



CENTRE FOR COMMUNITY-BASED RESEARCH



COMMUNITY BENTHOS BIO-MONITORING PROGRAM

Fall 2019

U-Links Centre for Community Based Research
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Background

Benthic macro-invertebrates, colloquially referred to as “benthics” or “benthos”, are aquatic, spineless organisms that live on the bottom of water bodies. Since the late 1980’s they have been used as biological indicators for common aquatic pollutants as they spend part or the entirety of their lives in the water. Due to this long-term contact with the water around them, certain groups of benthics are more sensitive to stressors such as organic pollution (including excess phosphorus and nitrogen). This makes the presence or absence of certain groupings of benthics indicative of the overall ecological health of the water body in which they reside. The use of benthics as an indicator of water quality is now used throughout the world and has been widely used in Ontario since the early 2000’s.

In July 2019, U-Links and the Trent Center for Community Based Education received a Trillium Foundation SEED grant to start a benthic biomonitoring program for participating lake associations in Haliburton County that could be replicated in other regions of the province. This pilot project has been effective in obtaining baseline information for all lakes involved in the pilot through community-university partnerships. The pilot project has also assisted in determining the processes and protocols necessary to ensure the best standard practices are being used to procure and analyze these data. All lake associations that were involved in the initial pilot project have confirmed interest in continuing with a long-term biomonitoring plan, along with several new lakes in the Kawartha Lakes and Peterborough region. Trent University and Fleming College have new courses planned for the Fall of 2020 that specifically address biomonitoring through experiential learning opportunities. We refer to these courses as “affiliate courses” throughout this document.

What is U-Links?

Established in 1999, the U-Links Centre for Community-Based Research works with community partners, faculty and students to deliver research and community service learning services to Haliburton County. Our innovative Community- Based Education (CBE) program partners local organizations with faculty and students from Trent University and Fleming College to explore important research questions and increase the capacity of organizations via community service learning initiatives. The result is lasting relationships and tangible benefits to the social, cultural, environmental and/or economic life of Haliburton County.

For more information on our organization, please visit www.ulinks.ca

Why should my organization be sampling benthos?

Certain benthos are sensitive to excessive levels of nutrients, such as compounds that contain phosphorus and nitrogen, that can lead to algae blooms. By studying the composition of the benthos in your lake you may be able to foresee subtle changes in your lake ecology earlier, giving you time to make changes before an algal bloom occurs. Besides being considered unhealthy, lakes that experience frequent algal blooms are less desirable for cottagers and can see property values around the lake fall.

Benthics are also a low tier on the food chain of the lake and changes to their populations can cascade up the food chain to higher trophic levels such as game fish. Ensuring that your lake's benthic population is stable is a proactive way to ensure that the entire ecosystem of your lake remains minimally impacted.

What is expected of me and my organization?

As a lake partner, your duties are minimal overall compared to the obligations of U-Links and your partner students; however, U-Links does require participating lake associations to commit to 1-2 days of volunteering which will primarily involve transporting students around your lake for an initial site assessment, and an additional day for the student sampling event. The following sections will outline the process and responsibilities of all parties involved in more detail.

Project Development

If you are reading this booklet, chances are you have already contacted or been contacted by a U-Links or TCRC employee. If you have not yet been in contact with an employee of U-Links or the TCRC and you are interested in being involved in this project, you should contact the U-Links Biomonitoring Coordinator at bmartin@ulinks.ca. The Biomonitoring Coordinator and/or another representative from U-Links/TCRC will most likely meet with you in person or over the phone to discuss the logistics of your project and answer any questions you may have. You and a U-Links/TCRC representative will then complete a project proposal that will lay out what research questions your organization is looking to have answered, what kind of deliverable you would like (i.e. a report, booklet, presentation, etc), who the students and U-Links/TCRC will be in contact with from your lake association, and any other information that is relevant to the project.

If you aren't sure what kind of questions you want answered, don't worry! Your Project Coordinator is here to assist you.

Health and Safety

We take health and safety very seriously with all of our projects. As such, a boating safety document has been created that must be signed by both students and your organization prior to any work being conducted on the water. This document outlines the responsibilities of the watercraft operator and all of those who are travelling in the boat in addition to procedures and equipment that are required prior to departure. A copy of this document is included at the end of this package.

Site Survey

During the summer prior to the first sampling event, U-Links/TCRC staff will need to conduct a survey of your lake in order to scout out viable sites that reflect the unique characteristics of your lake. This process will usually take one to two 8-hour days of boating. You or your lake association is expected to provide the boat and an individual who is licensed to pilot the boat. U-Links/TCRC will provide one to two staff members who will complete all the necessary information at each site. This information will then be collated by U-Links/TCRC staff for use during sampling to select sites that have some comparable characteristics (e.g. sediment type, water chemistry, etc.), but are also different in others such as disturbance, proximity to an inlet/outlet, etc. This data and all subsequent data will be shared with your lake association for your records and use as well.

After this survey has been completed, U-Links/TCRC will select a group of students who will be responsible for carrying out your project. These students and their supervising faculty will draft a project agreement that outlines what deadlines they will adhere to, what the end deliverables are, and the contact information of all parties involved. The project is reviewed and signed by all parties before the project officially starts. If you have additional comments, questions, or concerns about the project agreement you should voice those concerns to the Project Coordinator who will then bring the agreement back to the students and faculty for revisions.



Lake Partner volunteer and Fleming College student carrying out sampling on Haliburton Lake

Benthic Sampling

Once the project agreement is in place, the next step is to schedule benthos sampling. Sampling usually takes place during the late summer to early fall (from the last week of August to the week before Thanksgiving in October) unless one of the involved parties has arranged with you to sample during the summer months. During this step, the students working on your project will contact you to schedule a date that works best for both of you. A U-Links representative will most likely also join you during your scheduled sampling event in order to ensure consistency of sampling protocols and methods.

The amount of time spent sampling will depend on a variety of factors: how many sites your lake association would like to sample, input on the number of sites to be sampled from your students and their advising faculty member, and how much time you can afford to put forward. The current sampling protocol is attached at the end of this document if you would like more details on best practices for community-based research benthos sampling projects. **In general, we recommend that the number of sites sampled each day not exceed 3, as each site is divided into two samples that are processed individually.** This is done to discern any natural variability that may exist within a site. If the sampling time is estimated to be more than one day, student accommodation may be required. Lake association members are welcome to host students; however, this is not required and alternate accommodations can be sourced if needed.

Visiting 3 sites in a day also allows time for the students to pick the benthics out of their sample while the benthics are still alive, making it easier for students to locate, collect, and identify specimens. Access to a covered space with electricity to allow the students to use our microscopes to identify the collected specimens is required if you want the students to be able to identify samples while in the field.

Knowledge Sharing

Once sampling has been completed, the students will take the data that they have collected back to their school for analysis and will have your decided-on deliverable ready by the end of April. The students will also participate in a local Celebration of Research in order to present their findings. The Celebration of Research is usually held in Minden and Peterborough in mid-to-late March every year in order allow host organizations, students and faculty to share what they have learned with others in the local community.

Ultimately, your research project will also provide positive benefits to the social, cultural, environmental and/or economic health of Haliburton County. The completed report will be archived in the Haliburton County Collection, accessible through the U-Links website (<http://database.ulinks.ca>), as well as through the Haliburton County Library.

Host Support

We value your feedback!

Your Project Coordinator will be regularly checking in with you about the progress of your project. We also encourage you to call, email or drop into our office at any time before, during or after your project to discuss any questions or concerns you may have.

Following the release of the final project deliverables, you will be invited to participate in a survey to help us determine what was done well, what needs improvement, and to ensure that all host organizations are satisfied with our process. Most concerns can be addressed quickly by U-Links/TCRC staff, but larger concerns or suggestions may need to be brought to our Benthic Biomonitoring Sub-Committee-- a group of benthic experts, representatives from our partner post-secondary institutions, and U-Links/TCRC staff formed to monitor the Community Benthos Biomonitoring Project.

Financial Considerations

Reimbursement

We understand that your time and money is important, and it is important to us, too. As such, we will reimburse you for boat gas used during the initial survey and during primary sampling. You do not need to provide any receipts for gasoline purchased as the disbursement is equal among all lake partners. Additional reimbursement for other incurred expenses will be handled on a case-by-case basis.

Community Contributions

The total cost to support and administer a student research project is approximately \$3,500. We are fortunate to have a number of individuals and organizations who have made contributions to support this research over the past 20 years. We hope that your organization can participate in this effort.

Here is how your contribution can help:

- \$150 sponsors a Trent University student's transportation costs from Peterborough to Haliburton for the duration of the project.
- \$200 sponsors the presentation of a research project at the annual Celebration of Research in Haliburton County, a public showcase of university student talent, research and service learning. The results of the research are then made available to the public via the U-Links database and the County Library.
- \$500 sponsors project development required to help organizations develop their research questions and match the project with students and professors.
- \$1,200 sponsors the entire portion of the community's cost of the research project.

Please contact U-Links at 705-286-2411 or email admin@ulinks.ca if you have questions or would like to discuss a potential donation. Individuals can also donate directly via e-transfer at www.ulinks.ca/support-u-links.html. We welcome your contribution in any amount.

We will recognize a contribution made by your Lake Association in our print and web-based news releases and social media updates.



Outline of Community Benthos Biomonitoring Project Workflow

The above outline will generally be followed by U-Links/TCRC with some exceptions made due to scope limitations by certain student groups, timing changes that may be made possible by summer courses by our post-secondary institution partners, or other extenuating circumstances.

Appendix A

Community Benthos Bio-Monitoring Project Protocol

Background

Erin McGauley and Barb Elliot had an excellent conversation with Dr. Chris Jones, from the Ministry of the Environment, Conservation and Parks (MOECP) on Thursday, September 26th, to seek his guidance with respect to sampling protocols for the long-term benthos biomonitoring project that is currently in development through U-Links, Fleming College, and Trent University.

The following summarizes the conversation held on September 26th. In drafting these protocols, we aim to provide a working document for students embarking on U-Links community-based research in 2019 and beyond.

This protocol is intended to provide a consistent approach to sampling protocols across participating institutions and agencies. In addition to the specific details below, all student groups are to use lake sampling site field forms and sampling protocols per the Ontario Benthos Biomonitoring Network (2007).

Study Scope

It is recommended that student groups **collect 2-3 lake samples per lake and live pick those in a field location** (i.e. two samples per day, each with a minimum of two replicates of minimum 100-animal count). **For groups with higher capacity, additional sites may be added.**

Study Site Selection

There are often two basic questions for which people want an answer:

- Is my lake healthy?
- Are conditions changing over time?

Depending on the question of interest, there are many possible approaches to site selection. Student groups will need direction on site selection and study design, and collaboration with lake partners through U-Links will be integral to this process. The following 3 study design options are provided to guide site selection for student groups. Each group should clearly articulate what process they used and categorize their approach per the 3 schemes below.

1. Stratified Shoreline Segments:

Many of the study lakes identified for this joint U-Links/Fleming/Trent project have participated in the Love Your Lake (LYL) program, initiated by the Coalition of Haliburton Property Owners Association (CHA). The LYL program includes a shoreline assessment that can provide valuable data on shoreline habitats, and therefore inform site selection on individual lakes.

For example, if we have data on shoreline habitats, it would be best to use that to stratify sampling sites that reflect the overall shoreline condition (i.e. if 50% of the lake is developed, 25% is manicured and 25% is undeveloped, a student group would choose 2 sites in developed

areas, 1 in a manicured site and 1 in undeveloped areas). These sites may need to be divided between an existing student group and future groups depending on field work capacity but this overall design will help to ensure that representative samples are reflective of the condition of the lake over time.

2. Impact/Control

Alternatively, another way to proceed is to consider the cottage association's interests in tracking known lake impacts. In this case, sampling sites would be divided to represent 1 impacted site and 1 'control' site, where both sites have similar substrates. Or, if time and interest permit, you could choose one site that is developed, one site that is undisturbed, and one site that is somewhere between these two extremes and sample all three on a lake (ensure reasonable separation between these sites). Note that there are presently very few pre-identified control/reference sites within the OBBN (Ontario Benthos Biomonitoring Network) in the Haliburton area, so student groups and cottage representatives will be choosing 'control' sites based on visual and ecological knowledge. Sites used in this design should have similar dominant substrates to allow for direct comparisons to be made. This reduces the variables in the study and allows for comparisons within the lake.

3. Reference/Random

Given the background survey work conducted as part of this collaborative project, potential sampling sites have been identified by U-Links staff. Using these sites and their impact categorization, students might choose to select ONE site on the lake that can be considered a 'reference' site. This site should be one that will remain un-impacted over the long term (Crown Land, un-used shoreline, away from cottage or other impacts) and could be chosen based on cottage representatives' input. This reference site would be sampled every year, providing an opportunity to monitor change over time. One or two additional sites could be sampled each year, selected from a random 'pool' of available sites per U-Links data.

Replication

In order to ensure that within-site variation can be tested, replicates should be taken at each sampling site. A minimum of 2 replicates is recommended, while three is better if field capacity permits. Given time constraints for single day sampling, two replicates appears to be manageable, depending on how numerous bugs are at each site for picking.

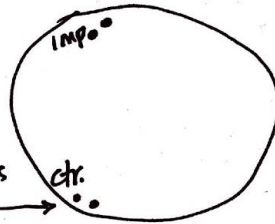
Study site selection - visual representation.

1. Stratified:

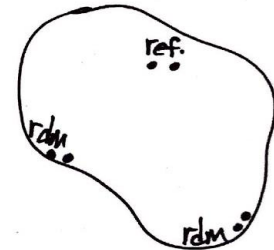
developed (d)
manicured (m)
undeveloped (ud)



2. Impact/Control:



3. Reference/Random:



*showing minimum level of replication (2) per site.

Field Site Selection

Once a study approach has been decided, the following should be used to guide on-the-ground sampling decisions. No matter what approach is chosen from a study design perspective, sites should only be compared if they have similar dominant substrates. As such, priority should be given to habitats that contain a mix of substrate types, as it would maximize the chances of ensuring similarity of sampling habitats, and therefore the ability to make reasonable comparisons within and across lakes. Shield lakes often contain a mix of sand, gravel, silt, and organics, which would serve as good spots to sample, and would more than likely provide enough benthos to satisfy the OBBN minimum requirements for sampling (i.e. minimum 100-count per sample). Certain site types are NOT recommended as part of this protocol.

Sampling should NOT be conducted within:

- Pure sandy beaches (generally there are limited benthos in these locations)
- Highly organic, wetland sites (very poor sites for benthos)
- Large boulder sites (unsafe)
- Pure bedrock sites (unsafe, limited benthos)

Site Creation

Participants are encouraged to use the OBBN Site Creator by entering the data on the Site Creator Excel spreadsheet available here:

<https://desc.ca/programs/OBBN>

Project coordinators will also be able to create sites with the Survey 123 app if they are present when sampling is being conducted. This can only be completed by the project coordinator as an OBBN username and password are required to input data into the app.

Through this process, a photo of the site can be taken, and GPS coordinates (in decimal degrees; e.g. 45.1234 -78.12345) taken at the site can be uploaded into the OBBN data base. A unique site code needs to be generated for each site, per the database:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	Username	Agency	Waterbody Type	Site	Waterbody Name	Wetland Type (mandatory for wetlands)	Physiographic Location (mandatory for wetlands)	Site Description (max 100 characters)	Elevation (m)	Candidate Reference Site	Site Comments (max 255 characters)	Photo Name (one file per site)	Photo Description (max 255 characters)	Latitude	Longitude	Zone	Easting	Northing
1	Yorkas	MECP	lake	PLK-01	Paint Lake			Site one of two. Access point off Bellwood Acres RD.	318	yes	High abundance of organic matter in lake	PLK-01_MECP.jpg	Site Overview	45.224773	-78.946493			
2	Yorkas	MECP	lake	PLK-02	Paint Lake			Site two of two. Access point off Bellwood Acres RD.	323	yes	Large boulders present	PLK-02_MECP.jpg	Site Overview	45.224575	-78.929649			
3	Yorkas	MECP	wetland	MW-01	Mining Wetland	swamp	inland	Site found within Mining Wetlands Conservation Area. Access point off George Johnston RD	180	no	Large wetland	MW-01_MECP.jpg	Site Overview	44.42172	-79.82334			
4																		
5																		

These codes should be based on the lake name (2-4 letters), then a site location code (2 numbers), and finally a replicate code ("R" followed by the replicate number. For Haliburton Lake, as an example: HL-01-R1. The agency is Trent_Ulinks or Fleming_Ulinks depending on the students working on the project, so that these projects can be differentiated from other College/University endeavors.

Sampling

All project members must follow the U-LINKS BOAT SAFETY GUIDELINES while sampling. These include ensuring that hosts have their Pleasure Craft Operators Card, that the boat includes all required safety items, that U-Links staff and Trent/Fleming students wear a PFD at all times while on the water, and that a trip plan including a meeting place, destination(s), expected length of trip, expected return time is created and communicated to someone on land. Depending on the season, additional cold-weather safety briefings or hazard assessments may be completed.

Sampling sites are only those sites for which permission to enter has been granted.

OBBN lake sampling protocols should be followed using the:

- Travelling kick and sweep method
- 500 micron mesh D-net
- Transects sampled from a 1m wadable depth in towards shore.
- The net should be checked after each transect to check numbers, and additional transects completed as required to ensure a 100-animal minimal count.
- Samples in nets should be well sieved in the field to remove fines and organisms smaller than the 500-micron size.

As per OBBN lake sampling protocol the time spent sampling must be recorded (to a maximum of 10 minutes), as well as all relevant data variables (e.g. macrophytes, dominant and second-dominant substrates, etc.)

Sample Transport

Given that samples will be moved from the sampling site to the picking location, any large cobbles or woody detritus should be rubbed and removed from the sampling bucket prior to transport in a boat or car as these items may crush specimens. Buckets must be kept in the shade or in a cooler to retain quality specimens prior to sample picking.

Sample Picking

Student groups are conducting live picking in the field. As such, the following protocol elements will ensure consistency between groups:

- Subsamples will be taken using the teaspoon method per OBBN.
- **Students will be instructed on appropriate sub-sampling procedures to ensure a reasonable number of animals is removed for picking.**
- A shallow ladle or teaspoon will be used to collect subsamples. This spoon will be used to stir the bucket contents.
- It is important that the ladle **contacts the bottom of the bucket**, and that small enough aliquots are taken each time so that participants are not overwhelmed by animals in the picking tray.
- **Lights and microscopes** will be available to all student groups for picking (this dramatically improves the quality of identifications for smaller animals such as those collected in the fall).
- **All animals in a tray must be picked** – that is, the teaspoon/subsample must be exhausted before a new teaspoon/subsample is retrieved. ALL animals must be enumerated even if there are more than 100! The minimum is 100, the maximum depends on your subsample size.
- Mandatory taxonomic and field training to the **OBBN 27-group level** will be required for all students participating in these projects. Cottagers may assist/participate in the picking process, but they must be overseen by a certified OBBN member, and OBBN members must verify all data on tally sheets.

Rules for picking include only counting heads, as these are more informative than the tail end of an animal, and this type of counting ‘rule’ is critical for animals like worms that often get broken. Specimens are counted as long as they were alive when you sampled.

Caddisfly cases are not counted if they are empty. Snail and mollusc shells do not count if they are dead (often these float and are white in colour).

Effort Cut-offs for Benthic Picking:

- Per OBBN protocol, if less than 80 animals are collected in a sample, re-sampling must be completed. In this case, a new site is recommended.
- (Fleming College Only) If over 2 person-hours of picking is required, no further picking is required. The site will be considered poor and not re-visited.

Sample Preservation

All samples are to be preserved in small glass vials. These vials are to be provided to students pre-filled with either 70% Isopropyl Alcohol or 70 – 95% Ethanol, and once projects are complete, U-Links staff are to send these vials for long-term storage to the Ontario Benthos Biomonitoring Network coordinator in Dorset, ON. **Vials must be labelled with the type of preservative clearly noted** in addition to the lake name, OBBN site code (per Survey 123/Site Creator), date sampled, U-Links project notation, and institution name.

Data Management

After picking, all field-based data is to be entered into the OBBN upload Excel format and sent to U-Links for database verification and input. The Excel entry form is found via the link above.

Raw data field sheets are to be scanned and digital copies stored with U-Links. U-Links should also be the storage location for any final reports. After field work and analysis are complete (i.e. mid-November at the latest), U-Links staff will request final documents and data sheets as well as coordinate and ensure that preserved specimens and data are transferred to the OBBN.

Data Analysis and Reporting

The following indices are recommended for student analysis to ensure that data can be readily compared between and within lakes:

e.g. the Hilsenhoff Index (though we know this to be inaccurate with 27-group ID) (Hilsenhoff, 1988); Simpson's Diversity Index; relative abundance metrics including Diptera, Mollusca, EPT (Ephemeroptera, Plecoptera, and Trichoptera), Odonata, Malacostraca, Worms, and Other (Jones *et al.*, 2007; Mandaville, 2002).

The use of multiple indices allows each individual metric to summarize or emphasize specific attributes of the raw data (Jones *et al.*, 2007).

Data Delimitations

Any deviations from the suggested protocols above should be clearly documented in any reports and shared with other members collaborating on these projects to ensure that protocol concerns are brought to light early in the process and addressed as needed.

Appendix B

U-LINKS BOAT SAFETY GUIDELINES – Students, Staff and Hosts

Making a Plan

- Create a trip plan including a meeting place, destination(s), expected length of trip, expected return time. Make sure someone on land knows your plan as well.
- Review maps of routes, launching sites and lakes. Double check the weather and water conditions, taking the proper safety precautions in case of expected bad weather.

Preparing for Departure

- Meet with the crew members and establish everyone's capabilities and responsibilities for the project.
 - This includes establishing who has their Pleasure craft Operators card, who is comfortable on the water and has boating experience and swimming skills as well as any insecurities or weaknesses from team members.
- By law, you are required to have the following safety equipment on board (Canadian Red Cross, 2019):
 - Canadian-approved floatation device or life jacket of appropriate size for each passenger on board
 - Buoyant heaving line at least 15 metres in length
 - Watertight flashlight OR Canadian approved flares – type A, B, or C
 - Sound-signaling device, such as a bead-less whistle
 - Manual propelling device (i.e. paddle) OR an anchor with at least 15 metres of rope, chain or cable
 - Bailer OR manual water pump
 - Class 5 BC fire extinguisher if your boat has closed compartments and a permanent fuel tank.
- If transporting a boat from one location to another:
 - Ensure the driver has an Ontario G-class driver license and the proper trailer back up training for launching the boat successfully
 - Ensure established route ahead of departure to avoid delays and unsafe road conditions
 - Take proper precautions when ensuring the boat and trailer are properly hitched and locked ready for transportation
- Fuel boat (on land if possible) before heading out and have extra full fuel tank as backup in in case of emergency.
- Refer to the equipment list to solidify that everything needed for the project is packed.
- Ensure everyone is prepared for the conditions (water, sunscreen, sunglasses, hat, etc. as needed).

On water safety- Boat Operator

- Follow all the safety procedures and boating laws that are outlined in the Safe Boating Guide, designated by the Government of Canada.
- Have Personal Floatation Device (PFD) within reach at all times when on the water.
- Communicate with crew members how they can successfully ensure that you can operate the boat safely.
- Identify any possible hazards and communicate changing conditions with crew members.
- When steering boat towards shore look for hazards, and ensure docking location is safe and secure.
 - Never access any land where permission has not been granted ahead of time.
 - Students are not permitted to drive boats.

On water safety- Crew Members

- Before the boat leaves shore, ensure that each crew member has checked that all necessary safety equipment is on the boat and that they know where to access it in case of emergency.
- U-Links staff and students must wear PFD at all times when on the water and when collecting samples.
- Remain seated and do not move around in the boat as the boat is moving, unless necessary for safety reasons.
- Place biomonitoring tools in a safe and stable location during travel.
- Be alert and communicate with other crew members of the possible hazards that you see.
- Have all crew members aware of navigation routes. To successfully access all sites, have one crew member review the maps and GPS to help assist the operator in navigation.
- When docking the boat or accessing the shoreline, have all crew members watch for hazards such as rocks, logs and unsuspected shallow waters.
- Make sure all crew members have appropriate footwear for the boat, i.e. no open toed shoes, and all shoes have good grip for when entering and exiting the boat.
- Always keep hands inside of the boat - never reach into water while the boat is moving.
- Speak up if you see a storm approaching and do not feel safe on the water;
 - In the event of observed thunder/lightening, return to shore, seek shelter, and do not resume on-water activities until 30 minutes after the last observed thunder/lightening event.