Inquiry-based Ecological Explorations in the Bras d'Or Lake Biosphere

Animals and their habitats; A question of balance
An Integrated, Multidisciplinary, Inter-Cultural Curriculum Resource for Elementary Classrooms

Bras d'Or Lake Biosphere Reserve Association
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Acknowledgements

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Background for the teacher

The Bras d'Or Lake Biosphere Reserve (BLBR) is nestled in the heart of Unama'ki, one of the seven traditional districts of the Mi'kmaw nation. This territory is covered by the "Treaties of Peace and Friendship" which Mi'kmaq and Wolastoqiyik (Maliseet) people first signed with the British Crown in 1726. The treaties did not deal with surrender of lands and resources but in fact recognized Mi'kmaq and Wolastoqiyik (Maliseet) title and established the rules for what was to be an ongoing relationship between nations. The indigenous Mi'kmaq have been joined by settlers from all over the world in this ancestral territory. With new waves of settlement have come newcomers to this unique ecosystem which often have disturbed the balance of the ecosystem.

Student-Centred Learning and Indigenous Philosophy

This unit is largely based on Indigenous philosophy of natural balance. The teaching strategy may be unfamiliar. To gain some understanding of the cultural bridges that are built between Western and Native Sciences, references to some resources are included at the end.

From Hatcher et al (2009):

> *"In the Indigenous Worldview, knowledge and the knowers or learners are intimately connected, in contrast to their separation in many Western Sciences. Because of this connection, Indigenous knowledge is more*

> *accurately described as Indigenous ways of living in nature (Aikenhead & Ogawa, 2007). Indigenous ways of living in nature are strongly place based and the goal of Indigenous Sciences is to become open to the natural world with all of one's senses, body and spirit (Cajete, 2000). Self-identities of Indigenous people are inextricably tied to their place in contrast to the common Eurocentric notion of land as a commodity. In the Indigenous Worldview, the Earth is so sacred that it is "Mother," the source of life (Little Bear, 2000). Indigenous Sciences represent a way of knowing which is relevant to all aspects of Indigenous tradition (Cajete, 2000). They are contextual and experiential, in direct contrast to many Western Sciences. In verb-based Indigenous languages, knowing is more about the journey than the destination. Indigenous Sciences is a plural term because of the diversity related to the strongly rooted place-based traditions that form their foundations. In Indigenous languages, knowledge is a verb, and the teacher and learner both play a constructive part in it. Thus, the Western concept of knowledge is more aptly referred to as a coming to know process in an Indigenous context. The children learn by close observation and not by being verbally taught. They have to learn to be close observers of nature. Advice is given indirectly in the form of legends and stories because there is a trust in the human consciousness and the ability of students to draw the conclusions that are best for them. Transformative education acknowledges that the educational process is one of unequal power relationships and that learners should be active creators of knowledge rather than passive recipients.(Royal Commission on Aboriginal Peoples, 1996).*

In this Learning Experience, we are going to appreciate what is meant by 'the balance of nature'. We are going to examine the components of a shallow-water habitat on a beach for its native inhabitants. We are then going to discuss how the balance of habitat components for an invading species might be a bit different and might impact Habitat Balance for native species. We will then adapt this exercise to look at habitat of the northern spring peeper frog, useful for field excursions in colder weather when nearshore excursions may not be comfortable. This Learning

Experience is designed to help elementary science students and their teachers to understand the concept of balance using a medicine wheel, a common metaphor in Indigenous philosophy. Habitat balance is impacted by the invasion of species that are not native to an ecosystem. This idea will be introduced using the example of the European Green Crab, an established invader in the Bras d'Or estuary.

This learning experience provides an opportunity to support many outcomes for the Nova Scotian streamlined 4-6 curriculum in several areas. For example, it provides strong support for the Science 4 Habitat unit. It provides the opportunity to explore a variety of local natural habitats and investigate the interrelatedness among animals, plants, and the environment. This learning experience also supports the new streamlined curriculum outcome for English Language Arts 4–6 because it opens the door to the understanding of habitat and invasive species in the context of Mi'kmaw philosophy. A traditional Mi'kmaw legend about a frog supports a developing environmental stewardship ethic. By using the medicine wheel metaphor, students will have a tool to assess balance in a manageable ecosystem (nearshore estuary or woodland pond) and communicate their understanding. It also supports the curriculum outcome for competency of citizenship in the Grade 4 to 6 streamlined curriculum. By recognizing the impact that introduced species may have on the relationship between native species and their habitats, students will become more informed environmental stewards. It also supports the competencies of creativity and innovation and critical thinking in the Grade 4 to 6 streamlined curriculum. The use of the medicine wheel metaphor gives students a tool to look at animals and their habitats in a totally different, culturally-appropriate way.

Using the medicine wheel in science education

The term 'medicine wheel' refers to a broad understanding of 'medicine' by many North American Indigenous cultures. Medicine is anything that promotes harmony. It is a symbol that helps to visualize balance in a person's life, a mechanism to help restore health because ill-health is visualized as a result of the lack of balance either within one's self or between one's self and Mother Earth. It is used to visualize balance in many natural processes. The term 'medicine wheel' was first used in the 1800's to describe circular stone artifacts left by Indigenous inhabitants of Alberta and the northwestern United States. One of the most famous of these is the

Bighorn Medicine Wheel in Wyoming (http://sites.coloradocollege.edu/indigenoustraditions/sacred-lands/bighorn-medicine-wheel-wyoming/).

The medicine wheel, or sacred hoop as it is sometimes called, is a good metaphor to unify science concepts and has been used in many education systems across Canada. For example, Manitoba and Alberta have re-designed elementary science curriculum using the medicine wheel model to unify science concepts, tie science to other disciplines and pay respect to the holistic principles inherent in the Indigenous world view.

There is no right or wrong way to draw a medicine wheel and its' representation varies among groups and locations. However, all forms convey an understanding of the interconnectedness and interrelatedness of all things. The wheel simply begins as a circle with four equidistant points. The points divide four quadrants which are four different colours. The points or the quadrants represent four teachings, four cardinal directions, four stages of life or many other relationships that can be expressed in sets of four. The medicine wheel metaphor can help us visualize things that are hard to understand as we might use a mirror to see behind ourselves. Within a medicine wheel there can be many rings of teaching which are constructed by considering a subject from four perspectives.

We will use the medicine wheel metaphor according to direction of Mi'kmaw Elder Murdena Marshall. In the east, the quadrant is red for the colour of the rising sun. It is the direction of new beginnings, awareness and wholeness. In the south the quadrant is yellow. This is the direction where warm breezes originate and renew life through the cycles. The quadrant in the west is black, representing knowledge, experience and inter-connectedness. In the north the quadrant is white, representing wisdom, balance and respect. To obtain that balance of the north, one needs to re-visit the other cardinal directions.

According to Lane et al (1984), the four First Principles for the medicine wheel are:

1. Everything is connected, and part of a larger whole.
2. All creation is in a state of constant change.
3. Changes occur in cycles, circles, or patterns.

4. A balance is important, because this honours all areas of reality, and all areas have an impact on all other aspects.

Habitat: To dwell

The word 'habitat' is derived from the Latin word *habitare* meaning 'to dwell' and it means the natural home of an organism or a population. The habitat of a flea may be a cocker spaniel and the habitat of sweetgrass is the exposed, wet soil on the shore's edge. Animals that migrate may depend on different habitats at different times of the year. The habitat of juvenile salmon in the BLBR may be Middle River but the Atlantic Ocean provides habitat for the adults. The summer habitat of the five species of shorebirds that are known to breed in the BLBR is local marshland but they may choose to overwinter in a tropical rainforest in Venezuela. The Bras d'Or Lake Biosphere provides habitat for many species, both resident and migratory. It is a very unique habitat in that it contains populations of arctic and of tropical species which arrived here a long time in the past when the sea levels were higher and the Atlantic Ocean was a different temperature.

Optimal habitats satisfy the needs of their inhabitants in terms of food, water, warmth, shelter and many other things. The goal of this learning experience is to examine the basic components of animals' habitats and how the animals define their habitats based on their requirements. Another goal of this exercise is to develop an understanding of how a newly-resident species might relate to its' new habitat. The Green crab, which is a recent arrival in the Bras d'Or estuary is used as a model species and the students will examine the habitat balance wheel to come up with ideas about how this species may modify the habitat balance for other species that have resided in the estuary for much longer.

Habitat balance is a learning experience which accompanies a visit to the shoreline of the Bras d'Or estuary. This is an activity that will be carried out on the shore, so choose a nice day and have the students dressed accordingly and prepared properly. Immediately after observation, students should fill in Habitat Balance sheets. This is described in detail. The exercise has been adapted to examine the habitat of a northern spring peeper frog which may appeal to teachers

during the spring (May- June) when the Bras d'Or waters are cold and weather is less predictable than early autumn (September).

Visualizing a balanced habitat

This exercise involves a visit to the nearshore area of the Bras d'Or estuary allowing the students to observe the communities of plants and animals. They then will choose target species and categorize and record their observations on a supplied Data sheet. After careful contemplation and analysis they can then use their Data Sheet to fill in a medicine wheel which helps them to visualize habitat balance according to the species' needs.

Figure 1: Students using underwater viewing tubes to look for crabs in the Bras d'Or estuary. Photo from Bras d'Or Watch 2017, Bras d'Or Lake Biosphere Reserve Association.

Preparation for 'Habitat Discovery'

1. Teachers should find a safe shallow-water area where students can wade and explore with boots or waterproof sandals and a glass-bottomed bucket. It is better to choose a cobble or gravel beach for this activity to minimize the disturbance of mud and resulting loss of visibility. Take care to avoid larger rock platforms because they can be very slippery. Alternatively, a safe dock may be used (see Figure 1).

2. Teachers are strongly advised to seek the assistance of a Mi'kmaw Elder or knowledge keeper to help them with this activity. Elders can be contacted through the Unama'ki Institute of Natural Resources in Eskasoni (Cape Breton) or Mi'kmawey Debert (http://www.mikmaweydebert.ca/home/sharing-our-stories/education-and-outreach/)
3. When inviting an Elder or knowledge keeper into the classroom, it is important to consider carefully the lessons that you want to impart to the students. Each Elder has unique knowledge and experience and you should form a relationship with them before they visit the class. Let them know what the students have been studying.

4. Students should have a field journal within which they can take notes about what they see. They should draw sketches of the habitats and animals that they are examining.
    a. When the students arrive at the shore, the teacher or guide should walk with them along an area beside their study area (so that the study area won't be disturbed) and point out the common plants and animals.
    b. This exercise should be a follow-up to a classroom activity where the students are introduced to the basic elements in a nearshore environment. Components of the habitat which can be noted include: rocks, periwinkles, mussels, clams, oysters, seaweed (ie: kelp, rockweed), seagrass, crabs, bare sand, bare gravel etc.
        i. Some examples can be found at sites like 'Enchanted Learning' (http://www.enchantedlearning.com/subjects/ocean/Intertidal.shtml). However, keep in mind that many species will look a bit different

because most of these sites feature more southerly species. Also keep in mind that the Bras d'Or estuary has tides which are small and mainly controlled by barometric pressure rather than lunar cycles. Thus, the intertidal area is small or non-existent in most areas of the Bras d'Or estuary.

5. The follow-up activity can be done at a picnic area near the study site or in the classroom following the investigation.

6. Make copies of the Habitat Balance Data Sheet and organism identification sheet for each student.

7. Teacher and students should brainstorm some interview questions beforehand and prepare a thank-you card that will be given to the Elder. Traditionally a gift of tobacco was given as a sign of respect. A tobacco offering is a universal protocol among First Nations people although it may be accompanied by other gifts. When an Elder accepts a tobacco offering, he/she is signifying their willingness to provide information. Always offer the gift of tobacco first as a sign of respect. It is a nice gesture to offer it in a small, decorated pouch.

Brainstorming for Habitat Balance

This exercise is to introduce the students to the nearshore ecosystem as a 'habitat'. This basic framework can easily be transferred to other animals and their habitats, as Simon Sylliboy has done for spring peeper frogs (see page 24). The teacher will need to do a bit of background research on the alternate animal and determine what its' basic needs are. Perhaps the class would like to examine the habitat of a grasshopper in a field or a salamander under a rock. There are many interesting possibilities.

Students will not be making measurements but will be conceptualizing their comparative observations as the first step in the formation of a more specific scientific question or hypothesis. Let's get them observing, thinking and building a holistic framework to communicate their observations. The students will fill in categories in the Habitat balance sheet based on what they know from pre-excursion preparation and from their own observations. Some examples follow.

The four suggested categories for the Habitat balance sheet are: Animal or Plant, Portion of their habitat surveyed, Food, Space, Shelter or Energy (Warmth or sunlight for photosynthesis). If a student chooses a periwinkle to study he/she may determine that they are surveying all of the habitat. Some basic research on the target animal will be required and the teacher can point the student to relevant reference material. For example, the student will know from their basic research that periwinkles are herbivores that browse algae on the rocks. They will look for this food source where they find the periwinkle and (probably) find lots. They may have to make some decisions about whether their periwinkle is not getting enough because it is in an area where there are many others. This is a subjective decision which will provide a basis for thinking about competition etc. There have been Ph.D. theses which were based on precise measurements of algal production and periwinkle intake. That is not the goal here. The goal here is to have the student develop a scientist's 'eye' and begin to ask targeted questions about relationships in nature. It will also lead to some decisions about space and how that relates to food supply because the area available to browse is restricted by crowding from other periwinkles. The last quadrant may be 'sunlight' and the student will have to think about how that relates to the periwinkle. Sunlight powers the food web by providing energy to the algae which are then fed upon by the periwinkles. Students may come up with other ideas as well.

Students may have reasons to change the categories in their data sheet. For example, perhaps the category of 'space' may not be considered as important for a site-attached worm as it is for the worm that slithers along the sand surface. Let the students use their imagination as they design their data collection and medicine wheel design as long as they can justify their modifications. Allow them artistic freedom to decorate their completed habitat balance wheels and display them in the classroom.

Instructions: Habitat Discovery

Materials:

1. Glass bottomed bucket or underwater viewing tube
2. Notebook or audio/visual recording device for each student
3. Habitat balance datasheets (everyone gets a copy of Figure 2)
4. Organism identification sheets
    a. Teacher can make a copy of Figure 3 or use the more detailed sheets available on the Bras d'Or Lake Biosphere Reserve Association website: (https://blbra.ca/initiatives_post/bras-dor-watch/)
5. Tobacco (in a small pouch that the students decorated) and Thank You Card for the Elder

Procedure:

1. Teachers should visit the habitat to be studied beforehand and make a list of common animals/plants. It would be beneficial to have photographs of the site and the inhabitants for students to examine before the excursion. The pre-preparation in class will involve some simple research about the animals' requirements. This research can either be an individual or group exercise. To keep the learning experience manageable, the teacher should choose two or three common animals in the habitat and then assign a group for each one.
2. Go to the shore with your class. The class will have a basic familiarity with some of the animals and plants that they will see in the nearshore area. Use the Mi'kmaw names and the English names so the students will become familiar with both. Upon arrival at the shallow-water habitat, ask the Elder about how humans interact with nature. You will learn about Mi'kmaw approaches to environmental stewardship, about responsibility and respect for Mother Earth.
    a. This exercise could be accomplished without the involvement of an Elder or knowledge keeper. However, the cultural context of 'the balance of nature' will be lost or diluted without such involvement.

3. Following the introduction from the Elder or knowledge keeper, you should wade in the shallow water and make observations using the glass-bottomed bucket and/or the viewing tube. Start the field work by doing a wading excursion to an adjacent area so that the study area won't be too disturbed when the students start to note their observations. Take notes and make sketches in your field notebook. Think about habitat. It is important to cause minimal disturbance to the animals; this is their home.

4. Look for any signs of animals and plants. There may be live animals and plants (some are very small), pieces of dead animals and plants, shells or pieces of skeletons, or the animals' droppings or footprints. Ask the Elder or knowledge keeper to point out the edible plants. It is important to wade slowly and allow lots of time for discussion and questions. If you find their traces (tracks or scats), think about what animals might use that area as habitat. Spend a long time staring at a particular spot and you will start to notice things that are missed in a brief scan. The teacher should take this opportunity to explain to students that they have to concentrate to be able to observe effectively. Don't forget that the sizes of habitats vary. Your study site may encompass all of the habitat of a small segmented worm but only 10% of the habitat of a rock crab!

5. Once you have completed your observations, you should summarize your observations on the Habitat Balance Data Sheet (Figure 2). A simple identification sheet for some common species is included (Figure 3) and a sample of a completed Habitat Balance Data Sheet is included (Figure 4). If you think that some important observations are being missed, add other items to the Sheet.
    a. Students may wish to explore other data collection techniques. For example, they may proceed directly to the medicine wheel and adjust size of the quadrats as they survey the nearshore without filling out the data sheet. Alternatively, they may wish to alter or customize their data sheet after observation and discussion with the other students and / or the teacher. They should be encouraged to adapt the data sheet so that it best represents their unique inquiry. This technique may be a great way for the student to become more familiar with the environment. A

research scientist would rely on a data sheet as it provides an independent record that can be referred to again as a comparison for future trips to the same area or as a comparison to other, similar areas.

6. Complete Follow-up Activity (Unbalanced Habitat; described below).

Figure 2: Habitat Balance Data Sheet

Animal or Plant	Portion of their habitat surveyed	Food	Space	Shelter	Energy (Warmth or sunlight for photosynthesis)

Figure 3: Organism identification sheet for some common residents

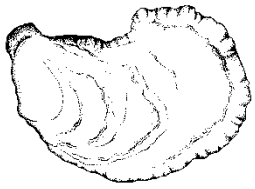
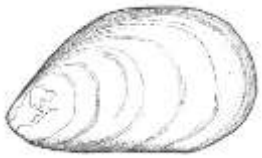
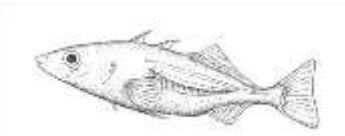
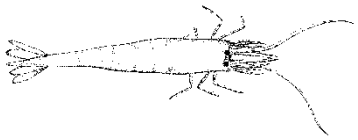
Seagrass Kata'skl 	Oyster mntmu 	Atlantic silversides fish Amjelakwe'j (minnow) 
Small green seaweed J'kulsi'l 	Mussel Ankata'law 	Stickleback fish So'qem'uj 
Brown seaweed J'kulsi'l 	Sand shrimp Sata'siw 	Starfish kakwet 
Periwinkle jikijij 	Northern pipefish Nme'j (fish) 	Eel katew 

Figure 4: Example of a Habitat Balance Sheet which has been filled out

Animal or Plant	**Portion of their habitat surveyed***	**Food**	**Space**	**Shelter**	**Warmth**
Oyster	Close to all	Small portion because their food supply comes in with water currents	Enough (doesn't move around much)	Enough (moves very little as an adult)	Enough on an average year
Small segmented worm	all	Enough small particles in water (dead and alive)	Enough (doesn`t move around much)	Enough (burrows in sand)	Enough (Can burrow deeper if needed)
Green seaweed attached to a piece of gravel	all	Enough (needs sunlight and nutrients)	Enough (water flows past and delivers nutrients; is not shaded by anything)	Enough sunlight (water clear and shallow)	Enough (overwinters as dormant spores)
Sand shrimp	Maybe 1/2	Small animals and pieces of dead things picked off bottom	Not enough (many sand shrimp which seem to be crowded)	None here (needs larger rocks to hide under)	Enough (can move to warmer water if needed)
Green crab	Much less than 1/4	Not enough (must travel far to get enough food)	Not enough (very active feeder; needs more space)	Not enough (no rocks or seagrass)	Enough (can move to warmer water if required)

Now it is time for the student to start thinking about their observations to put into a medicine wheel. If all four quadrants of the species' habitat were in balance, the medicine wheel would look like this:

Figure 5: Habitat Wheel showing a `balanced` nearshore habitat

The students will take some time to design their habitat wheels and this will require some research to identify habitat characteristics. An 'ideal' habitat wheel is pictured in Figure 5 where the animal's needs for warmth, space, food and shelter are met and balanced. The quadrants will change shape with changes in the animals' needs or quality and or size of the habitat. This exercise draws on the students' abilities to imagine and reason. It is not an exercise in measurement. Every medicine wheel may look different and the important thing is that the student can justify their decisions. There is no right or wrong way to conceptualize Habitat balance. The survey that the students undertook on the shore covered different proportions of the total habitats of some organisms. For that reason, the habitat wheels for some surveyed species may not be balanced.

Sharing Habitat Wheels with Collaborators

The drafting of habitat wheels is a way for the student to conceptualize the environment from the viewpoint of one of the inhabitants. The next step is to share the observations that led to the individual habitat wheels with the other students. The students should be given some class time to present their wheels to the class and discuss their reasons for sizing the quadrants. After this class discussion, students should be encouraged to revisit their own habitat wheels and revise them if they desire. Science is a collaborative activity and this exercise will help the students realize that there are different opinions about habitat balance from each of the observers and that we can learn from others.

Unbalanced Habitat: Animals that don't belong

To help the student start to think about interconnectedness of all components and species in an ecosystem, we will spend some time thinking about how an invading species may impact habitat balance for residents. We have chosen the European Green Crab as the invader. These crabs are now common in the Bras d'Or estuary. They may be visible during the 'Habitat Discovery' exercise. If not, researched information can help the student fill in a Habitat Balance Sheet and draw a medicine wheel.

Crabs which dwell in the Bras d'Or estuary (in Mi'kmaq nmjinikej)

There are two obvious species of crabs in the shallow areas of the Bras d'Or estuary which can be easily seen using an underwater viewing tube (as pictured in Figure 1) or a glass-bottomed bucket (available at most fishing and yacht supply stores). This is a popular activity during Bras d'Or Watch Field Day, a family-oriented citizen science event that takes place in the Bras d'Or estuary every July. When the water is warmer (ie: in September) European Green Crabs will almost always be visible.

The Rock crab (*Carcinus irroratus*) (Figure 6) and European Green crab (*Carcinus maenus*) (Figure 7) are similar sizes. The Rock crab is native to the Bras d'Or estuary and the Green Crab is invasive.

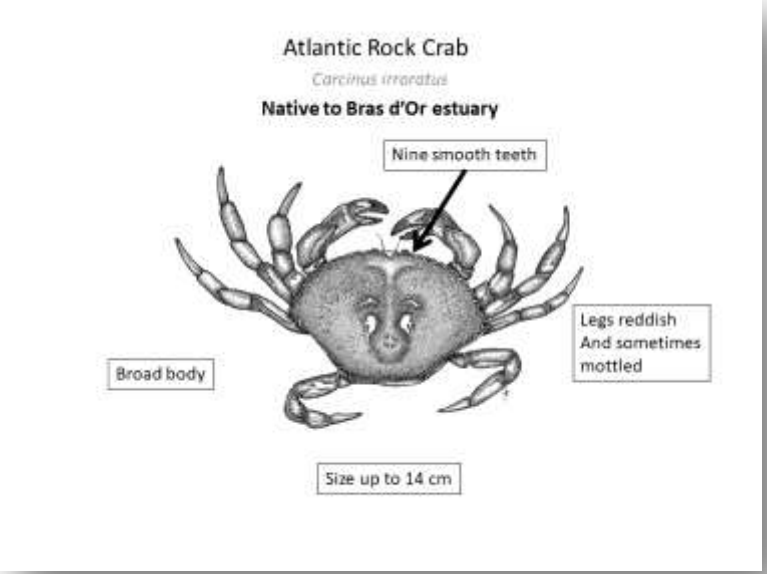


Figure 6: Rock crab

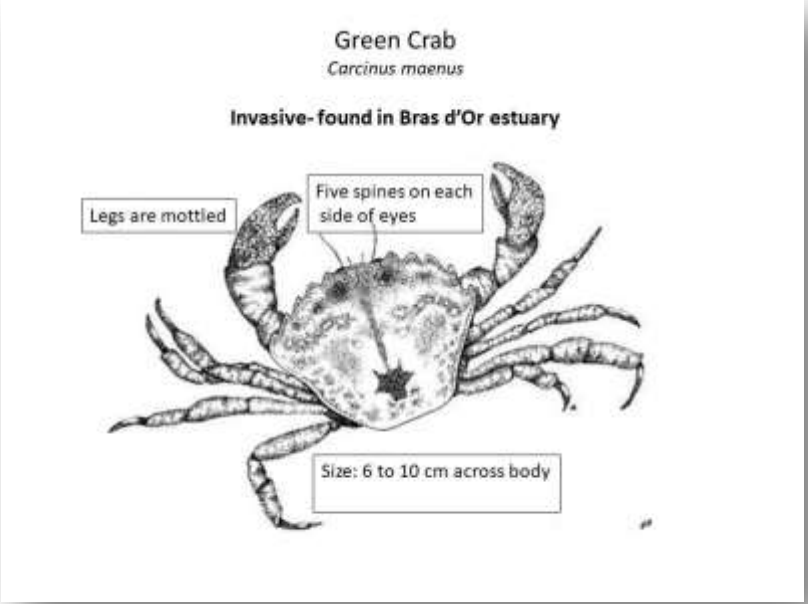


Figure 7: Green crab

Rock crabs occur on the eastern coast of North America, from Labrador to South Carolina. They are largely carnivorous, eating an assortment of marine animals including young lobsters. The main predators for adult rock crabs are lobster and Green crab.

The Green crab is ranked among the worst alien invasive species in the world. In many ways it could be considered a model invader. It is a native of coastal and estuarine waters of Europe and Northern Africa but it has successfully invaded the Atlantic and Pacific coasts of North and South America, South Africa, Australia, and Asia. The species likely originated in the Mediterranean and were first introduced to New Jersey in 1817. By the 1950s, the crabs found their way north to waters off southern Nova Scotia. In recent years, they have rapidly expanded their range around Cape Breton, north to Prince Edward Island the Magdalen Islands of Quebec and into Newfoundland. These crabs are largely carnivorous, but they have been destroying seagrass beds (Figure 9) by digging up the plants to get at animals in the mud. Green crabs were first documented in the Bras d'Or estuary in the 1970's. They eat almost anything, live or dead, and are very aggressive. The species has a wide tolerance for salinity, temperature, and oxygen levels. (http://www.dfo-mpo.gc.ca/Library/330845.pdf).

A Rock crab can be distinguished from a Green crab by its scallop-shaped carapace (main body) consisting of nine rounded teeth on either side of the eyes. Green crabs have five pointed spines appearing on the outside of each eye and the three small rounded spines between the eyes. Other characteristics of green crab include slightly flattened back legs that aid in its rapid movement. Its colour can range from bright green, brown and orange to red, often depending on how recently the crab has moulted.

Figure 8: Seagrass beds of the Bras d'Or estuary (upper panel). The dead grasses wash up on Bras d'Or beaches (bottom panel) to form habitat and a food source for many animals. Photographs submitted by B. Hatcher.

Unbalanced Habitat: Teacher's background

For this exercise, the teacher should encourage the student to think on a broader scale. For example, we will look at the Green Crab. This exercise can be accomplished in the classroom after the visit to the shore. After that visit students will have a good idea of what a Green Crab habitat looks like and they may have even seen a green crab or two in the habitat. Ideal habitat for this species can be identified as: protected or semi-protected wave exposure, mud or sand flats in the intertidal and eelgrass in the subtidal. The intertidal area (zone between low and high tides) of the Bras d'Or estuary is very small because the tides are largely controlled by barometric pressure changes rather than the lunar cycle. The extensive seagrass beds of the estuary are important habitat for the Green crab.

If a Green crab moved to a habitat with no seagrass, it would use alternate sources of food which may require more time and energy to hunt and process. Thus the balance of food available within the habitat may change if space remains the same (see Figure 9). Shelter will also be impacted because the crabs hide within the stems of the eelgrass. Space will increase because the animals that the crabs will now hunt and eat will probably move along the surface of the sediment. There will be no seagrass rhizome (underground stems) structure to feed oxygen below the sediments or to break up the hard surface. Therefore, the animals that the crabs prefer to eat will not find the habitat suitable (ie: their habitat balance wheel will be impacted).

The students will begin to discuss various aspects of the habitat balance wheels that they develop for the green crab and (maybe) compare them to habitat balance wheels that they constructed for the animal or plant studied during the field excursion. Students respond well to this learning approach and, because of the presence of an Elder, will remember lengthy stories months after the lesson. Many teachers will not be comfortable discussing the Aboriginal worldview, so they should have this taught by an Elder where possible.

Figure 9: Impacted habitat wheel

Some questions that might come up for the Elder or knowledge keeper are:

1. How did your ancestors use seaweeds?
2. Are any significant medicines found in the habitat that we studied? (Note: In this context, medicines are traditionally-used plants that are tonics (usually vitamin-rich) or particular plants that have been used to treat wounds and illnesses).
3. Would the habitat have looked different when your ancestors lived here?
4. What other animals depend on some foods from the area that we studied?

After this activity the students will be able to:

1. Gain a better appreciation of what 'the balance of nature' might mean. They will think about habitat using the metaphor of the medicine wheel, which emphasizes the cyclic, balanced nature of life. This appreciation of connectedness and relationships aligns well with a holistic view of our place in the natural world.

2. Learn that Mother Earth's secrets are revealed to them when they become more careful and patient observers. Students should be prepared to use their powers of observation to explore the habitat.

3. Develop a stronger environmental stewardship ethic. Local habitat studies which incorporate traditional knowledge and which honour the original inhabitants of the Bras D'Or watershed will plant the seeds of environmental stewardship in the students. They will feel more personally connected to the ecosystem.

4. Understand that habitats and ecosystems change over time. Students need to gain an appreciation that the environment didn't always look like it does today and that many people lived here and walked the same path before we did. A short lesson in Mi'kmaw history may prepare the student.

5. Students should appreciate the role of an Elder in Mi'kmaw society. An Elder is not just an old person. He or she is a person who is entrusted by the community to teach about their cultural heritage. A Mi'kmaw Elder is someone who exhibits seven gifts from the Creator: love, honesty, humility, respect, truth, patience and wisdom. These gifts are delivered approximately every seven years, so a person who has all of them is fairly old!

From Crabs to Frogs: A modification of the Habitat Balance Learning Experience

There are many beautiful days in spring in the Bras d'Or Lake Biosphere when you would like to take your students outside. However, the Bras d'Or estuary water is cold at that time of year so you may want to examine the habitat of a creature that is closer to the school and doesn't require wading in the water or looking through a viewing tube. Simon Sylliboy designed and tested a modified habitat balance exercise which is perfect for the spring when the spring peepers herald the warming weather of the new season in freshwater wetlands across the Biosphere.

Teacher's background for: Frogs in the Bras d'Or Lake Biosphere; Jijawej

The Mi'kmaw word for May is Squoljuiku's which translates to 'frog croaking time'. The scientific name for the Jijawej (northern spring peeper) (*Pseudacris crucifer*) reflects its' distinguishing feature (Figure 10). The species name 'crucifer' means cross-bearer, because of the obvious X on their little backs. They are tiny frogs, weighing in at about 4 grams with a body length of about 30 mm, which is slightly larger than a twoonie. Although the spring peeper is

often called a tree frog because of its' toe pads for climbing, it is usually hidden in the dense vegetation and leaf litter around ponds and swamps at ground level.

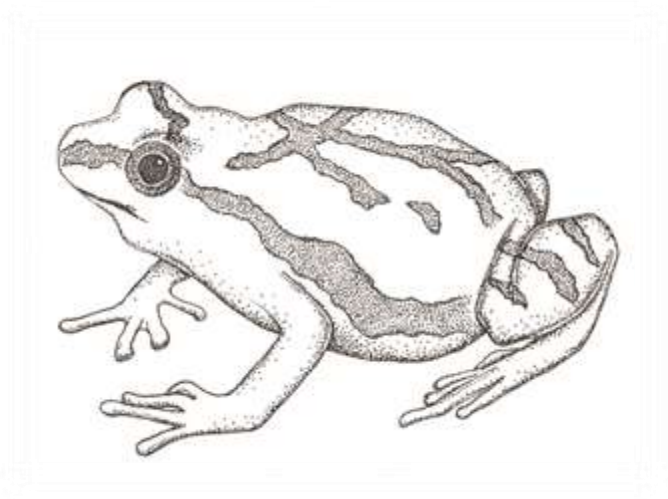


Figure 10: The spring peeper; Jijawej

In the Bras d'Or Lake Biosphere, the first calls of the northern spring peeper are anxiously awaited as they herald a much-anticipated change in the weather. Northern spring peepers can be found from southeastern Canada throughout the eastern United States as far south as northern Georgia. That all-male, love-sick chorus starts in March in the southern end of Nova Scotia but not until April and May in the Bras d'Or Lake Biosphere.

In this learning experience, we are going to examine the habitat of a spring peeper. We are going to assess the components of the habitat, explore whether the habitat is balanced using the medicine wheel, and discuss possible restoration of frog habitats that students may recognize as 'damaged'. This is a simpler exercise that the one on the shore of the estuary. What the students are looking for is a small pond with grasses around the edge. Northern spring peeper frogs need the pond for about 8 or 9 weeks for mating, release of eggs, hatching of eggs and growth of tadpoles into froglets that can leave the water. So, students should examine the pond with this in mind. Is it large enough? Does it have a source of water feeding it? Maybe there are egg masses in the pond or maybe the students can hear the calls of the lovesick male frogs. Have the students imagine that they are a frog looking for a nursery for their offspring. Have they found a suitable

one? Have them answer that question by looking at the medicine wheel that they are developing to determine whether the habitat is balanced.

Jijawej habitat

In the Bras d'Or Lake Biosphere there are many suitable spring peeper habitats. The best ponds are ones that are mainly open with encircling grass and small shrubs. Nearby sugar maples produce a rich soup of water entering the pond which will fuel the aquatic food webs. Other trees such as oaks produce runoff that is not as attractive. A rich diversity of habitat provides a variety of perches for the male chorus and hiding places for the young tadpoles. Interconnecting ponds at the edge of a hardwood forest are ideal!

When the students are assessing 'damaged habitat', they should be looking for low areas that may have been drained or infilled for a road or house construction or areas where all of the trees have been cut down or the tall grasses near a pond cleared.

Preparation:

1. The teacher should locate an area nearby where students can explore. Choose an area such as a woodland pond or marshy area.

2. Students should be familiar with the sound of Jijawej. There are recordings available on the internet (https://www.youtube.com/watch?v=UwVEI5M-948). Although the location of a spring peeper is indicated by its' song, it is very hard to see one as they are very small and cryptic.

Materials:

1. Notebook or audio/visual recording device for each student
2. Habitat balance sheets (everyone gets a copy of Figure 2)

Procedure

1. Ask students to sit quietly for 20 seconds and explore the environment using all of their senses. Ask students how they feel or what does it remind them of. This may lead to a richer discussion of what they sense.

2. After a brief discussion, begin to tell the story of how the bull frog was conquered (see below). Once the story is completed, have a brief discussion about the significance of the story, this can be done through a talking circle. Then begin to discuss the values within the story such as greed, sharing and taking care of water.

    a. Talking circles come from the traditions of indigenous people of North America and are based upon equality among participants. A talking piece such as a feather facilitate communication. Both talking and listening are important in the circle. Only participants holding the talking piece can talk and the others listen. There are many resources available on the use of talking circles in the classroom. As an example: http://www.heartland.edu/documents/idc/talkingcircleclassroom.pdf

    b. Make sure that you let the students know that bullfrogs do not occur in Cape Breton, although they are common in the rest of Mi'kmaki.

3. Once the story is complete, allow the students to explore the habitat for 5-10 minutes. Tell student to describe any animals (including insects which are a potential food source) or plants they see in their Journals.

4. Gather the students in an area for a lesson, discuss the life cycle of the frog and emphasize on the dependence of both terrestrial and aquatic systems the spring peeper depends on. Discuss the importance of frogs in our habitat, such as acting an environment indicator for pollution. If there are no spring peepers around, play a recording to the students and then ask the students what this reminds them of. Most students will have thought that the song of the spring peeper was that of a cricket so their interest will be heightened when told that it was actually a male frog calling for a mate!

5. Tell students that the Mi'kmaq use their senses to understand their world. Traditionally the spring peepers call was used as an indicator for spring, the snow melting, and the smelt run (the journey of the smelt from the ocean up rivers and streams for spawning).

6. Ask students to take out their Habitat datasheets, tell them to explore the habitat and to determine if the habitat is balanced. Can a spring peeper live here? Remind students to look at the available resources to see if food, space and shelter are available for the spring peeper. For example, if students notice insects flying around, they simply write a check mark under the food column to indicate food is available. Do they need to change/ modify any of the categories for data collection?

7. Once they are finished their worksheets, if time permits, allow free time for students to explore the area with their journals. Let them re-examine their data sheet to include any new observations.

Follow up

For a follow up activity, you can discuss ecosystem restoration. Discuss what changes within the habitat will allow frogs to live again in 'damaged' habitats?

How the Bullfrog was conquered

It should be noted here that there are no bullfrogs in Cape Breton (Unama'ki). The reason for this lack is not known. However, this story is often told here as it is all over Mi'kma'ki. This version is from a collection by Stanley Spicer (1991):

> *'A band of Indians lived and hunted by the banks of a little, bubbling stream. They were happy people and they prized the stream for in the whole country thereabout it was their only source of water.*
>
> *One summer they were dismayed to find the brook beginning to run dry. Not even the heavy summer rains helped to swell the water supply. Slowly the stream became smaller and smaller until*

it was completely dry. Now there was trouble. Babies began to cry with thirst and men and women suffered under the hot sun. But there was no water. The chief called a meeting of his braves to discuss the emergency but no one seemed to know what to do. Then one brave said that he had heard of another encampment far up the stream. Could it be that these people had dammed the brook? He volunteered to journey up the stream to find out if there was a dam.

For three days the Indian made his way up the bed of the stream. On the third day he came upon a strong dam which stretched across the brook, cutting off all the water from flowing below. He asked to meet with the chief and was led to a great bank of mud on the side of the stream. Here, in gthe mud, lay a bloated creature with yellowish eyes and broad feet from which stretched very long toes.

The brave recoiled at the sight of this creature but the desperate mission he was on held him steadfast.

"Why have you dammed the stream so that our people have no water?" he asked the chief.

The beast in the mud hardly stirred as he grunted: "If you want water go elsewhere for it."

"But my people are dying of thirst and the stream is our only supply," argued the brave desperately.

The chief laughed. He waddled to the dam and made a small hole which permitted a tiny trickle to flow through. When he had finished he turned to his visitor. "There now, you have water. Go back and tell your people what a generous chief I am."

The Indian followed the little stream of water back to his village but there wasn't enough water flowing to even reach there. It simply ran along the dry earth and sank into the ground. When he had returned and made his report the village was in despair. Not knowing of any other means, the chief selected his best man and ordered them to go to the dam and destroy it, even if they should all be killed in the attempt.

It was while the Indians were preparing for this journey that Glooscap came suddenly among them. In his scalp lock he wore a hundred feathers and on his shoulder rode a great eagle. He was a majestic sight and hope stirred in the breasts of the visitors.

Glooscap went to the chief who explained the dire situation of the village. When he had told his story, Glooscap rose to go. "Keep your braves here," he said. "and I shall go to this encampment myself."

Glooscap travelled at great speed and soon reached the dam. Nearby a boy was playing.

"Bring me some water," Glooscap asked the boy.

"No one can touch the water without the permission of the chief," replied the youth.

"Then get this permission," said Glooscap.

After awhile the boy returned and in his hand he carried a half-cup of muddy water. Glooscap glanced at the brownish liquid with distaste. "Take me to your chief," he ordered.

The boy led Glooscap to the mudpile where the great creature lay sunning himself . Glooscap confronted the beast: "Give me the best water you have to drink, O filthy beast."

The chief sat up angrily. "Who do you think you are to speak thus to me? Get out before I have you in the fire. If you want water, seek your own." The yellow eyes blazed and his great belly shook in his fury.

Glooscap suddenly thrust his spear into the beast's belly. A mighty river gushed out forming pools of sparkling water. He reached down, fastened the creature in a horrible grip and threw him into the mud.

"Henceforth," he commanded, "You will live in dirty water and your throat will be forever dry. May the wrinkles on your back always remind the world what happens to those who prey on other men."

And ever since the frog has followed the streams and to this day he can only make croaking sounds with his dry throat. His back still has the wrinkles caused by Glooscap's mighty grip.

When Glooscap returned to the village he found the people overjoyed with the bountiful supply of clear water which tumbled down the once empty stream bed. In their gratitude they feasted him with venison and succotash with honey. Glooscap appreciated their kindness and asked those seated near him what they would do if they had all the clear, sparkling water in the world.

The Indians pondered a moment, then one spoke up. "I would like to live in the mud by the water and always be cool and wet," he said, remembering the drought and his suffering from thirst.

> *Glooscap smiled and touched him lightly on the forehead. Instantly the man became a leech*
>
> *A second Indian said: "I think I would like to wash up and down with the waves, living on land but ever near the water." He too remembered what ir was like to live without water. Glooscap touched him and he became a crab.*
>
> *A third Indian was silent for a long time. But then he spoke. "I would always like to live in the water, to find my food there and never again have to live on land." Glooscap repeated his magic procedure and the man became a fish.*
>
> *The leech, crab and fish were washed down the stream and out into the open sea. In time their descendants multiplied and spread over all the waters of the earth.*

(note: In Mi'kmaw the 'k' is pronounced as a 'g'. In earlier texts we see 'Glooscap' and in later 'Kluscap' but they both are pronounced the same.)

Background for the teacher on Mi'kmaw Storytelling and 'How the Bullfrog was Conquered'

Lessons delivered through storytelling are often retained more effectively than lessons delivered by other means. Mi'kmaw stories are adapted by the storyteller to suit the intended audience. The story of the infamous greedy bullfrog appears in many compilations and is told to many children but it is always a little bit different. The following excerpt is taken from a discussion by Dr. Cheryl Bartlett and Mi'kmaw Elder Dr. Murdena Marshall which was published in 'HorizonZero Issue 17 (http://www.integrativescience.ca/uploads/articles/2004-Bartlett-Marshall-Kavanagh-how-rabbit-got-his-long-ears-Mi%27kmaq-legend-horizon-zero.pdf)'

> *"Another Mi'kmaq story, the legend of How Bullfrog was conquered, is about the importance of maintaining natural resources in an enriched state by promoting appropriate human*

attitudes with respect to their use. In the story, Bullfrog is the chief of a community - a bloated creature who lies in the middle of the local creek, blocking the flow of water to a second community downstream. When some courageous young men from the affected community discover the source of the blockage, Bullfrog releases a trickle of dirty water. People downstream are dying of thirst, and talk with one another about the need to share. Discovering their distress, Kluscap intervenes: he spears Bullfrog, permitting clean water to flow once again. Kluscap tells Bullfrog that from now on, "You will live in dirty water and your throat will always be dry (croaky). May the wrinkles on your back always remind the world what happens to those who do not share."
…….the frog's wrinkles become a reminder to the people that their communal happiness, health, and longevity depend upon their ability to overcome greed. How Bullfrog was conquered carries the message that individual human greed must be conquered by actions at the community level. The Mi'kmaq concept ***Keknuaqnasit kulaman mikuite'tew****, meaning "via me, remember this message", indicates the symbolism of the gifts/lessons that animals offer human beings through the recollection of these stories. The idea that an animal may offer a lesson for humans conveys something special about Aboriginal worldviews and stories, and their lived relationships with nature. Consider the following comparison: in reductionist worldviews like that of Western science, the world "hangs together" as parts and wholes - nature's patterns are disassembled piece by piece in order to construct understanding. Science tries to explore the unknown while staying largely in the realm of the known. On the other hand, in more "integrative" worldviews like the Mi'kmaq, one must weave oneself into the ever changing, ever transforming patterns of nature; one must participate within it. Nature "gestures" to humans: weaving the self into nature requires an openness to journeys into the unknown, where the gift of creativity resides. Often this involves journeys made possible by animal guides and spiritual warriors. Aboriginal stories constantly call upon the learner to "grow forward", not just "go forward".*

Many Mi'kmaq words from "How Bullfrog was conquered" contain related symbolisms within their meanings. Just as frogs

*undergo metamorphosis from tadpole to adult (**nikwet** means "growing"), an individual human's consciousness should change with time toward a more advanced wisdom, or **nsi-tuo'qn**. Expanding one's consciousness within one's life journey is articulated via the term "wisdom visible" (**nsi-tuo'qn kekunm**). As life advances, there is a necessary movement in consciousness from the level of the individual (**nestu'et**) to the collective (**nestua'tijik**), and ultimately toward the idea that "we are all one" (**nkte'ji'k**). Changing one's thinking from a "me-centred" consciousness to an "us-centred" pattern of thinking is **wiaqi telsi nike**. Other concepts linked to resource sustainability in "How Bullfrog was conquered" include "clean water" or "the flowing is clean" (**waqmapua'q**) and "dirty water" or "the flowing is dirty" (**mejikapua'q**), and also the larger understanding that water is essential for life ("water medicine" is **samqwan npisunapu**; "divine gift" is **ikn namakwemkeway**). Making changes toward the "bad" in terms of sustainability is **emekwe'k,** while changing toward the "good" is **tepjike'k.***

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Notes to teacher: A video or reference books showing a diversity of marine animals and plants might familiarize them with some of the kinds of organisms that they will encounter.

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