



2017 Mussel Monitoring Handbook

Thank you for participating in the 2017 Mussel Monitoring Program! This handbook can be used as a tool for both Mussel Observers and Mussel Searchers. Please pay special attention to the differing protocols for Mussel Observers and Mussel Searchers. If you have any additional questions please contact our Water Quality Specialist, Zac Driscoll, at zac@milwaukeekeeper.org.

Project Partners:



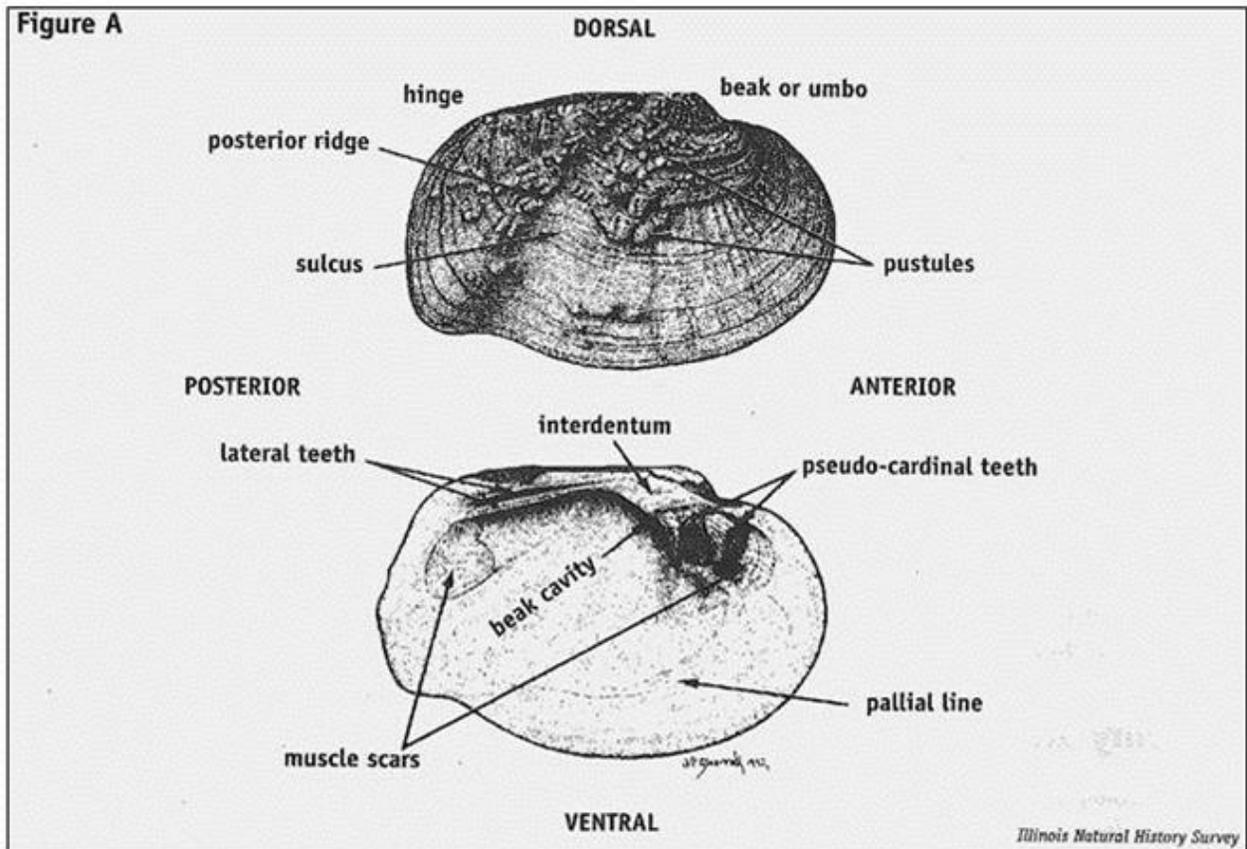
Contents

Anatomy of Mussels.....	3
Protocols for Mussel Observers.....	6
Method #1: Random Shoreline Searches	6
Method #2: Random Shallow Water Searches	7
Protocol for Mussel Searchers.....	9
Method #1: 2 Man-Hours Timed Search.....	9
Appendix 1 – How to Properly Take Photos of Mussels	12
Appendix 2 – How to Properly Label Photos of Mussels	14
Appendix 3 - How to Fill Out Data Sheets.....	15

Anatomy of Mussels

Freshwater mussels look similar to other bivalve animals like freshwater clams. The following images can help you determine if what you find are freshwater mussels and their species.

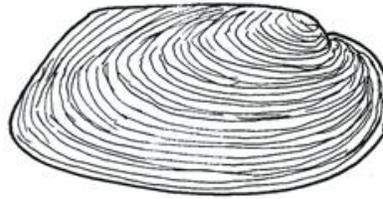
Exterior and Interior Shell View, showing the major parts of a mussel.



SHELL SHAPE



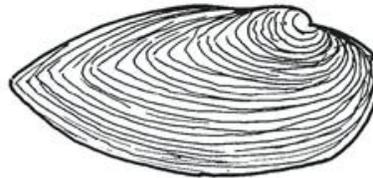
ROUND



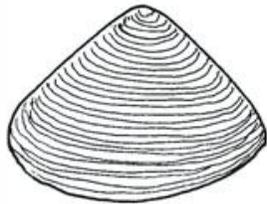
RHOMBOIDAL



OVAL



ELLIPTICAL



TRIANGULAR

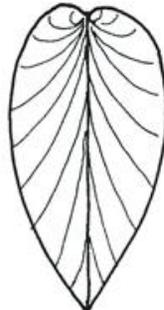


QUADRATE

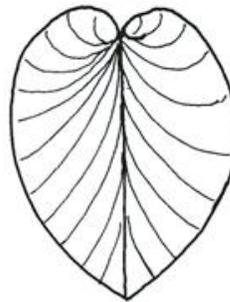
SHELL WIDTH



COMPRESSED

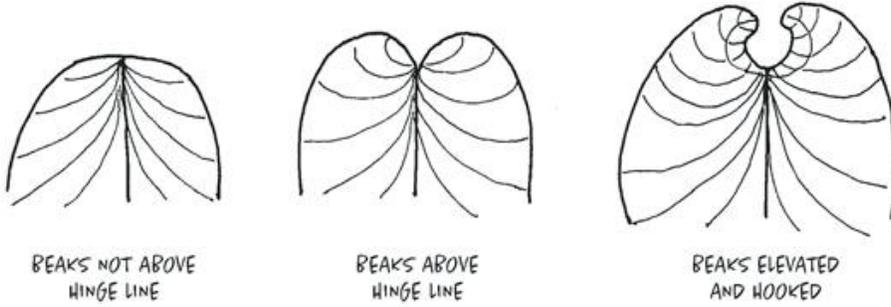


NORMAL

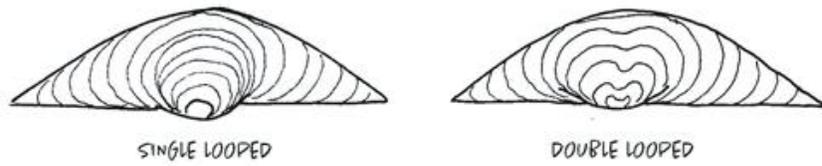


INFLATED

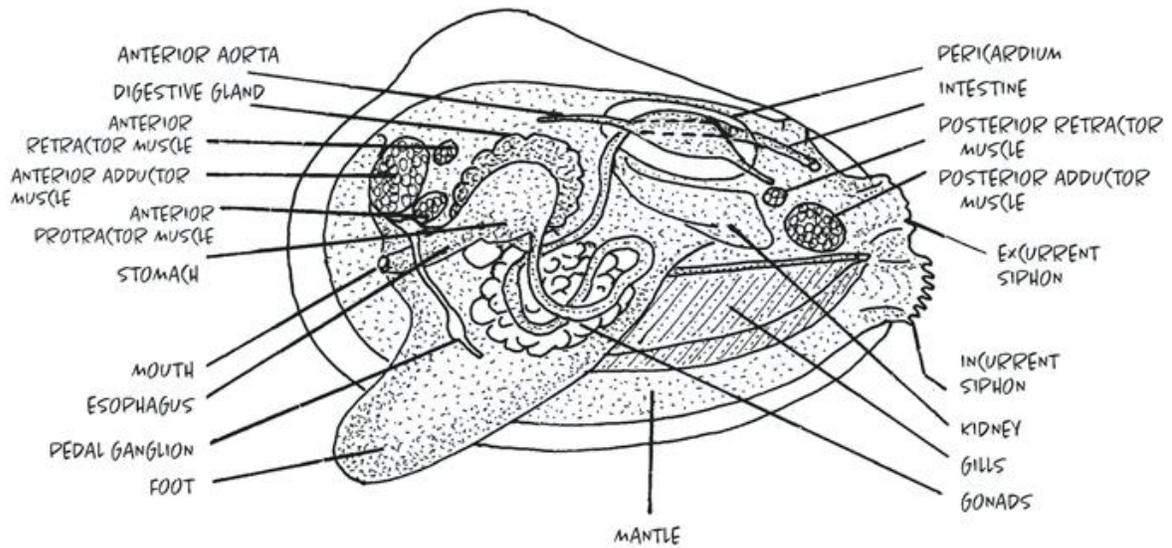
BEAK MORPHOLOGY



BEAK SCULPTURE



INTERNAL SOFT TISSUE ANATOMY



Protocols for Mussel Observers

Mussel Observers is the more casual mussel monitoring group. Those interested can participate as part of a team or as an individual. Observers simply visit any waterway within the Milwaukee River Basin looking for mussel presence and fill out a data sheet. If mussels are found, Observers photograph them then send the pictures and data sheets to Zac at zac@milwaukeekeeper.org

There are two methods that Mussel Observers can use to look for mussels: Random Shoreline Searches and Random Shallow Water Searches. See below for detailed descriptions of each method.

Method #1: Random Shoreline Searches

Equipment Required: (If you need to borrow any of these items, except a Camera or Phone, please contact Zac at zac@milwaukeekeeper.org)

- Dish gloves
- Data Sheet and writing utensils
- Camera or Phone
- Freshwater Mussels of the Upper Mississippi River Guide Book

Time Requirement: No time limit

Survey Method:

1. Choose your favorite river or creek within the Milwaukee River Basin to perform a Random Shoreline Search. If you need help choosing a location, contact Zac at zac@milwaukeekeeper.org
2. Begin walking along the shoreline.
3. Collect any mussel shells that you find.
4. If you see any live mussels in the water and can SAFELY grab them, feel free to do so.
5. Use a camera or your phone to take photos of any live mussels or mussel shells. Follow the photograph guidelines (See Appendix 1).
6. Fill out a data sheet for each site you visit (See Appendix 2).
7. Place any live mussels that you find back into the water on their sides.
8. **Email the pictures along with your data sheets to Zac at zac@milwaukeekeeper.org within one week of completing a Random Shoreline Search. Additionally, if you find**

any very unusual shells, you can send them to Milwaukee Riverkeeper for further analysis. Please contact Zac for directions on how to do so.

Method #2: Random Shallow Water Searches

Equipment Required: (If you need to borrow any of these items, except a Camera or Phone, please contact Zac at zac@milwaukeekeeper.org)

- Dish gloves
- Bathyscopes
- Data Sheet and writing utensils
- Garden Trowel or Cultivator
- Camera or Phone
- Freshwater Mussels of the Upper Mississippi River Guide Book

Time Requirement: No time limit.

Survey Method:

1. Choose your favorite river or creek within the Milwaukee River Basin to perform a Random Shallow Water Search. If you need help choosing a location, contact Zac at zac@milwaukeekeeper.org
2. Assess the safety of your waterway. Is the waterway safe to enter? If so, proceed. Any time you feel uncomfortable, exit the waterway. Safety first!
3. Begin looking for mussels.

Where and How Do I Look for Mussels?

Where to Look for Mussels: Mussels can be tricky to find, but many are commonly found in the following locations:

- a. In the bottom sediments of shallow water areas
- b. On exposed sand and gravel bars
- c. In the bottom sediments above or below riffles
- d. Near islands or streambanks
- e. In moderate run habitats with stable mixed substrates.
- f. During periods of low water, in pools of rivers that are too deep to wade in otherwise

How to Look for Mussels:

Search Method 1: Hand Sweeps

This method is recommended for water banks or very shallow areas. With your hands, feel between and underneath rocks. Fan away the substrate to expose mussels potentially buried in the substrate of the waterway. Additionally, you can use a garden tool, such as a trowel or cultivator, to gently move substrate away from the stream bed to expose mussels.

Search Method 2: Using a Bathyscope

This method is recommended for deeper water that can't be reached with hand sweeps. Look down into your bathyscope, searching for mussels that are on the surface of the substrate. Start at one bank of your waterway and move slowly, straight across to the other bank. You can use your feet to gently fan away the substrate to find any mussels that might be buried there. When you reach the opposite bank, turn around and repeat the process, slowly moving downstream.

If you're searching with a partner, you can divide the waterway in half. Each person starts on an opposite bank and walks towards each other. At the middle of the stream, each searcher turns around and moves back towards their starting bank.

4. Collect any mussels that you find. On shore, use a camera or your phone to take photos following the photograph guidelines (See Appendix 1).
5. Fill out a data sheet (See Appendix 2).
6. Place any live mussels back into the water on their sides.
9. Email the pictures along with your data sheets to Zac at zac@milwaukeekeeper.org **within one week of completing a Random Shallow Water Search.** **Additionally, if you find any very unusual shells, you can send them to Milwaukee Riverkeeper for further analysis. Please contact Zac for directions on how to do so.**

Protocol for Mussel Searchers

Mussel Searchers primary job is to determine which types of mussels live at a specific site within the Milwaukee River Basin. Mussel Searchers complete Timed Searches at as part of a team of 2-4 people.

Method #1: 2 Man-Hours Timed Search

Equipment Required:

- Dish gloves
- 2 Bathyscopes
- Hip Waders
- Garden Trowel or Cultivator
- Data Sheet and writing utensils
- Camera or Phone
- Freshwater Mussels of the Upper Mississippi River Guide Book

Time Requirement: 1.5 hours

Survey Method:

1. Refer to the Milwaukee Riverkeeper Mussel Monitoring Site map that can be found at <http://milwaukeekeeper.org/become-mussel-monitor/> to select sites where you would like to search for mussels.
2. Upon arrival at your site, assess the safety. Is the waterway safe to enter? If so, proceed. Any time you feel uncomfortable, exit the waterway. Safety first!
3. Plan your 2 Man-Hours Timed Search. '2 man-hours' is equal to the total cumulative time Searchers are looking for mussels. See the chart below to calculate how much time each Searcher needs to be looking in the water for mussels.

# of Searchers	Amount of time each Searcher looks for mussels
1	120 minutes
2	60 minutes
3	40 minutes
4	30 minutes

Since 120 consecutive minutes can be a long time to be looking into a bathyscope, time spent searching can be divided into 15 minute 'dives'. See the chart below to calculate how many dives each Searcher can take during each survey.

# of Searchers	# of 15 minute dives each Searcher can take during each survey
1	8 dives
2	4 dives
3	**Two 20 minute dives**
4	2 dives

4. Set a timer or have someone watching the clock for each dive. Searchers may take breaks between each dive before starting again.
5. Begin searching for mussels.

Where and How Do I Look for Mussels?

Where to Look for Mussels: Mussels can be tricky to find, but many are commonly found in the following locations:

- a. In the bottom sediments of shallow water areas
- b. On exposed sand and gravel bars
- c. In the bottom sediments above or below riffles
- d. Near islands or streambanks
- e. In moderate run habitats with stable mixed substrates.
- f. During periods of low water, in pools of rivers that are too deep to wade in otherwise

How to Look for Mussels:

Search Method 1: Hand Sweeps

This method is recommended for water banks or very shallow areas. With your hands, feel between and underneath rocks. Fan away the substrate to expose mussels potentially buried in the substrate of the waterway. Additionally, you can use a garden tool, such as a trowel or cultivator, to gently move substrate away from the stream bed to expose mussels.

Search Method 2: Using a Bathyscope

This method is recommended for deeper water that can't be reached with hand sweeps. Look down into your bathyscope, looking for mussels that are at the surface of the substrate. Start at one bank of your waterway and move slowly, straight across to the other bank. You can use your feet to gently fan away the substrate to find any mussels that might be buried there. When you reach the opposite bank, turn around and repeat the process, slowly moving downstream.

If you're searching with a partner, you can divide the waterway in half. Each person starts on an opposite bank and walks towards each other. At the middle of the stream, each searcher turns around and moves back towards their starting bank.

6. Once the full 2 Man-Hour Timed Search is complete, begin identifying the mussels you found. The simplest way to begin identifying your mussels, is to sort them by similar shape. Create sections of like-shaped mussels in neat piles.
7. Take a photo of each pile of like-shaped mussels to get a visual count of each group.
8. Then, photograph the best looking mussel from each pile to represent the group using the photograph guide (See Appendix 1).
9. Fill out a data sheet (See Appendix 2).
10. Once the all mussels are photographed, return any live mussels to the water. Place them on their sides on the streambed.
11. **Email the pictures along with your data sheets to Zac at zac@milwaukeekeeper.org within one week of completing a Random Shallow Water Search. Additionally, if you find any very unusual shells, you can send them to Milwaukee Riverkeeper for further analysis. Please contact Zac for directions on how to do so.**

Appendix 1 – How to Properly Take Photos of Mussels

Groups of Mussels

If multiple mussels of similar shape are found, group them together by placing them in neat piles. Photograph each pile to get a total count of like-shaped mussels:



Individual Mussels

Take close-up photos of mussels to A.) represent a group of like-shaped mussels and B.) show any individual mussels found. When photographing a representative mussel, pick the cleanest, most complete mussel or shell from each group.

Take 3 photos of the mussel or mussel shell in these specific views:

1. Lateral exterior view



Photograph the outside of the mussel or shell by placing it in your palm to add size perspective.

1a. Lateral interior view



Use this view only if you're photographing single shells or dead mussels. Never pry open a live mussel!

Photograph the inside of the mussel shell by placing it in your palm to add size perspective.

2. Dorsal view



Turn the mussel or shell on its side so the hinge side is facing the camera lens.

3. Anterior View



Turn the mussel or shell on its side so the hinge side is facing upwards in the camera frame.

Appendix 2 – How to Properly Label Photos of Mussels

Before emailing your mussel photos to Zac, make sure they are clearly labeled to assist with identification.

Groups of Mussels

(Date found using MMDDYYYY format)_(Waterbody where the mussels were found)_(Group # from your data sheet)

Example: 07082017_CedarCreek_Group1

Representative Mussels from Groups

(Date found using MMDDYYYY format)_(Waterbody where the mussel was found)_(RepGroup # from your data sheet)

Example: 07082017_CedarCreek_RepGroup1

Individual Mussels

(Date found using MMDDYYYY format)_(Waterbody where the mussel was found)_ (Mussel# from your data sheet)

Example: 07082017_CedarCreek_Mussel1

Appendix 3 - How to Fill Out Data Sheets

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

- Area (m or ft/dimens)
- Quadrat (size of quad)
- Transect (length of t

Don't fill out this section

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)
Group 1	1	0	0	3	0	All brown w/ white interior. Oval in shape. No teeth. Monitor ID: <i>Pyganodon grandis</i> . 07082017_CedarCreek_RepGroup1
Group 2	0	0	0	5	1	Roundish in shape. White interior. Teeth present. Pronounced ridges on shell. Monitor ID: <i>Amblema plicata</i> . 07082017_CedarCreek_RepGroup2
Mussel 1	1	0	0	0	0	Exterior is yellowish-brown with perpendicular lines. Small and oval-ish. Monitor ID: <i>Venustaconcha ellipsiformis</i> . 07082017_CedarCreek_Mussel1

- 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.

Using a bathyscope is considered a Visual Search.

Mussel Searchers' Total Volunteer Time should equal 2 man-hours or 120 total

If multiple like-shaped mussels are found, they can be labeled by 'Group #'. If individual mussels are found they can be labeled as 'Mussel #'. Make sure that the corresponding photographs of each mussel or group of mussels are labeled the same as the data sheet.

This section can be used for notes about each Group or Mussel. Don't forget to include your photo label! If you like, you can include a mussel identification, just use the scientific name.

FIELD OBSERVATIONS

Water Depth _____ (average in m or ft)
 Water depth range _____

Water Temperature _____ (C or F)
 _____ (m or ft. throughout the collection area)

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 0.006 cm

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

- | | |
|--|--|
| <input type="checkbox"/> Undisturbed area | <input type="checkbox"/> Agricultural land (pasture) |
| <input type="checkbox"/> Suburban residences | <input type="checkbox"/> Recreation area (describe) _____ |
| <input type="checkbox"/> Urban residences | <input type="checkbox"/> Rural residences |
| <input type="checkbox"/> Cropland _____ | <input type="checkbox"/> Commercial/Industry/Manufacturing |
| <input type="checkbox"/> Other _____ | |

Notes: _____

Site Map (on this or other sheet)

This section is optional, but you may use this space to write a description, include photographs, or draw a picture of the site.

Fill out the Field Observations section to the best of your ability. Items like Water Depth and Water Temperature can be estimated.