posterior ridge of the shell, and the arrangement of pustules or other features on the surface. Inside the shell, the depth of the beak cavity and color of the nacre or often pearly internal surface 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).

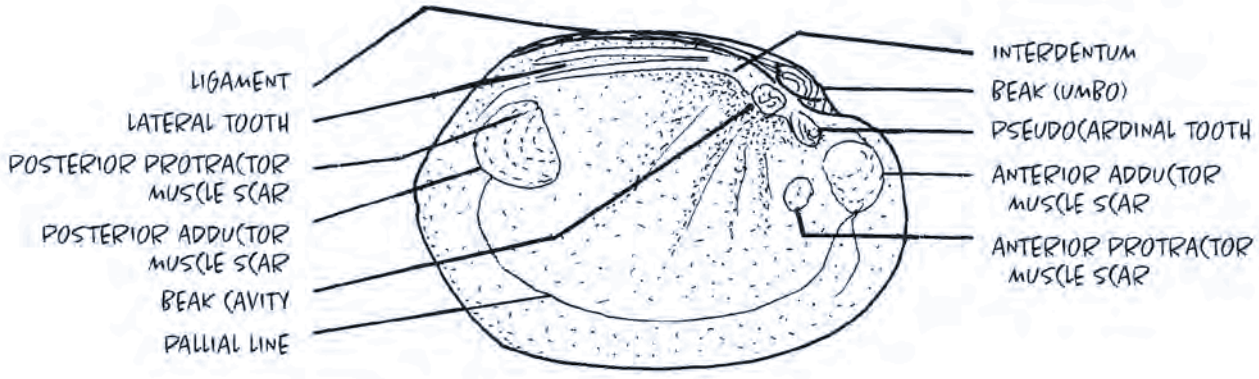
The body of the mussel consists of a thickened, central mass that is attached to the valves near the hinge. The forward or bottom part of the body forms the muscular foot. On each side of the foot lie the thin double gills and outside these is the mantle, the thin sheets of tissue that adhere to the 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.



EXTERNAL SHELL FEATURES

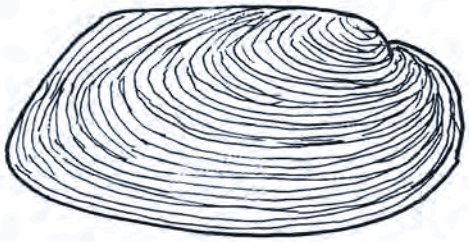


INTERNAL SHELL FEATURES



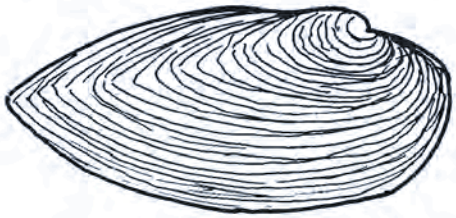
SHELL SHAPE

ROUND

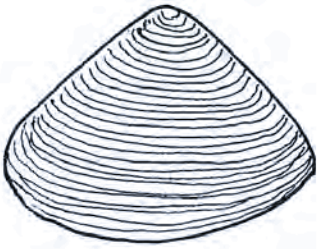


RHOMBOIDAL

OVAL



ELLIPTICAL

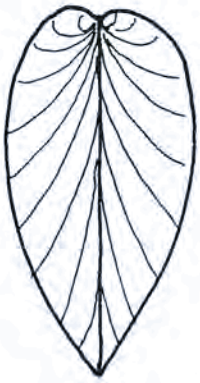


TRIANGULAR

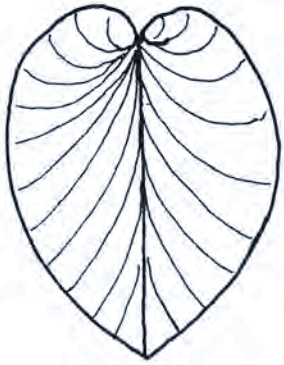
QUADRATE

SHELL WIDTH

COMPRESSED

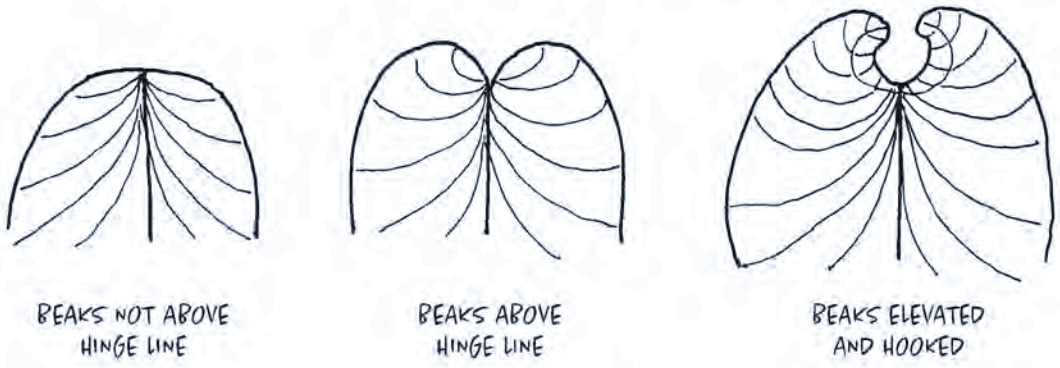


NORMAL

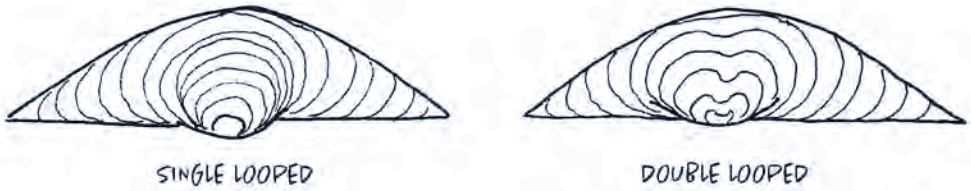


INFLATED

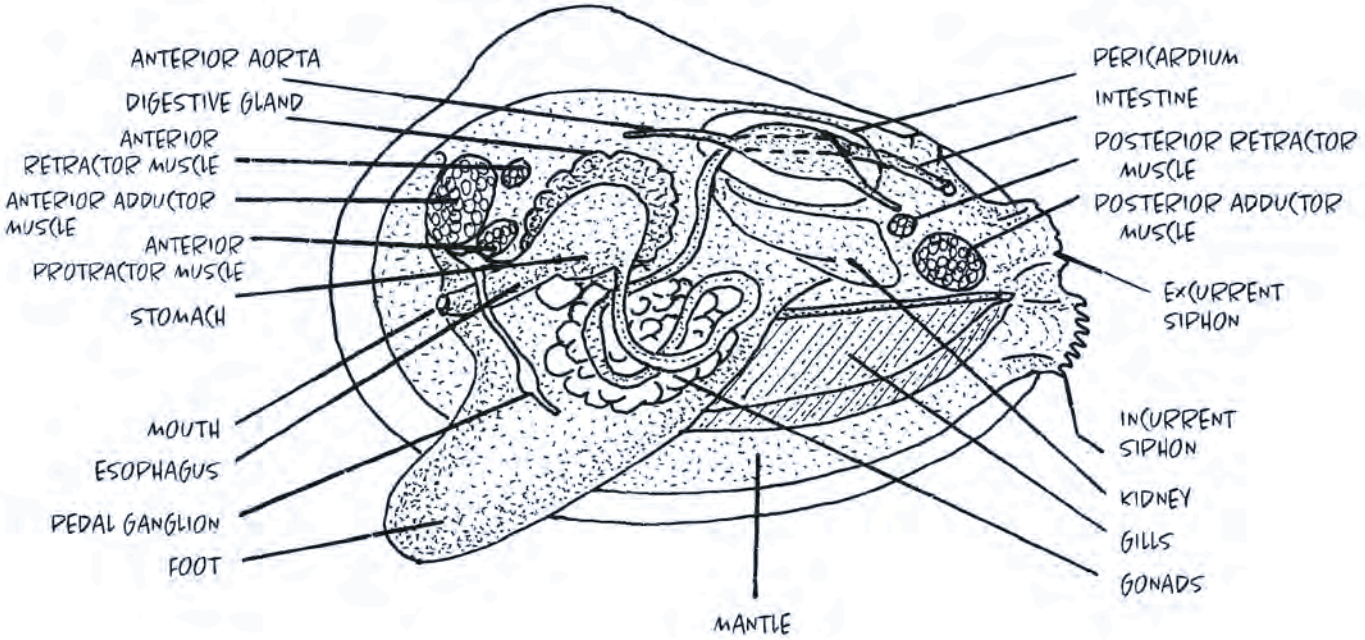
BEAK MORPHOLOGY



BEAK SCULPTURE



INTERNAL SOFT TISSUE ANATOMY



FRESHWATER MUSSEL LIFE CYCLE

Most North American freshwater mussels species are sexually dimorphic (at least 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 can 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. The glochidia resemble adult mussels externally, with two shells only 0.05-0.35 mm in diameter. But internally 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 by other means in response to tricks that various species use to lure a potential host. Wherever they attach needs to be vascularized as they need the fish blood to fully develop. 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

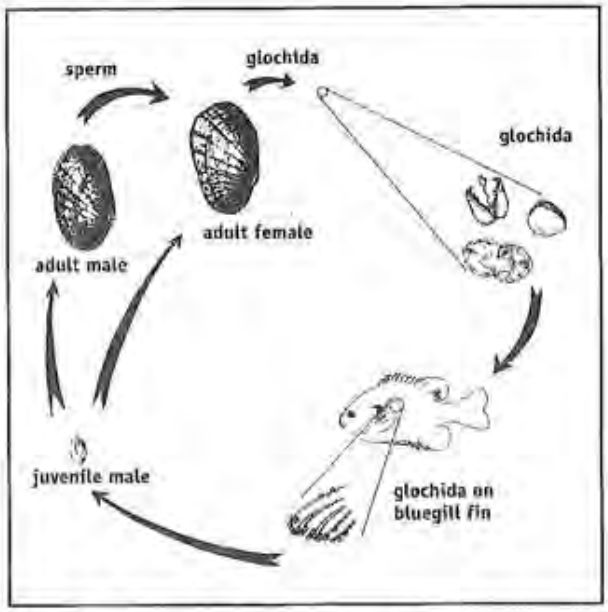


Figure B. Typical life cycle depicting the various stages. The life cycle for most species of naiades is very similar to that depicted here.

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. *Strophitus undulatus* is able to metamorphose while still in the mother's brood pouch, but can also use a fish host. 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 "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 known 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. Although few embryos survive into adulthood, the high losses are compensated for by long life spans. Some of the thin-shelled species may live only five to ten years, the thick shelled species may live twenty or forty years or much longer. Live mussels have been documented as old as 200 years.

FRESHWATER MUSSEL ACTIVTY 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 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 personal 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 quiet 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 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 Co 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 public Wisconsin waters (except shells may not be taken from the Scenic River designated portions of the St. Croix and Namekagon Rivers).

Threatened or Endangered Mussel Species

It is illegal to remove threatened or endangered clams from any Wisconsin water without a permit.

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

Threatened or Endangered Mussel Species in Wisconsin (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

Higgins' Eye Pearly Mussel**
Yellow Sandshell
Slough Sandshell
Spectacle Case**
Purple Wartyback
Butterfly
Elephant Ear
Snuffbox**
Ebony Shell
Bullhead**
Rainbow Shell
Winged Mapleleaf**

** Also listed as Federal Endangered

State Threatened

Rock Pocketbook
Buckhorn (Pistolgrip)
Wartyback
Monkeyface
Slippershell
Ellipse
Salamander mussel

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.

Native Mussels of Wisconsin *(rev. 2014)*

Scientific name	**Common name**
Actinonaias ligamentina	Mucket
Alasmidonta marginata	Elktoe
Alasmidonta viridis	Slippershell
Amblema plicata	Threeridge
Anodonta suborbiculata	Flat Floater
Anodontoides ferussacianus	Cylindrical Papershell
Arcidens confragosus	Rock Pocketbook
Cumberlandia monodonta	Spectaclecase
Cyclonaias tuberculata	Purple Wartyback
Ellipsaria lineolata	Butterfly
Elliptio complanata	Eastern Elliptio
Elliptio crassidens	Elephant-Ear
Elliptio dilatata	Spike
Epioblasmatriquetra	Snuffbox
Fusconaia ebena	Ebonyshell
Fusconaia flava	Wabash Pigtoe
Lampsilis cardium	Plain Pocketbook
Lampsilis higginsi	Higgins Eye
Lampsilis siliquoidea	Fatmucket
Lampsilis teres (anodontoides)	Yellow Sandshell
Lampsilis teres (teres)	Slough Sandshell
Lasmigona complanata	White Heelsplitter
Lasmigona compressa	Creek Heelsplitter
Lasmigona costata	Flutedshell
Leptodea fragilis	Fragile Papershell
Ligumia nasuta	Eastern Pondmussel
Ligumia recta	Black Sandshell
Megalonaias nervosa	Washboard
Obliquaria reflexa	Threehorn Wartyback
Obovaria olivaria	Hickorynut
Plethobasus cyphyus	Sheepnose(Bullhead)
Pleurobema sintoxia	Round Pigtoe
Potamilus alatus	Pink Heelsplitter
Potamilus ohiensis	Pink Papershell
Pyganodon lacustris	Lake Floater
Pyganodon grandis	Giant Floater
Quadrula fragosa	Winged Mapleleaf
Quadrula metanevra	Monkeyface
Quadrula nodulata	Wartyback
Quadrula pustulosa	Pimpleback
Quadrula quadrula	Mapleleaf
Simpsonaias ambigua	Salamander Mussel
Strophitus undulatus	Strange Floater(Creeper)
Toxolasma parvum	Lilliput
Tritogonia verrucosa	Pistolgrip(Buckhorn)
Truncilla donaciformis	Fawnsfoot
Truncilla truncata	Deertoe
Utterbackia imbecilis	Paper Pondshell
Venustaconcha ellipsiformis	Ellipse
Villosa iris	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. See Appendix 1 for a watch list of plants.

While in the water:

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

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

Sharp objects such as rocks, downed wood, and man-made materials such as glass or metal may be encountered while surveying. It is recommended that surveyors protect their feet with a pair of shoes for water use (wading shoes, tennis shoes, neoprene dive boots, or other footwear). Gloves are also recommended.

MUSSEL MONITORING PROGRAM OF WISCONSIN: VOLUNTEER MONITORING

GENERAL VOLUNTEER COLLECTION METHODS

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 locations fall into two basic groups: (1) locations that have been surveyed for freshwater mussels at an earlier date and are being reexamined and (2) sites that have never been examined.

Sampling Methods – wading

1. Casual collection of specimens (no measure of time, area, or effort)
2. Number per unit of time (number per person-hour – e.g. 2 people searching for one hour = 2 person-hours)
3. Number per unit of area (e.g., number per unit area – e.g. 10 mussels per 2 meters)
4. Number per unit of distance (e.g., number per distance – e.g. 20 in 100 meters of shoreline)

Without proper authorization from Wisconsin DNR, volunteers are not authorized to use scuba or hookah diving, 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 (see attached dats collection sheet)

1. Species (if you have received the appropriate training to identify Wisconsin mussels, or verified later by expert)
2. Number (or number/time, number/area, number/effort) – may separate live and dead shell
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, but do not pass up an opportunity to collect data on mussels present because a thermometer was not available.

Specimens Retained or Shipped to Mussel Monitoring Program of Wisconsin

Live specimens should not be collected, they maybe be photographed and returned to the site. Shells may be collected or photographed for verification. Photos maybe be sent or e-mailed to the Mussel Monitoring Program. Shells being sent or mailed to the Mussel Monitoring Program of Wisconsin 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 a site 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.

Mussel Monitoring Program of Wisconsin SURVEY DATA SHEET

Date: _____ Collected by: _____ Identified by:_____

Address: _____ City: _____ State: _____Zip: _____

Phone Number: _____ E-mail _____

Location (trib of river if appropriate, note landmarks, roads, etc. nearest town or site name):

_____

County: _____ Waterbody name: _____

GPS/UTM (if available) Lat: _____ Long: _____

OR Township/Range/Section with location noted on map_____

COLLECTION METHOD: □ Hand Search □ Visual Search □ Snorkel □ Other _____

RANDOM OR TIMED SEARCH
□ shoreline search
□ shallow water
□ timed search (time _____)

AREA OR TRANSECT SEARCH
□ Area (m or ft/dimensions) _____
□ Quadrat (size of quadrat X number) _____
□ Transect (length of transect X number)_____

Total Volunteer Time (Hours Searching X Number of Volunteers): _____

Comments: _____

Asian clams (*Corbicula spp.*) □ Present □ Absent □ Rare □ Common □ Abundant
Zebra/Quagga Mussel (*Dreissena spp.)* □ Present □ Absent □ Rare □ Common □ Abundant

Mussel Species	**N Alive**	**N Shells (whole)**	**# Shells kept**	**N Valves (halves)**	**# Valves kept**	**Shell Condition** (Example: fresh dead, dead, subfossil - see def. below)

Fresh dead: No soft tissue remains, but otherwise in good condition (looking like a living specimen that had been killed and cleaned); internally nacre is glossy and without evidence of algal staining, calcium deposition, or external erosive effects; internal and external colors are not faded.

Dead: Early signs of internal and external erosion, staining, calcium deposition, or some combination of these; most or all of the internal coloration and glossy nature has faded; epidermis with major sections absent, or if present, clearly aged and flaking.

Subfossil: Little or no epidermis; nacre faded white and entire shell often white; sometimes with signs of erosion, staining, or calcium deposition; typically chalky and powdery to the touch; shells often brittle and crumbling.

Mail completed data sheet and/or photos or shells to: Lisie Kitchel, WDNR Bureau of Natural Heritage Conservation, 101 S. Webster St. Madison, WI 53707 – send photos via e-mail to Lisie.Kitchel@wi.gov

FIELD OBSERVATIONS

Water Depth _____ (average in m or ft)
Water depth range _____(m or ft. throughout the collection area)

Water Temperature _____ (C or F)

FLOW RATE
If known,
m/sec or ft/sec:
_____

1 – no flow
2 – slow
3 – moderate
4 – fast
5 – high

WATER COLOR

1 – clear
2 – light green
3 – dark green
4 – tan
5 –brown
6 – black

WATER CLARITY

1 – clear
2 – cloudy

WATER SURFACE

1 – clear
2 – scum
3 – foam
4 – debris
5 – sheen

SUBSTRATE

1 –bedrock _____
2 –silt _____
3 –sand _____
4 –gravel _____
5 –cobble _____
6 –boulder _____
7 – other:_____
(wood, debris, vegetation)

Check all that apply,
- Indicate estimated percentage (should add up to 100%)

Wentworth scale substrate size

Boulder: greater than 25.6 cm
Cobble: 6.4-25.6 cm
Gravel 0.2- 6.4 cm
Sand: 0.006-0.2 cm
Silt: less than 0.00 6cm

What land uses are directly adjacent to this site? Check all that apply:

□ Undisturbed area
□ Suburban residences
□ Urban residences
□ Cropland _____
□ Other _____
□ Agricultural land (pasture)
□ Recreation area (describe) _____
□ Rural residences
□ Commercial/Industry/Manufacturing

Notes:_____
_____
_____
_____

Site Map (on this or other sheet)