

Bugs Below Zero – A Community Science Activity

Project Description:

Winter-active aquatic insects including stoneflies, mayflies, caddisflies, and non-biting midges are able to survive below-zero temperatures and can often be found on snowbanks. They are also a vitally important food for trout and other fish over winter and are sensitive to warming winter temperatures. Join university researchers from around Minnesota to document winter aquatic insect activity and the conditions under which they are active. Data from this project will be open to the public and be used to inform research on the biology of winter-active insects, effects of climate change and habitat use. The data will also be used for education and informing management of streams in winter. This project is divided into three activities, 1) *Winter Insect Species Account*, 2) *Ethogram for Winter Insects*, and 3) *Stream Substrate Data*. Volunteers participating in this project are encouraged and welcome to participate in all three activities, however if time is limited, participation in only one or two activities is fine - all contributions are welcome!

Project questions:

- 1) *How does winter insect abundance and type of winter-active aquatic insect change with different air temperatures, water temperatures, observation dates, distance from stream, stream characteristics, and landscape characteristics over fall, winter, and early spring?*
- 2) *What behaviors do winter-active insects exhibit?*

Equipment:

- Camera to take pictures of stream and insects
- Aquarium thermometer to collect water temperature (**optional**). Here is one model we recommend: <https://a.co/d/0OvesmB> Note: Ensure you have solid footing and are not standing on ice when approaching the stream to get a measurement!
- Hip or chest waders (**optional**)

ATTENTION: Please upload observations to <https://www.anecdata.org/projects/view/949> after using this form.

Meet the Insects!

Below are examples of some aquatic insects that can complete their life cycles and emerge from streams that are open during winter. More information on how to identify adult winter-active insects can be found at: <https://www.bugsbelowzero.com/meet-the-species>



Top left: male midge (chironomid); top right: stonefly; bottom left: caddisfly; bottom right: mayfly

General Instructions for Collecting Insect and Ecological Data

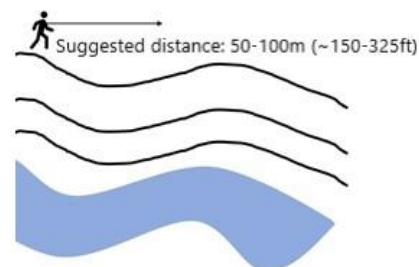
Below are three community science activities that will provide researchers with valuable information about the type, abundance, and activity of winter active insects as it relates to ecological conditions. The first activity, *Winter Insect Species Accounts*, involves searching for and documenting the type and number of winter active insects. The second activity, *Ethogram for Winter Insects*, involves watching a winter-active insect for a period of time and documenting observed behaviors. The third activity, *Stream Substrate Data*, involves collecting additional information related to in-stream substrate. Volunteers participating in this project are encouraged and welcome to participate in all three activities, however if time is limited, only one or two. If time is limited, please prioritize the *Insect Species Account* activity, followed by the *Winter Insect Ethogram*.

Activity 1: Winter Insect Species Accounts (Time requirement: 20-50min)

Spend 10 minutes slowly walking in a line (called a transect line) located 3ft (1 m) from the edge of a stream bank and count the number of each type of insect you see on the snow about 3 ft on either side of you.

Repeat the process again at 9 ft (3 m) distance from stream and 15 ft (5 m). If you have waders and are comfortable walking in the stream (and can do so safely), you may select this option. Note: For safety purposes, a field buddy is always recommended when entering the water!

Suggested approximate distance for each line is 50-100m.



- This will leave you with a total of 3 transect lines that you've walked.
- If you are collecting data with more than one person or in a group, two people or more can walk the transect lines at the same time. If you are by yourself and/or time is limited, you may opt to walk a single transect line. We suggest the 3 ft line to collect data – this will maximize the number of insects spotted, as insects tend to be found closer to the stream channel.
- If you have a larger group or class, consider using this protocol on multiple stream sections.

TIP: If you want to maximize your chances of finding insects, try to go out on days that are above freezing!

[Insect Species Account Observation Data Sheet](#)

NOTE: this information will be uploaded to AneCDATA – you may choose to upload directly using a mobile device. Alternatively, print this form and take to the field.

Observer Information:

Name: _____

Date: _____

Time entered field: _____

Time left field: _____

Your role (circle): student faculty volunteer

Your Email: _____

Your City of Residence: _____

Stream Locality Information:

Stream Name (if known): _____

Stream GPS Coordinates*: _____

Stream County: _____

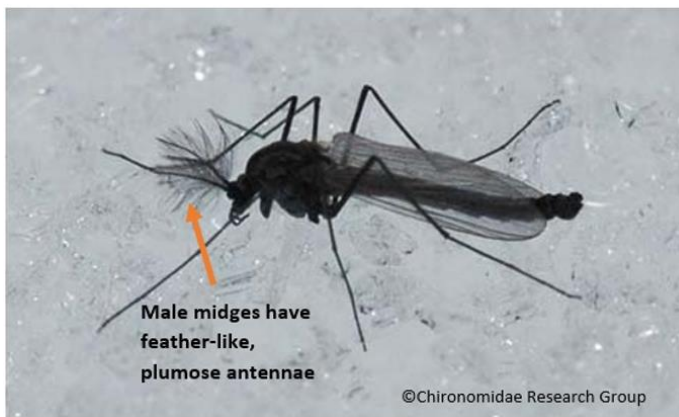
Nearest City/Town: _____

*Directions for finding GPS location on Google Maps App on smartphone:

- Zoom into your location
- Drop a pin where you can see your location marked by tapping and holding your finger down briefly on the screen above your location
- A new screen will pop up titled “Dropped pin”
- Under the space with the location icon (📍) you will see the GPS location information in decimal degree notation. Example: 44.986533 °N, 93.185669 °W

Insect Observations:

Enter the number of each type of insect that you observe alive on the snow. If you see chironomids (midges), how many males and females are there? Look at images below to differentiate males vs. females. Note that male midges have feather-like, plumose antennae, while females have small, stick-like antennae:



Count the number of males and females and enter the total number of each from each transect line.

TIP: If you are not in a group and time is limited, you may opt to just fill in Line 1. If you have waders and are comfortable walking slowly in the stream, you may opt to observe insects directly on the stream edge or located on exposed gravel bars or “islands” within the stream.

	Line 1 (3ft)	Line 2 (9ft)	Line 3 (15ft)	In-stream
# of Caddisflies				
# of Stoneflies				
# of Mayflies				
# of Male Midges (chironomids)				
# of Female Midges (chironomids)				
# of Other Invertebrates				

When entering observations into Aneccdata (<https://www.aneccdata.org/projects/view/949>), if possible, please upload one image of each insect type you observed. Images should be close to the example image in terms of quality.



Weather and Habitat Information:

Air temperature (°F): _____ Water temperature (°F): (optional): _____

Air temperature can be collected from a smart phone weather app; water temperature can be collected with an aquarium thermometer (see *Equipment* at top)

Weather Conditions (circle most appropriate):

Cloudy Partly Sunny Sunny Snowing Raining

Adjacent Land Use (circle most appropriate):

Crop/field Protected land (e.g. CRP, park) Pasture Prairie Urban

Forest (agricultural buffer: i.e., a few trees and then fields) Forest (hardwood/conifer habitat)

Stream Conditions (use images to determine condition and circle the most appropriate category):

Completely open – Ice free Partially frozen Largely frozen Completely frozen



Stream habitat (use images to determine stream habitat type):

Collect this data if you can see stream bottom. Look at the stream bottom over 40ft. (12m) of stream near where collecting insect data and estimate by sight the percent that each habitat type makes up within the 40ft area.

- **%riffles**-fast running water over rocks and little falls, fairly shallow, ripples break surface of the water_____
- **%runs**-areas of moderate current, deeper than riffles, smoother flowing surface, ripples do not break surface of water_____
- **%pools**-areas where current is slower, water is deeper, and many times debris accumulates

Photograph of stream site: When entering observations into Anecdata, upload one image of the stream stretch you just observed to <https://www.anecdata.org/projects/view/949>

Do you have any other ecological observations (birds feeding? Other predators?):



Activity 2: Ethogram for Winter Insect (Time requirement: 10+ minutes)

An ethogram is a descriptive list of behaviors displayed by an animal. Constructing an ethogram requires keen observation of animals, detailed notes, and thoughtful analysis of those notes. Each new behavior that is observed is written down and accompanied by a descriptive name and definition. Ultimately, definitions within an ethogram allow others to identify behaviors by the appropriate name. An ethogram for winter active insects is shown below (Table 1). Once an ethogram is in place, researchers/observers can use the ethogram to construct a time-budget, or an analysis of the amount of time the animal spends doing each activity.

Using the ethogram below, construct a time budget for insects you observe on snow covered stream banks. Over at least a five minute period, document the activity of either a midge (chironomid) or stonefly you see on the snow. Record the amount of time in seconds (unless otherwise noted) the insect spends doing each of the activities noted below (not all activities will be observed!). If you have additional time, either continue watching your insect for a maximum of 20 minutes, or select a new individual to watch. **While watching, do your best not to disturb your insect, so as not to modify natural behaviors - watch from the farthest distance that still allows comfortable observation.** Please take at least one picture of your insect and record the air temperature/weather conditions.

Table 1: Ethogram for winter-active midges (chironomids) and stoneflies.

Behavior	Description
Stationary	Insect is not moving
Walking upstream, parallel to stream channel	Insect walks upstream, roughly along the stream channel. Insect is not clearly walking towards another individual, and some deviation to parallel movement is expected.
Walking downstream, parallel to stream channel	Insect walks downstream, roughly along the stream channel. Insect is not clearly walking towards another individual, and some deviation to parallel movement is expected.
Walking perpendicular to channel, towards stream	Insect walks towards the stream channel. Insect is not clearly walking towards another individual and some deviation to perpendicular movement is expected.
Walking perpendicular to channel, away from stream	Insect walks away from the stream channel. Insect is not clearly walking towards another individual and some deviation to perpendicular movement is expected.
Approach same-sex conspecific (member of same species)	Insect approaches a same-sex member of its species. Insect is seemingly directing movement toward another individual within 1m of current location.
Approach opposite-sex conspecific (member of same species)	Insect approaches a opposite-sex member of its species. Insect is seemingly directing movement toward another individual within 1m of current location.
Move away from same-sex conspecific	Insect moving away from a same-sex member of its species. Insect is seemingly directing movement toward away from an individual it was previously in close contact with (10cm)
Move away from opposite-sex conspecific	Insect moving away from an opposite-sex member of its species. Insect is seemingly directing movement toward away from an individual it was previously in close contact with (10cm)
Flying (still visible to viewer)	Insect is flying, but is visible to observer.
Fly away (no longer visible)	Insect is flying and has left the field of view of the observer
Swarming	Insect flies and joins a swarm of multiple other individuals; location of insect of focus may not be possible once swarming
Mating attempt	Insect has attempted to mate with another individual, but attempt was unsuccessful
Mating	Mating occurring between insect of focus and another individual
Contact (non-mating)	Physical contact occurs between two conspecifics, however contact does not appear to be related to mating
Seeks cover	Insect actively seeks cover in snow crevices/cracks, near logs or rocks, under leaves, grass or other debris, or near undercut stream bank
Other	Please describe other behaviors observed!

Time Budget Data Sheet

For each behavior observed, provide the number of seconds the behavior occurred during the observation period. Certain behaviors are better documented by either a yes/no check (e.g. fly away) or indication of number of times (e.g. mating attempts) instead of indicating amount of time – these are noted in the *Behavior* column.

Behavior	Documentation of behavior - provide number of seconds behavior was observed unless instructed otherwise parenthetically next to a behaviors
Stationary (seconds)	
Walking upstream, parallel to stream channel (seconds)	
Walking downstream, parallel to stream channel (seconds)	
Walking perpendicular to channel, towards stream (seconds)	
Walking perpendicular to channel, away from stream (seconds)	
Approach same-sex conspecific (member of same species) (seconds)	
Approach opposite-sex conspecific (member of same species) (seconds)	
Move away from same-sex conspecific (seconds)	
Move away from opposite-sex conspecific (seconds)	
Flying (still visible to viewer) (seconds)	
Fly away (no longer visible) (yes/no)	
Swarming – note: insect may not be discernable once in swarm (yes/no)	
Mating attempt (number of attempts)	
Mating (seconds)	
Contact - non-mating (seconds)	
Seeks cover (indicate type of cover)	
Other – please describe other behaviors observed!	
Total time spent observing this insect	

Activity 3: Stream Substrate Data (Time Requirement: 15 min)

(**TIP:** This is for those who want to be challenged! **This data is optional to collect:**)

- Collect this data if you can see the stream bottom.
- Group 40ft. (12m) of stream near where collecting insect data into 8 segments of 5 ft. (1.5m) in length. Look at the stream bottom within each of the 8 segments and group all of the substrates within one size category together to estimate the total percent of that substrate in that segment. Substrate descriptions are found below the table.
- Document your data in the table below. To get the average of each substrate type within the whole 40 ft. (12 m), add up each category percent and divide by 8. Example: add all the percentages for sand up from each of the 8 segments and divide by 8.

Stream Substrate Data Table

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Average
% Sand									
% Gravel									
% Rock									
% Boulder									
% Woody Debris									

Substrate Descriptions:

Sand: grain size between <1-20 mm (smaller than a lady bug)

Gravel: 20 mm-4 cm (ladybug size to ping pong ball size)

Rock: 4-40 cm (ping-pong ball to large basketball)

Boulder: (40 cm- >1 m) (larger than a large basketball)

Woody Debris: (branches/twigs in stream)

Survey Questions

Please provide answers to the following questions as you are able. Answers will help us improve the program and get volunteers more involved in the research. Participation is optional, but valuable!

- What motivated you to participate in this project?

- What did you enjoy about this activity?

- What was hard or challenging about this activity?

- In general, what information about streams or insects would you like to still know?