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@milwaukeeriverkeeper.org.

Project Partners:
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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
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@milwaukeeriverkeeper.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@milwaukeeriverkeeper.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@milwaukeeriverkeeper.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 mussels 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@milwaukeeriverkeeper.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@milwaukeeriverkeeper.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@milwaukeeriverkeeper.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!


**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@milwaukeeriverkeeper.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://milwaukeeriverkeeper.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.

<table>
<thead>
<tr>
<th># of Searchers</th>
<th>Amount of time each Searcher looks for mussels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>120 minutes</td>
</tr>
<tr>
<td>2</td>
<td>60 minutes</td>
</tr>
<tr>
<td>3</td>
<td>40 minutes</td>
</tr>
<tr>
<td>4</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th># of Searchers</th>
<th># of 15 minute dives each Searcher can take during each survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8 dives</td>
</tr>
<tr>
<td>2</td>
<td>4 dives</td>
</tr>
<tr>
<td>3</td>
<td><strong>Two 20 minute dives</strong></td>
</tr>
<tr>
<td>4</td>
<td>2 dives</td>
</tr>
</tbody>
</table>

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@milwaukeeriverkeeper.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 (trb 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**
- **Area (m or ft)***
- **Quadrat (size of quadrat)***
- **timed search (time _______)**

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

**Comments:**

<table>
<thead>
<tr>
<th>Asian clams (Corbicula spp.)</th>
<th>Present</th>
<th>Absent</th>
<th>Rare</th>
<th>Common</th>
<th>Abundant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zebra/Quagga Mussel (Dreissena spp.)</td>
<td>Present</td>
<td>Absent</td>
<td>Rare</td>
<td>Common</td>
<td>Abundant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mussel Species</th>
<th>N Alive</th>
<th>N Shells (whole)</th>
<th># Shells kept</th>
<th>N Valves (halves)</th>
<th># Valves kept</th>
<th>Shell Condition (Example: fresh dead, dead, subfossil – see def. below)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1</strong></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>All brown w/ white interior. Oval in shape. No teeth. Monitor ID: Pyganodon grandis. 07/08/2017_CedarCreek_RepGroup1</td>
</tr>
<tr>
<td><strong>Group 2</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>Roundish in shape. White interior. Teeth present. Pronounced ridges on shell. Monitor ID: Ambeloma plicata. 07/08/2017_CedarCreek_RepGroup2</td>
</tr>
<tr>
<td><strong>Mussel 1</strong></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Exterior is yellowish-brown with perpendicular lines. Small and oval-ish. Monitor ID: Venustracocha ellipsiformis. 07/08/2017_CedarCreek_Mussel1</td>
</tr>
</tbody>
</table>

**Fresh dead:** No soft tissue remains, but individual in good condition (looking like a living specimen that had been killed and dehydrated). Internally tissue 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; epizoites with major sections absent; or if present, dehydrated and flaking.

**Subfossil:** Little or no epizoite, no decayed white and orange shell; often white, sometimes with signs of erosion, staining, or calcium deposition; typically chalky and powdery to the touch; shells often brittle and crumbling.

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*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.*

*Don’t fill out this section.*

*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.*

---

*Using a bathyscope is considered a Visual Search.*
**FIELD OBSERVATIONS**

<table>
<thead>
<tr>
<th>Water Depth ______ (average in m or ft)</th>
<th>Water Temperature ______ (C or F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water depth range ___________</td>
<td>(m or ft. throughout the collection area)</td>
</tr>
</tbody>
</table>

**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:

- □ Undisturbed area
- □ Agricultural land (pasture)
- □ Suburban residences
- □ Recreation area (describe) ____________________________
- □ Urban residences
- □ Commercial/Industry/Manufacturing
- □ 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.