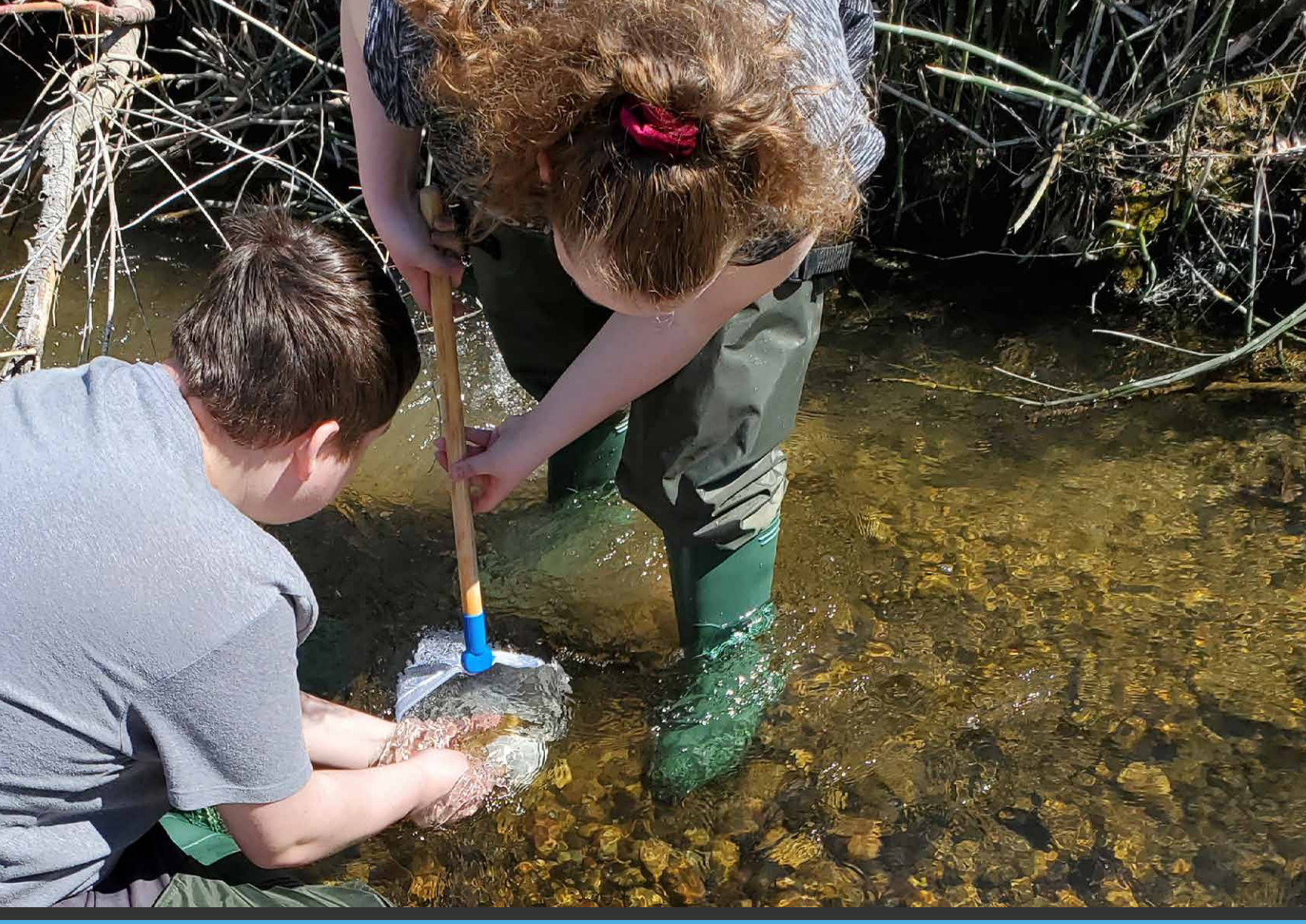


Stream Study

A Learning Resource Module for Middle and High School Ecology Programs

- Watershed primer
- Tracking basic stream information
- Stream morphology and habitat
- Fish and aquatic invertebrate communities

LEAP

HCTF Education

Stream Study Module designed and prepared by Christy Wright, BSC, Salmon Arm, BC

Methods and forms are adapted from DFO Stream Survey methods, BC Resource Inventory Standards Committee (RIC) and Streamkeepers protocols.

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Objectives

Curriculum Big Ideas

- Scientific information affects our daily lives.
- Scientific procedures used in the work force.
- Learning about scientific procedures used by biologists, foresters, and other field professionals.
- What can we do to modify our impacts on local streams?

Aim

- Familiarize students with local aquatic ecosystems and functions.
- Become familiar with how to evaluate health of local aquatic systems. What is a healthy stream?
- How can we mitigate our impacts on aquatic ecosystems?
- Connect students with experts that evaluate healthy ecosystems.

Actions

Student teams will collect data in a consistent manner on:

- General watershed information
- Human related impacts and historical information
- Stream morphology and stream habitat attributes
- Fish inventory and aquatic invertebrates

Time of Year

- Early Spring – before spring freshet OR early fall

Many of the modified procedures in this document are consistent with data collection done by professional stream survey crews, and can be found on DFO stream survey forms[1] and Inventory standards (RIC) of BC.

An educator is encouraged to use whatever aspects of the module will work for them. Many aspects of the modules can be conducted independently or be partnered with other curriculum; community projects (tree planting or conservation initiatives), geometry (slope), evolutionary adaptations (aquatic invertebrates), chemistry (water quality), etc. If time allows, we encourage a stream study that compares a stream from one year to the next, one section of a stream to another, or compares different streams.

1 DFO Site Card and procedures



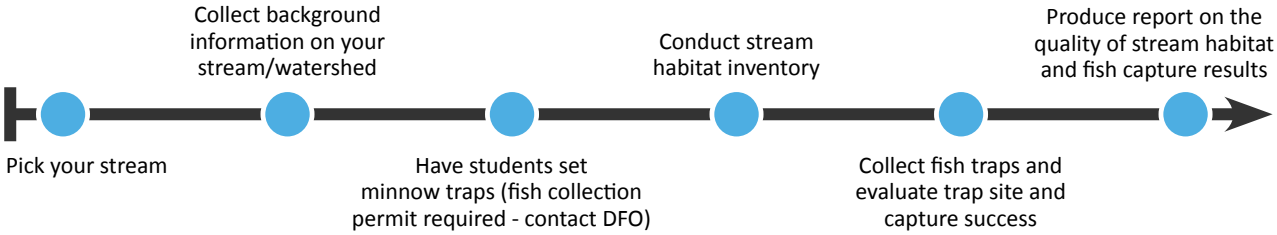
The focus of this stream study is to collect information about the biotic stream community and link it with abiotic attributes of the stream. Data forms should be collected and maintained in a separate folder for later reference and data entry. An educator may choose to have students prepare a report on the stream information that they collect. This report might include an Introduction or Purpose, Question, Methods, Data Results, and a Discussion of the results.

A Stream Habitat Assessment Table is available at the end of the report to highlight areas that would improve stream habitat and could involve local students in stream restoration.

The intent of the BACKGROUND information section is to provide educators with a more detailed understanding of a topic. The sections labeled SIGNIFICANCE describe why specific pieces of information on the data form are collected.

Conceptual time line for stream study

For safety reasons, the field study should be during low to medium flow periods (not during spring floods!)



Background

Food, water, shelter, and space. In the appropriate arrangement, are all fundamental to the health of plant and animal populations. This concept applies to aquatic systems that include fish, invertebrates and plants. Scientists look at the structure of a stream to evaluate its existing and potential habitat values. Abiotic information is collected to quantify the habitat for a particular species.

Most of these attributes can be linked back to morphologic and climatic conditions that create an ecological site and habitats within that site. For example, geologic material will affect the type of stream bed materials and quality of habitat for spawning.

Links between geology and fish population



Activities within the watershed can also affect the quality of the stream and any downstream systems. Human development and settlements can affect water quality and fish habitat through actions such as land clearing, dam building, farming, forestry, and mining.

Resources

- Local DFO office
- City or Town public works departments typically conduct water quality assessments.
- Local fish conservation NGO (Pacific Salmon Foundation, Local Salmon Society, Trout Unlimited, etc.)
- Fisheries Biologists or Hydrologists working for the Gov't of BC in your area
- Atlas of Wildlife in BC
- Ecosystem Explorer
- Contributions to Citizen Science in BC through photo records
- Pacific Salmon Foundation Streamkeepers
- iNaturalist



Watersheds

Key Message

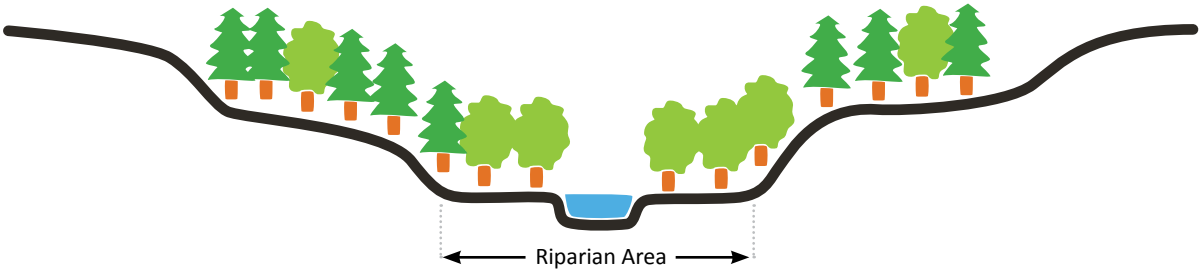
A watershed is an area of land that collects precipitation and drains into a common point at a lower elevation. Because water runs downhill, the highest points of a watershed like the ridges, mountain tops, or high hills define the watershed's boundaries.

Almost all ponds, streams, rivers and lakes are eventually linked to the ocean. Streams and rivers are dynamic systems constantly moving across a valley.

Background

The concept of a stream includes connections to activities upstream and habitats that exist downstream (vertical connections).

Streams and rivers also have connections to the forest around them (horizontal connections). There is a constant relationship between the movement of the water and the surrounding ecosystem, called a *riparian area*. A riparian area is terrain influenced by a waterbody. A lowland area or floodplain adjacent to a river, stream, or lake is a riparian zone. Many towns and communities are located within riparian zones.



Significance

The connections of the stream to upstream and downstream habitats affect the stream's value to the biotic ecosystem. The activities that occur upstream impact the stream habitat quality. Documenting this information and considering the impacts on habitat quality is important for understanding the system as a whole.

Materials

- A map of the stream
  - NTS maps for stream *or*
  - Access to iMapBC or Google Earth



Resources

People

- Make inquiries of the people who know the area including those who live there – other students, teachers, residents, Indigenous Communities, etc.
- Community Public Works are often very knowledgeable regarding the streams in their district.
- Watershed councils

Websites

- Information about your stream might be found on a government interactive map site such as habitatwizard (old) or iMapBC (newer site)
- 1:50,000 NTS maps can be purchased from a local dealer. Online dealers include ITMB.
- Digital copies can be downloaded through the BC Data Catalogue.
- Water Surveys of Canada

Procedures

1. Identify a local stream less than 0.5 m deep (at the time of sampling) for study.
2. Locate this stream on Google Earth or iMapBC.
3. Identify the watershed boundary on a hard-copy map.
4. If you are considering a fish inventory you will require a fish collection permit; contact the Gov't of BC or the local DFO office for assistance. The process may take 3-4 weeks.
5. Identify potential human impacts to the riparian areas that may be of concern (agriculture, dams, mines, forestry, settlements, etc.)
6. Collect existing information;
    a. Interview locals for anecdotal information (students in the class, farmers, First Nations, etc.)
    b. Fisheries: Identify existing fish and stream data using the iMapBC site or Habitat Wizard
    c. Water surveys: Search for existing water data at Water Surveys Canada.

Consider the following questions to engage students in their stream:

- Where does the water come from? Name a creek, stream or place upstream.
- Where is your town's water source?
- What role do you think lakes and rivers have played in the selection of human settlement of your town?
- Where does the stream go? Name a town or city downstream.
- Who responsible for the water?

Transition Questions

- *How can we best keep track of the information we've collected for our stream that shows upstream and downstream connections?*
- *Would you say the existing human impacts on our stream are high, medium, or low?*



Stream Information

Key Message

When conducting field surveys, it is important to always collect basic information, such as WHEN and WHERE to give field data context. Without this context, the data is not useful.

Background

Organizing a Stream

Scientists in BC have a numbering system that shows the connections of a stream to the larger system. The watershed code helps to track information on a stream.

For example: The watershed code for Chase Creek is 128-371300. The first 3 numbers in the series identifies major systems downstream:

- All tributaries of the South Thompson River are 128 series.
- All tributaries of the Thompson River are 120 series.
- All tributaries of the Fraser River are 100 series.
- 371300 is a unique number to Chase Creek, its tributaries will retain this part of the code.

A watershed code for your named stream can be found here.

Stream Reach

As single stream tributary can be divided up into habitat units or stream reaches. A reach is a length of a watercourse with similar channel morphology, channel dimension and gradient. Reach breaks should be identifiable on a 1:20 000 contour map. The first section of stream, starting at the mouth is Reach 1. Reach 2 is begins where a distinct habitat change occurs (gradient break) in the next section of stream and extends to the next gradient break.

Significance

The stream name is the easiest and most familiar tool to retrieve information about the stream. Tracking the date and time is important as the stream will change annually, seasonally, and daily. The UTM coordinate provides an exact location of the survey. This is the most accurate description of the WHERE. The agency and crew information connect people with the survey data.

The Watershed Code describes the downstream connection and uniquely identifies watersheds. All sections of a stream do not have the same habitat value, as a result each reach of a stream is uniquely identified with a number. A map representation of the site helps communicate stream conditions when not in the field.



Temperature is important to aquatic life. Water temperature increases when the sun shines directly on a stream. Warm water contains less oxygen than cold water. When the water temperature increases, the concentration of dissolved oxygen decreases. As the water temperature increases, animals become stressed and are more likely to succumb to contaminants, parasites, and disease. Stream temperatures are usually highly correlated with spawning success in most salmonids.

Stream Life in BC at Various Temperatures

- 20 - 25° C (warm) lots of plant life, high fish disease risk
- 13 - 20° C (cool) plant life, moderate fish disease risk
- 5 - 13° C (cold) plant life, low fish disease risk

Materials

- GPS
- Hard-copy or digital map sources might include NTS maps, Google maps or Google Earth
- Thermometer

Resources

- Fish Survey Sites
- Government Data maps: iMapBC
- Watershed Codes

Field Data Form

Stream Data Field	Procedure
Stream Name	Identify the official stream name and any local aliases it is know by.
Date and Time	Enter the date and time of the field survey. Enter the date as dd/mm/yy. Enter the time using 24 hr clock.
UTM coordinate	When in the field, enter the exact location of the field survey; including the northing and easting of the sample site (using a GPS/phone).
Watershed Code	Each stream is identified with a unique watershed code. This code can be found by entering the stream name here.
Reach Number	Reach number 1 starts at the mouth of the stream, reach number 2 is usually at the next major gradient shift, and reach 3 identifies the next habitat unit.
Agency	The name of the organization conducting the surveys.
Crew	The name of the crew members (full name).
Stream Temperature	When in the field, record the stream temperature by placing the thermometer at least 10 cm below the water surface and keep it submerged for 2 minutes. Read the temperature while the thermometer is still in the water.
Potential Watershed Impacts	Using the work from the Watershed Primer, identify major Land-clearing (agriculture, forestry cutblocks, mining, etc.), Contaminants (sediment, agriculture, fertilizers, effluent, etc.) and Settlements (water use, houses, storm drainage, etc.).
Map	Draw an image of your stream, marking important information on it.

Transition Questions

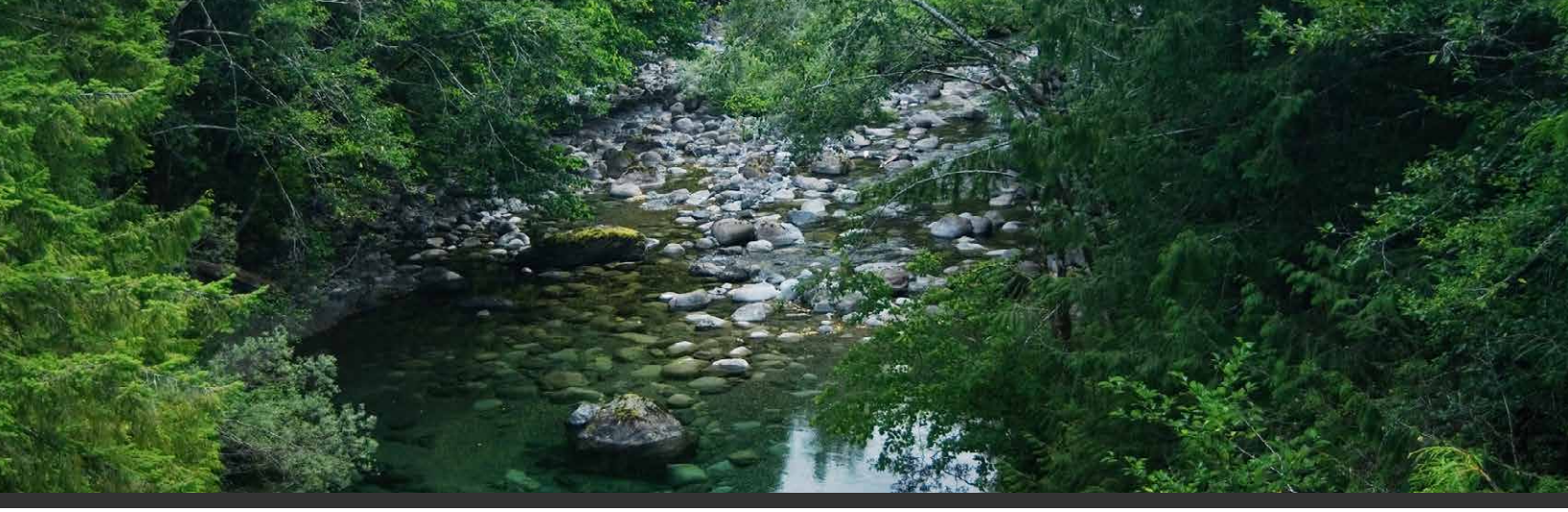
- *Do you think the stream has good habitat?*
- *Based on the existing information do you expect to find a large diversity of fish and aquatic invertebrates?*

Stream Information	
Stream Name:	**Date:** (dd/mm/yy) **Time:**
Weather*:	**Watershed Code:**
UTM Coordinates:	**Reach Number:**
Northing:	**Agency:** **Crew:**
Easting:	**Stream Temperature:**

Watershed Impacts
Land clearing:
Contaminants:
Industrial:
Settlements:

Stream Watershed Map (mark locations of features and watershed impacts listed above)

* For in-classroom work, it is not necessary to fill out entries for Weather, UTM Coordinates, or Stream Temperatures. This information MUST be filled out during outdoor field work.



Stream Morphology and Stream Habitat

Key Message

Stream attributes determine the quality of stream habitat for the biotic community.

Background

Fish are typically found in streams larger than 5 m and with gentle gradients (< 5 %). Steep (> 12 %), small streams (< 1.5 m) are less likely to provide good habitat. There are exceptions, as fish species occupy different aquatic habitat niches to reduce competition; Bull Trout prefer streams with steep gradients and higher oxygen levels; Rainbow trout can tolerate gentle warmer water with lower oxygen levels.

Functioning riparian areas and a healthy forest (800-1500 trees/ha) along the banks contribute habitat cover to the stream. Fallen trees in the channel create pools, cover and meanders. Attributes of good quality habitat includes at least 12 pieces of cover (in a 40 m section), pool features dominating the channel, and bed material composed mostly of boulders and cobbles (>50%).

For this assessment we identify *Cover Habitat* as:

1. Large woody debris (logs >10 cm in diameter)
2. Undercut banks (where the bank of the stream is overhanging the water)
3. Large boulders that create eddies on the downstream side, and
4. Overhanging vegetation that creates shaded areas difficult to access by terrestrial predators.



Stream with abundant cover habitat



Stream with poor cover habitat



Attribute[1]	Good Habitat	Acceptable Habitat	Marginal/Poor Habitat
Slope	Gentle (<5%)	Moderately steep (5-12%)	Steep/falls (>12%)
Bed Materials (% boulder & cobble)	>50%	30% - 50%	30% - 50%
Aquatic Habitat (% pools)	>50%	40%-50%	<40%
Cover Habitat (# of items of cover in 40 m section)	>12	8-12	<8
Riparian Vegetation	Many trees and shrubs (over 800trees/ha)	Many shrubs	Few trees and shrubs

Significance

Aspect or the direction the slope is facing can influence snowpack and snow free conditions; south-facing slopes have less snowpack and earlier freshets; stream temperatures are also warmer on south-facing slopes. The slope or gradient of the stream affects the velocity of the water and the ability of different biota to live in it. The stream velocity can also affect the erosion potential of the stream and its ability to carry material downstream.

Different kinds of stream bed materials influence plant and animal life in a stream. Substrate sizes range from "fines" like silt, sand, and clay, to large boulders and bedrock. Although variety in substrate size is desirable, a stream bed comprised primarily of fine sediment is less stable than one comprised primarily of boulders, cobbles, and gravel. Large substrates also provide better quality fish and aquatic invertebrate habitat.

Stream width provides a description of the kind of stream being sampled and also has legal ramification for protection. The depth of the channel can indicate the volume of water that is carried by the stream and the potential for habitat at different times of the year. A diversity of habitat units increases the habitat value of a reach. The presence of pools and riffles is a critical element for a good habitat rating.

Describing the habitat attributes of the riparian area enables us to assess if the adjacent area is contributing to a healthy aquatic habitat: a source of nourishment, shade, shelter, and sediment filter. Without shelter provided by large woody debris or an undercut bank, aquatic animals cannot escape predation by mammals, birds, or larger fish. The healthy forest along the stream banks contributes habitat cover to the stream (overhanging vegetation, falling logs, etc.) as well as detritus and insects that falls into the stream.

Materials

- Compass (aspect)
- Clinometers (optional to measure slope)
- Meter stick or Hula hoop (to assess bed materials)
- Fibreglass measuring tape (stream width)
- Metal tape measure or metre stick
- Flagging Tape

Resources

- Local foresters or survey consultants may be able to help with equipment
- RIC standards and procedures

1 Criteria Adapted from *Streamkeepers Module 2 Stream Habitat* and *USDA Investigating Your Environment*.

Field Data Form

Before heading to the stream, educators might consider having a practice session, on a school sidewalk, to become familiar with the equipment and methods. Students can be set up in stations that include; aspect (compass), slope (clinometers), width (tape measure), tree density (tape measure) and bed materials (evaluate 5 rock samples).

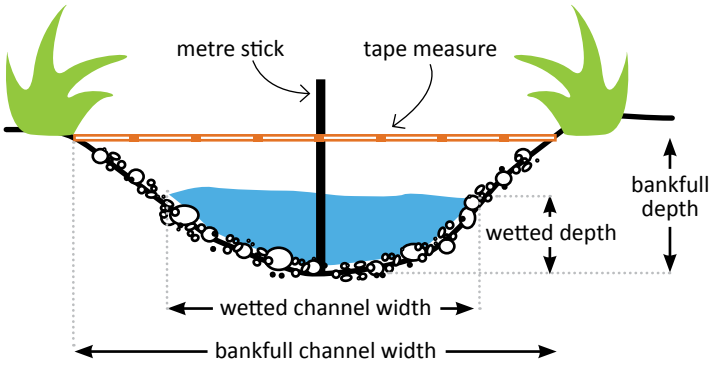
Below is a practice form for student to become familiar with the equipment and inventory techniques before they go to the stream. The students can practice on a sidewalk (slight incline) with 5 equipment stations – tree density plot centre can be established in an adjacent forest or make a 'pretend forest' with 10-15 pylons. Be prepared to provide accurate answers!

School yard 'sidewalk' stream measurements

Field	Equipment	Directions	Result
Aspect	Compass	What direction does the slope of the sidewalk/ stream face?	
Slope	Clinometer	Measure the percent slope of the sidewalk/ stream.	
'Stream' Width	Tape measure	Take 3 measurements of the stream width. What is the average width?	
Tree Density	Tape measure	Record the number of trees/pylons within a 4 m circular plot.	
Bed Materials	Ruler to identify gravels	Identify rocks as A, B, C, or D based on their size. boulder >25 cm diameter cobble 5-25 cm diameter gravel 0.2-5 cm diameter fines <0.2 cm diameter	



Procedures for measuring stream morphology

Stream Morphology	Procedure
	Mark the stream reach into 40m sections. Each 40m sections will be assessed by a group of students. Mark the beginning and end of each section of stream with flagging tape or other marker.
Aspect	Using a compass, determine the direction the downhill slope the stream is facing. Stand on the edge on the stream bank facing downstream. Record the direction.
Slope	Circle the description that is most accurate. If a clinometer is available, measure the percent gradient upstream and downstream from the survey site. Ensure that gradient is measured to a partner's eye level upstream/downstream. The percent gradient is a calculation of the change in elevation/distance (rise/run) so a 10 % grade is a 10 m elevation change over 100 m horizontal distance.
Bed Materials	Place a hula hoop in an average section of the stream bed (hold it down with your foot). Assess the % area of boulders, cobbles, gravel and fines within that circle. Repeat at another location and average observations. If the stream is cloudy, this procedure can be conducted on the stream edge, below the high water mark. boulder >25 cm diameter cobble 5 - 25 cm diameter gravel 0.2 - 5 cm diameter fines <0.2 cm diameter
Stream Width Category	Circle the most accurate description of the stream width based on a visual estimate. These categories are part of a standard stream classification system used in forestry in BC. This field was included in case the stream was unsafe to cross for standard width measurements.
Average Bankfull Width	Using a fiberglass tape, measure a straight section of the reach from rooted vegetation to rooted vegetation. This measurement is a reflection of the potential water level, not necessarily the existing one. The next width measurement should be taken a stream-width from the first (if the stream width is 5 m, the stream measurements should be taken every 5 metres) 
Average Bankfull Depth	Using a tape measure and a metre stick, measure from the level of rooted vegetation to the stream bed. Take 3-6 measurements.
Aquatic Habitat	In the 40 m section of stream, estimate the percent of pools relative to other habitats.
Cover Habitat	Count the number of attributes that constitute cover in the 40 m sample section; woody debris (log over 10 cm), boulders, undercut banks, overhanging vegetation and in-stream vegetation.



Stream Morphology	Procedure
Riparian Vegetation	Evaluate the lowland area adjacent to the stream. Relative to a naturally forested site, does the area have many trees? Conduct a vegetative sample plot, Measure 20 m (20 steps) perpendicular to the stream (20 m ~tree height – distance of influence). Using a tape measure of 4 m to determine the number of trees in the circular plot. A circular plot with a known radius of 4 metres (m) has an area of 50 m^2 (πr^2). The plot multiplier to determine 1 hectare is 200. For example, if you have 7 trees within a plot, you can calculate that there are 1400 trees/hectare by multiplying 7 trees by 200.* * Juvenile Spacing Quality Inspection FRBC

Transition Questions

- *By evaluating the data collected against the criteria provided in the background information, what habitat could be improved?*
- *Based on the stream habitat data, does your stream have good habitat for fish and aquatic invertebrates?*

Stream Information	
Stream Name:	**Date:** (dd/mm/yy) **Time:**
Weather: clear / cloudy / overcast / rain	**Watershed Code:**
UTM Coordinates:	**Reach Number:**
Northing:	**Agency:** **Crew:**
Easting:	**Stream Temperature:**

Stream Morphology						
Aspect:	**N / NE / E / SE / S / SW / W / NW**					*What direction does the stream face?*
Slope:	**Gentle / Moderately Steep / Steep / Falls**				**%**	*Include % gradient if you have a clinometer.*
Bed Materials:						**=100%**
	% Bedrock	**% Boulder** *> basketball*	**% Cobble** *< basketball*	**% Gravel** *< tennis ball*	**% Sand** *< ladybug*	

Stream Habitat					
Stream Width Category:	**< 1.5 m**	**1.5-5 m**	**5-20 m**	**>20 m**	*Visual Estimate*
Average Bankfull Channel Width (m):					*Rooted vegetation to rooted vegetation X3.*
Average Bankfull Channel Depth (m):					*Measure from the level of the rooted vegetation to the stream bed X3.*
Aquatic Habitat:					**=100%**
	% Pools	**% Run/Riffle**	**% Rapid**		
Cover Habitat:					*Tally the number of pieces of cover in the 40m section of stream*
	Woody Debris	**Boulders**	**Undercut Banks**	**Overhanging Vegetation**	
Riparian Vegetation:	**Trees: Many / Common / Few or None**				*Assess riparian vegetation within 30m of the stream*
	Shrubs: Many / Common / Few or None				
Vegetation Plot: (4 m radius)	**Number of trees in plot:**				*Tally the number of trees in a 4 m plot (50 m^2). Multiply by 200 for trees per hectare.*



Fish Inventory and Aquatic Invertebrates

Key Message

Water that has a rich and varied range of aquatic creatures is usually a healthy environment, whereas water with just a few different species usually indicates conditions that are less healthy. Different species of fish and aquatic invertebrates are adapted to different habitats throughout their life stages.

Animals welfare is paramount, be careful not to injure any creatures during this module.

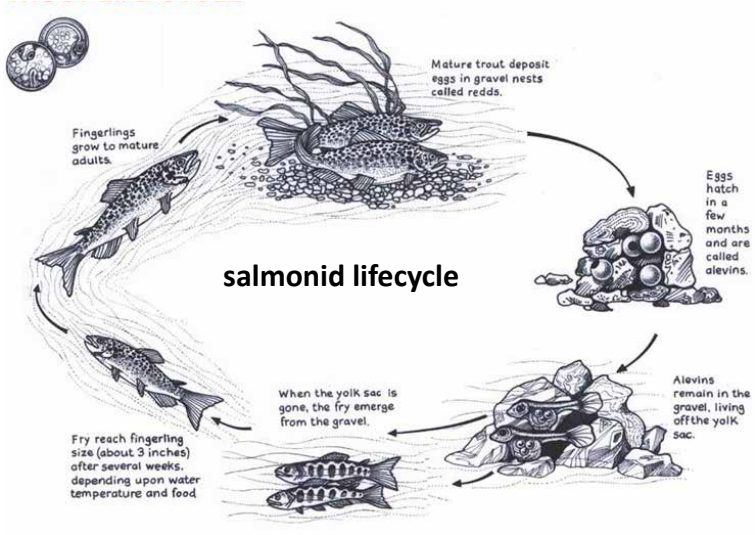
Background

Fish

Generally, fish habitat can be divided into 4 key categories;

- Spawning habitat (eggs require a gravel nest - a '*redd*')
- Feeding habitat (source of food)
- Cover habitat (juveniles shelter in aquatic vegetation and adults shelter in deep pools or under logs)
- Overwintering habitat (water depth >2 m)

This module will focus on cover habitat that includes boulders, overhanging vegetation, logs, and undercut banks. By choosing the placement of their minnow traps, students can 'test' their knowledge of juvenile fish habitat needs – as they will catch more fish in better habitats.



A salmonid life cycle includes Egg, Alevin, Fry, Smolt, Adult and Spawning Adult. More information about Pacific salmon species is available here.

Minnow traps, also known as 'Gtraps', will be used to target juvenile fish. Fish collection permits are necessary, and must be obtained before any fish sampling is undertaken. This is not a difficult process and the agencies are generally very helpful for school programs. Typically the 'license holder' is someone familiar with fish collection procedures. The appropriate Ministry of Environment, Lands & Parks (MELP) regional office must be contacted in regard to sampling for all freshwater fish species, and the appropriate Department of Fisheries and Oceans (DFO) divisional office contacted to sample for anadromous salmon. (*See Appendix for copy of a federal Scientific License.*)

Aquatic Invertebrates



Aquatic Invertebrates includes a wide variety of biota including molluscs, beetles, worms, mites, amphipods and a variety of insects. A basic key is provided in the Appendix.

Life spans of invertebrates range from days to years, depending on the species. Worms, snails, and clams spend their lives in water. Adult aquatic insects live very briefly in the air, mate, and then lay eggs in the water. Most of their life is spent in the water, in the larval stage. Some dragonflies spend 5-6 years in their aquatic larval form and only emerge into terrestrial environments for a few weeks.

Significance



Salmonids

Salmonids prefer clean cool water where food is plentiful and dissolved oxygen is high. Many salmonid species are sensitive to warmer water temperatures (>16°C) and associated low oxygen levels (>6 ppm). Trout populations prefer streams fed by groundwater and are susceptible to stressors such as siltation, urbanization, and riparian destruction.

Clean gravel substrate is necessary for spawning. After the fry emerge from the gravel, Pink and Chum salmon head directly to the sea. Chinook and Coho salmon take up residence in the stream for 6-14 months in deeper pools, around large boulders or log jams, eating mainly insects and other fish. Sockeye salmon stay in local lakes for over a year before heading to the ocean.[1]

Suckers and Minnows

Suckers prefer clear water with coarse substrate such as sand, gravel or cobble. The suckers are, for the most part, sensitive to pollution and habitat degradation. Pollution tolerance varies greatly with minnows, some species can tolerate high degrees of turbidity, disturbance and pollution, other species are only found in pristine creeks and rivers.

Sculpins

Sculpins prefer areas with a current and groundwater influence, and favour gravel, cobble and boulders. They are aggressive predators feeding on insects and smaller fish. Sculpin populations generally decrease in the presence of silt, pollution, and disturbance. Flourishing populations occur in the clearest and cleanest brooks of higher gradients.

Pollution

The impacts of pollution can cover a variety of factors including changes in temperature or turbidity, or more serious chemical contamination of the water. The impacts may range from avoidance and reduced productivity to development of lesions or disease. The following table provides an overview of pollution tolerance for fish families developed in the southern US.

Pollution Tolerance for Fish Families (% of species rated in that family)[2]

Family	Tolerant of Pollution	Moderately Tolerant	Intolerant of Pollution
Salmonids	**0%**	**76%**	**24%**
Minnows	**17%**	**47%**	**36%**
Suckers	**22%**	**43%**	**35%**

1 Pacific Salmon; from egg to exit. Gordon Bell, 1996. Hancock House publishers.

2 An introduction to Freshwater Fishes as Biological Indicators (Grabarkiewicz and Davis, 2008).

Family	Tolerant of Pollution	Moderately Tolerant	Intolerant of Pollution
Sculpins	**0%**	**60%**	**40%**

Aquatic Invertebrates

Many aquatic insects thrive in the gravel and cobble substrate of streams. These habitats provide cover while providing a constant supply of food items. Aquatic Invertebrates are used as key indicators of stream health.

In BC, there are 93 species of Mayfly (Order ***E****phemeroptera*), 131 Stonefly (Order ***P****lecoptera*), and 300 Caddisfly (Order ***T****rihopera*). All require clean water and healthy habitat conditions. These insects are used as an indicator of stream conditions called the EPT Index. Further details of an EPT index can be found in Module 4 of *Streamkeepers*[1]

The following table provides a summary of aquatic invertebrates as an indicator of water quality.

Aquatic Invertebrate Community	Condition
High diversity, lots of pollution sensitive invertebrates (like EPT taxa)	Good water quality
Low diversity, high numbers, lots of scrapers and collectors	Lots of algal growth resulting from nutrient enrichment (fertilizers)
High diversity and low numbers; or no insects, but the stream appears clean	Toxic pollution (e.g. Chlorine, acids, heavy metals, pesticides, oil) or another severe problem of unknown origin
Reduced numbers of all types of invertebrates	Physical problem (e.g., dam, sediment) or sometimes streams are unproductive for natural reasons (cold)

Materials

- Minnow traps (Gtraps)
- 5 gallon buckets with lids
- Dip nets (Nets with a flat top works best in a stream - the net can rest flush to the stream substrate.)
- Bait for traps (can of tuna or sardines, or a small nylon bag of dry catfood)
- Key to fish identification and aquatic invertebrates
- Small transparent aquarium

Resources

People

- Local DFO office
- Local fish conservation NGO (Pacific Salmon Foundation, Local Salmon Society, Trout Unlimited, etc.)
- Fisheries Biologists or Hydrologists working for the Government of BC in your area

Websites

- Pacific Salmon Foundation
- Streamkeepers
- Aquatic macroinvertebrate fact sheets
- Freshwater invertebrate ID guide
- Guidelines to sampling benthic invertebrates
- Juvenile fish identification

Book

- Field key to the Freshwater Fishes of British Columbia; RIC. May 1994. J.D. McPhail and R. Carveth. Gov Publication Center

1 Streamkeepers Module 4 Aquatic Invertebrates

Field Data Form

Fish Inventory	Procedure
Setting and recovering GTraps	1. Place traps in good habitat in the stream a day prior to sampling. Likely locations are near undercut banks, under a log or overhanging vegetation. Orient the trap parallel to the current (so fish will follow the bait sent into the trap - make sure bait is on upstream side of trap). 2. Wait ~24 hrs to retrieve the trap. 3. Fill a bucket with stream water and take it to the trap 4. Untie the trap from the branch and gently place the fish into the bucket, place the lid on the bucket and return to shore. 5. Identify fish - may be easiest using a clear aquarium or sterile plastic bag filled with water. 6. Return fish to stream unharmed
Trap Number	Write down the number marked on the Gtrap
Time In	Enter the date and time and day the trap was placed in the water
Time Out	Enter the date and time and day the trap was removed from the water
Species	Identify the species of fish
Family	Identify the family of fish
Aquatic Invertebrates	**Procedure**
Invertebrate collecting	1. Become familiar with groups of common aquatic invertebrates by studying guides or keys, especially Stonefly, Caddisfly and Mayfly insects and life cycles. 2. Visit your stream of study or a local pond to collect and identify aquatic invertebrates. 3. Ponds: Using a dip net, scoop water near weeds or along rocky bottoms. Invert net into a bin of water and rinse the items on the net into the bin. Sort the different kinds of aquatic invertebrates into ice cube trays. Ensure all creatures are immersed in water. 4. Streams: Sample a shallow riffle area with moderate flow and cobble substrate. Fill the bucket with water and leave it on the stream bank. Approach the area from downstream with the Dnet and place the net downstream of the sampling area holding it firmly to the stream bed. Ask the students to stand upstream of the Dnet and agitate the streambed with their feet "(Do The Twist"). This will dislodge aquatic invertebrates in the stream bed and carry them downstream into the net. Larger stones should be picked up and lightly scrubbed with a brush to dislodge invertebrates clinging to the cobble. Take the net to the stream bank and turn it inside out in the bucket filled with stream water. Shake or scrape to slide the insects into the bucket if necessary. 5. Return all aquatic invertebrates back to their habitat.
Sorting and counting	Sort the aquatic invertebrates into ice cube trays, placing the same kinds into the same tray. This will give you the Number of Different Kinds of Aquatic Invertebrates in the Sample. The diversity of species in the field sample is also an indicator of stream health; at least 12 kinds of invertebrates indicates a healthy invertebrate community.

Stream Information	
Stream Name:	**Date:** (dd/mm/yy) **Time:**
Weather: clear / cloudy / overcast / rain	**Watershed Code:**
UTM Coordinates:	**Reach Number:**
Northing:	**Agency:** **Crew:**
Easting:	**Stream Temperature:**

Fish Inventory				
Trap #	**Time In**	**Time Out**	**Species**	**Family***

* Likely fish families include salmonids, whitefish, sculpins, minnows, and suckers

Aquatic Invertebrates	Number Tally
Number of different kinds of aquatic invertebrates in the sample (sort them into ice cube trays):	
List aquatic invertebrates you are able to identify, note any species of stonefly, mayfly, and caddisfly:	

Application for Scientific License
Fisheries and Oceans Canada - BC

Please provide the following information in order to process your application.
If you require more space to fully explain your project, please attach additional material as required.

Company Name: _____

Address: _____

_____

Contact Name (License Holder) and Date of Birth: _____

_____

Email Address: _____

Phone Number: _____

Fax Number: _____

Client's Name: _____

Names and Dates of Birth of Crew Members: _____

_____

_____

Collection Period - From: _____ **To:** _____

Collection Area:

a) Identify Major Watershed (eg: Fraser, Skeena, Peace, etc.): _____

_____

b) Rivers/Streams and Locations: _____

_____

Species (Quantities): _____

_____

_____

Retention (Quantity) or Non-Retention: _____

Collection Methods: _____

Vessel permitted to be used: _____

Appendix

Freshwater Fish Distribution in BC

Distribution of Families of Freshwater Fish in the Eight Biogeographical Regions of BC.

Family	S. Coast & Vancouver Island	Fraser	Columbia	Mackenzie	Yukon	N. Coast	Haida Gwaii	Central Coast
Lamprey	X	X				X	X	X
Sturgeon	X	X	X			X		X
Herring	X	X				X	X	X
Minnow		X	X	X	X	X		X
Sucker		X	X	X	X	X		X
Catfish	X	X	X					
Smelt	X	X				X	X	X
Salmonid (salmon, trout, char)	X	X	X	X	X	X	X	X
Salmonid (white-fish)		X	X	X	X	X		X
Salmonid (grayling)			X	X	X	X		
Cod		X	X	X	X	X		X
Stickle-back	X	X		X		X	X	X
Sculpin	X	X	X		X	X	X	X
Sunfish, Bass	X	X	X					
Flounder	X	X				X	X	
Perch			X					
Golden-eye				X				
Pike				X	X			
Trout-Perch				X				

There are a variety of fish species within each family. For example Sockeye salmon (*Oncorhynchus nerka*) and Rainbow trout (*Oncorhynchus mykiss*) are both salmonids. Minnows include the Longnose dace (*Rhinichthys cataractae*) and Redside shiner (*Richardsonius balteatus*). Sculpins include Slimy sculpin (*Cottus cognatus*) and Prickly sculpin (*Cottus asper*).



Stream Habitat Assessment Table

A stream with good quality habitat for fish and aquatic invertebrates will have the following attributes. After conducting the stream habitat assessments, review this list to evaluate the habitat of the stream. Place a ✔ (or an ✖) in the last column if the field meets the criteria.

Riparian Area	Functioning riparian area that can filter runoff, contribute detritus and structural material (trees/logs) to the stream.	
Connections	Stream is connected to fish bearing stream and overwintering habitat (>2m deep).	
Watershed Impacts	The majority of the stream has not been impacted by human development.	
Contaminants	Contaminant sources are minimal (only a few, well managed farms and a few storm sewers).	
Fish	Salmonids and Sculpins are present.	
Aquatic Invertebrates	A high diversity of species (>12) identified including stonefly, mayfly and caddisflies.	
Slope	Less than 5% gradient.	
Substrate	>50% Cobble and Boulders.	
Aquatic Habitat	>50% Pools.	
Cover Habitat	There are at least 12 pieces of cover habitat in a 40 m section of stream (logs, boulder, overhanging vegetation, undercut banks).	
Riparian Vegetation	There is a forest of at least 800 tree/ha (> 4 in 50 m^2 plot).	
Stream Temperature	<12°C	

What attributes of the stream need improvement? What can we do to help the stream out[1]?

- Will planting more trees/shrubs help?
- Can we create pools in the stream?
- Should we add more gravel/cobble material?
- Can we create more cover habitat?
- Can we discuss our concerns with someone?
- Can we improve storm sewer runoff to mitigate contaminants?

1 Any in-stream works needs professional design and government approval.



Safety Procedures

Concern for personal safety is essential when working outdoors.

- Always tell someone where you are going and when you will return.
- Work in pairs, never alone.
- Do not attempt to wade in fast water or water deeper than your knees. Watch out for slippery stream beds, undercut banks, waterfalls, and fast flowing areas. Do not step on logs. Test boulder and rocks before putting full weight on them. Log jams can be unstable, so take care to walk around them.
- Get permission to cross or use private property. Beware of domestic animals and wildlife.
- Warn everyone, especially children, about urban hazards such as syringes, needles, broken glass, and condoms. Remove them with tongs and place them in a special hazardous materials bucket, or flag them with bright tape. Avoid foul smelling areas, spills of unknown substances, or containers of hazardous or unidentified materials.
- Carry a phone and the numbers of emergency contacts.