CONSERVATION IN ACTION:

An Educator's Guide to Species at Risk in BC for Grades 8 – 12

Module 2: Amphibians at Risk in BC

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Written and edited by
DG Blair and Kelly Nordin
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WILDERNESS COMMITTEE

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An Educator's Guide to Species at Risk in BC for Grades 8 - 12
Module 2: Amphibians at Risk in BC

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Contents

Module Summary:

This module uses a project-based learning approach suitable for science and social studies.

- In Activity 1, students are introduced to amphibians in BC and the challenges they face;
- in Activity 2, they develop appropriate field investigative questions by going through an inquiry and discovery (research) process;
- in Activity 3, they collect information as to the basic biology of the species and/or the current and historical human interactions with ecosystems in a field study of a local wetland; and
- in Activity 4, they begin the process to produce a case narrative about amphibians based on the information they have gathered, to share with students in their school and other community members.

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The Vancouver Foundation – without their generous support, this project would not have been possible.

Students observe an amphibian during a field investigation led by biologist Aleesha Switzer (Sarah Bacon)

PREFACE

Scientists first began to notice a decline in the numbers of amphibians, especially frogs, about thirty years ago. In BC, almost half of all amphibian species are assessed as at risk.

The main threats to amphibians are habitat destruction, invasive species and disease. Because many amphibians require both an aquatic and a terrestrial habitat, loss or damage of either habitat can destroy a population. The draining of wetlands, clearing of forests and expanding urban and agricultural areas all impact the amount of amphibian habitat in the province.

Amphibians are an important component of global biodiversity. As they are very sensitive to changes in their environment, they are indicators of ecosystem health. Today, the need to address the decline in amphibian populations represents one of the greatest species conservation challenges in human history – globally and locally.

The Wilderness Committee has been working hard for many years to raise awareness about BC's species at risk, and to inspire the public to take action. Since 1980, we have helped protect millions of hectares of wilderness including the Khutzeymateen Grizzly Bear Sanctuary and Carmanah Walbran Provincial Park. We have also set legal precedents to safeguard endangered wildlife, including legal judgments requiring the protection of endangered killer whale and greater sage-grouse habitat.

In partnership with teachers, wildlife biologists and curriculum specialists, we have developed *Module 2: Amphibians at Risk in BC* as part of our series of curriculum modules designed for secondary schools, *CONSERVATION IN ACTION.*

Amphibians at Risk in BC uses a project-based learning approach that can be integrated into a variety of classes for secondary schools. This resource gives students the opportunity to learn about amphibians at risk in their local environment, understand the threats those species face, and identify what they can do to help. It encourages students to become scientists in the field as well as educated citizens.

Understanding and solving issues related to BC's amphibians at risk cannot be done within a single discipline. Different issues require different approaches. As a result, this program promotes collaborative activities that facilitate outdoor learning experiences where students and teachers can work within their communities. The resource emphasizes collaborations among teachers from different subject areas including science, social studies, English, art and other disciplines.

This resource does not attempt to be a complete guidebook on amphibians at risk in the province. Rather, we envision it as a way for teachers to work together across a variety of disciplines and introduce issues related to endangered amphibians using real-world activities and problem-solving tools. Through field trips and hands-on exposure to local community groups, conservation biologists and naturalists, we hope this program will inspire students to gain a deeper knowledge and appreciation of amphibians at risk in their communities.

Amphibians at Risk in BC gives students the opportunity to address a "real-world" issue in their own backyard. The guiding principle of this program is to develop educated citizens who are inspired to learn about the topic from different perspectives, help make thoughtful decisions and work toward lasting solutions.

Gwen Barlee
Policy Director,
Wilderness Committee

"Precious Frog" by Sarah Whang, Grade 10 Honours Art Class, Lord Byng Secondary School

Primer for Teachers: Introduction to Amphibians at Risk in BC

In BC, almost half of all amphibian species are assessed as being of conservation concern.[1] Amphibians (frogs, toads and salamanders) are animals that have a characteristic two-stage life cycle – the name "amphibian" comes from the Greek *amphi-* ("two") and *bios* ("life").

Because they require multiple habitat types during their life cycle, a variety of threats – including habitat loss and degradation (especially wetlands), high road mortality and emerging diseases – are causing population declines both globally and in British Columbia.

What are amphibians?

There are three main groups of amphibians in the world:

- The relatively poorly-known aquatic or soil-dwelling caecilians – legless, tailless, tropical amphibians (Order Gymnophonia),
- the more familiar frogs and toads (Order Anura, meaning "tailless"), and
- salamanders and newts (Order Caudata, meaning "tailed").

Most amphibians have an aquatic, gill-bearing larval stage (e.g. the tadpole stage for frogs) and an air-breathing adult stage, during which they may live partially or almost entirely on land. Amphibians are ectothermic; their internal body temperature is dependent on the temperature of their surroundings. The skin of most amphibians is delicate and can absorb water and oxygen, indeed most amphibians breathe partially through their skin. Because of this, water-borne pollutants and pathogens can cause serious damage to amphibian populations, especially during sensitive development stages.

Aquatic-breeding amphibians lay their eggs in spring amongst the vegetation in shallow areas of wetlands, lakes, ponds and slow-moving streams. For the majority of species, larvae develop and undergo metamorphosis in these aquatic habitats within the same year, often in late summer. Most amphibian adults are terrestrial and spend much of their lives near wetlands, streams or in upland forest areas. We know little about how far amphibians travel from their breeding habitat, but some studies suggest that they move hundreds of metres, and sometimes even a few kilometres into upland areas.

Most amphibians in BC become dormant during winter, with the majority seeking cover underground or underwater away from freezing temperatures. A few species, like the wood frog, have a unique physiology that allows them to withstand very cold temperatures by freezing solid in winter and "thawing" when temperatures increase.

Wood frog (Jakob Dulisse)

Who and where are BC amphibians?

There are 13 species of frogs and toads (including two invasive species) and nine species of salamanders in British Columbia. While a few species are widely distributed within BC, many of our amphibian populations occur at the northern edge of their range – which means these species are also found further south in the United States.

Many amphibian populations in BC occur at the northern edge of their range. For example, this map illustrates that the coastal giant salamander is found primarily in the United States, with just a small portion of its range extending north into BC.

Most amphibians are found at low elevations in and near wetland or riparian habitats. However, there are frogs and salamander species in BC that are adapted to live in, or near, fast-flowing mountain streams. These species include the Pacific tailed frog and Coeur d'Alene salamander. There is also one desert-adapted frog, the Great basin spadefoot, which occurs in dry southern interior areas, particularly within the Thompson, Okanagan and Similkameen Valleys[2].

There are two amphibian "centres" or "hot spots" in BC where amphibian habitat needs may be in conflict with urban development and agricultural land use: the Lower Mainland/Fraser Valley and the Okanagan/Thompson regions.[3] Vancouver Island and the Kootenay-Boundary region also provide important habitat for amphibians, many of which are currently listed as species of conservation concern. In the Kootenays, many amphibian species have experienced significant declines, including the northern leopard frog, western toad and long-toed salamander.

Coeur d'Alene salamander (Jakob Dulisse)

Some of the species you are likely to find in these regions are listed below:

Lower Mainland/Fraser Valley	Okanagan/Thompson
Western toad	Western toad
Oregon spotted frog	Columbia spotted frog
Northern Pacific treefrog*	Northern Pacific treefrog*
Pacific (coastal) tailed frog	Wood frog
Northern red-legged frog	Great Basin spadefoot
Northwestern salamander	Long-toed salamander
Pacific (coastal) giant salamander	Blotched tiger salamander
Bullfrog (invasive species)	Bullfrog (invasive species)

** also referred to as Pacific chorus frog*

Northern red-legged frog (Isabelle Groc)

Great Basin spadefoot (Jakob Dulisse)

Why should we care about amphibians?

Amphibians are often inconspicuous and secretive in their habits, and their life cycle is poorly understood by many people. However, they are an important component of global biodiversity. Because they are very sensitive to changes in their environment, they are good indicators of ecosystem health. Amphibians are also valuable as natural insect control.

Why do some amphibian species become at risk?

Scientists first began to notice a decline in the numbers of amphibians, especially frogs, about thirty years ago. Currently in BC, the main threats to amphibian species are habitat destruction, range fragmentation, invasive species and disease. One key reason is that many amphibian species require both an aquatic and a terrestrial habitat (see Table 1). Loss or damage of either habitat can destroy a population. The draining of wetlands, clearing of forests and expanding urban and agricultural areas all impact the amount of amphibian habitat for both larval and adult stages. Several species, like the Oregon spotted frog, have very limited range, making them highly vulnerable to habitat destruction as well as invasive species like the American bullfrog[3].

It is thought that amphibian declines are not caused by any single factor but by a combination of causes. Amphibians in their aquatic stages are particularly vulnerable to any environmental changes. A slight alteration of water temperature, turbidity, dissolved oxygen levels, other characteristics of water chemistry, predatory regime or physical complexity of habitat can be harmful. Most amphibians have moist, sensitive skin, used for both hydration and respiration, so that pollution and pesticide run-off are dangerous to any life stage. Recently, amphibian populations worldwide have been found to be infected with chytridiomycota fungi – a type of fungi that causes skin damage and death. Another fungus (*Saprolegnia ferax*), which is introduced into bodies of water during fish stocking, has also been linked to mortality in amphibian eggs[2].

Amphibian invaders!

Non-native bullfrog populations are increasing and invading BC's wetlands, while the population numbers of native species of frogs – including northern Pacific treefrog and northern red-legged frog populations – are decreasing. Since the early 1900s, bullfrogs (*Lithobates catesbeiana*) have been introduced to southern BC regions multiple times by unsuccessful frog farmers, unknowing gardeners and pet owners. In both adult and tadpole stages, bullfrogs are much larger than any native frog species and outcompete them for space, shelter and food.

As voracious eaters, adult bullfrogs are predators of most any wetland animal, including other frogs! In addition, bullfrogs carry and spread a fungal infection that kills native species.

Green frogs (*Lithobates clamitans*) are also an introduced species, but their distribution and abundance are not well known – nor is their impact. While there are complex factors involved in the decline of native amphibian species, invasive plant and animal species, including bullfrogs, have potentially contributed greatly.

Table 1: Amphibian Habitats in British Columbia

	TERRESTRIAL				AQUATIC				
GENERAL HABITAT TYPES	Rural/ Agricultural/ Disturbed	Forest	Sparsely Veget. (shrub, scrub, rock)	Subterranean	Lakes	Wet-lands/ Ponds	Sloughs/ ditches/ dugouts	Creeks/ Streams/ Rivers	Springs and Seeps
Northwestern Salamander	X	X	X	X	X	X	X	X	
Long-toed Salamander	X	X	X		X	X	X	X	X
Blotched Tiger Salamander	X		X	X	X	X	X	X	
Roughskin Newt	X	X			X	X	X	X	
Pacific Giant Salamander		X	X	X	X			X	X
Wandering Salamander	X	X	X						
Ensatina		X	X			X			
Coeur d'Alene Salamander	X		X	X		X		X	X
Western Redback Salamander	X	X	X	X					
Pacific Tailed Frog		X	X			X		X	
Rocky Mountain Tailed Frog		X	X			X		X	
Great Basin Spadefoot	X		X	X	X	X	X	X	X
Western Toad	X	X	X		X	X	X	X	
Northern Pacific Treefrog	X	X		X	X	X	X	X	
Boreal Chorus Frog		X			X	X	X	X	
Northern Red-legged Frog	X	X	X		X	X	X	X	
Columbia Spotted Frog	X				X	X	X	X	
Oregon Spotted Frog					X	X		X	
Wood Frog		X			X	X	X	X	
Northern Leopard Frog	X		X		X	X		X	
American Bullfrog	X						X		
Green Frog	X						X		
# amphibian species	**15**	**14**	**14**	**7**	**14**	**17**	**13**	**17**	**4**

Source: Best Management Practices for Amphibian and Reptile Salvage in British Columbia (2014, draft in progress).

What is being done?

Legislation

Governments, organizations and institutions have identified numerous amphibian species that are at risk in BC.

Both the federal government, through the Species at Risk Act (SARA), and the provincial government, through the BC Conservation Data Centre (CDC), track species and ecosystems at risk in British Columbia.

SARA applies to federally listed amphibian species at risk by:

- Assessing the species status,
- Collecting available scientific and local knowledge about the species,
- Using scientific research to better understand the species' needs and what is threatening their survival, and
- Creating recovery plans for species that are threatened, endangered and threatened or extirpated.

Legal protection for amphibian and reptile species in BC is limited, and their habitats are largely unprotected – particularly on private land3. A ranking system expresses species conservation status rank in BC. Currently, five amphibians rank as Red, five species rank as Blue and ten species rank as Yellow (see Table 2).

However, the BC provincial government has no stand-alone endangered species act that provides legal protection to the full range of BC's at-risk biodiversity. Currently just four species at risk are protected under BC's Wildlife Act.

BC's Provincial Ranking System for Species at Risk*

RED LIST:

Includes any ecological community, indigenous species or subspecies that is extirpated, endangered or threatened in BC. Extirpated species no longer exist in the wild in BC, but do occur elsewhere. Endangered species are facing imminent extirpation or extinction. Threatened species are likely to become endangered if limiting factors are not reversed.

BLUE LIST:

Includes any ecological community, indigenous species or subspecies considered to be of special concern in BC. Species are of special concern because of characteristics that make them particularly sensitive to human activities or natural events.

YELLOW LIST:

Includes species that are apparently secure and not at risk of extinction or extirpation.

**It is important to note when a species is ranked in BC, it does not automatically receive protection.*

Table 2: Status of BC Amphibians

FROGS AND TOADS			
Common Name	**Scientific Name**	**Status - BC**	**Status - Canada**
Rocky Mountain Tailed Frog	*Ascaphus montanus*	Red	Threatened
Pacific Tailed Frog	*Ascaphus truei*	Blue	Special Concern
Western Toad	*Anaxyrus boreas*	Blue	Special Concern
Northern Leopard Frog	*Lithobates pipiens*	Red	Endangered (BC population)
Wood Frog	*Lithobates sylvaticus*	Yellow	Unranked
Boreal Chorus Frog	*Pseudacris maculata*	Yellow	Unranked
Northern Pacific Treefrog	*Pseudacris regilla*	Yellow	Unranked
Northern Red-legged Frog	*Rana aurora*	Blue	Special Concern
Columbia Spotted Frog	*Rana luteiventris*	Yellow	Not At Risk
Oregon Spotted Frog	*Rana pretiosa*	Red	Endangered
Great Basin Spadefoot	*Spea intermontana*	Blue	Threatened

SALAMANDERS			
Common Name	**Scientific Name**	**Status - BC**	**Status - Canada**
Northwestern Salamander	*Ambystoma gracile*	Yellow	Not At Risk
Long-toed Salamander	*Ambystoma macrodactylum*	Yellow	Not At Risk
Blotched Tiger Salamander	*Ambystoma mavortium*	Red	Endangered
Wandering Salamander	*Aneides vagrans*	Blue	Special Concern
Pacific Giant Salamander	*Dicamptodon tenebrosus*	Red	Threatened
Common Ensatina	*Ensatina eschscholtzii*	Yellow	Not At Risk
Coeur d'Alene Salamander	*Plethodon idahoensis*	Yellow	Special Concern
Western Redback Salamander	*Plethodon vehiculum*	Yellow	Not At Risk
Roughskin Newt	*Taricha granulosa*	Yellow	Unranked

Adapted from http://www.env.gov.bc.ca/wld/frogwatch/whoswho/
and http://www.speciesatriskbc.ca/advancedsearch?taxonomicgroup=Amphibians

Recovery Plans

Currently, there are nine recovery plans or strategies for BC amphibians[4]. For some species, recovery plans include breeding programs. For example, Oregon spotted frogs are bred in captivity to produce eggs. In 2014, close to 1,600 cultured tadpoles and juvenile frogs were released into natural habitats near established populations[5]. In addition to breeding programs, there are habitat management, monitoring, research and restoration programs that are conducted in partnership with multiple groups – including volunteers, local, provincial and federal governments, and non-governmental conservation organizations – to aid in the recovery of vulnerable populations.

Take Action

Become a citizen scientist. Amphibians have been assessed as the most at-risk vertebrate (species with a backbone) globally. Information contributed by citizen scientists on the distribution and abundance of local populations of amphibian species can help alert scientists to declining trends or loss of certain populations or species, identify areas of high conservation concern or value for protection, implement mitigation measures to reduce road mortality and other conservation measures, and promote amphibian conservation in general. Contribute your or your classes' observations to BC's provincial FrogWatch website, or download data collection apps like Project Noah or iNaturalist (see Activity 3).

Be active in habitat cleanup and restoration. Participating in habitat cleanup by removing garbage can reduce or eliminate point-source pollution into amphibian habitat. Help restore amphibian habitat by volunteering to plant shrubs along stream banks to help slow the spread of invasive grasses, herbaceous plants and shrubs that destroy prime wetland habitat.

Take action to ensure BC has laws to protect amphibians and other species at risk, and the critical habitat they need to survive and recover. Engage and support youth in conservation projects, either as a class or club. See the case example below for inspiration!

Kids in BC have been taking action to protect amphibians like the western toad. (Isabelle Groc)

Taking a stand for tailed frogs!

When a group of kids in West Vancouver discovered that a prime piece of Pacific tailed frog habitat was about to be turned into a housing development, they got active! Tailed frogs are on the Blue list of species at risk in BC and these kids found that McDonald Creek, a fast flowing mountain stream, had a healthy tailed frog population. After doing research into the frogs' habitat needs, students contacted the BC Ministry of Environment and made presentations at West Vancouver City Council meetings. They met with people from the development company and got on the radio and TV. As a result of their work, the creek and the trees around the threatened frog population were made into a protected park, and the development company committed to a five-year monitoring study on the tailed frogs to ensure that they stay healthy[6].

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OTHER RESOURCES

Species at risk: A Primer for British Columbia http://www.speciesatriskbc.ca

Develop with Care http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare/

E-Fauna Fact Sheets - Amphibians
http://ibis.geog.ubc.ca/biodiversity/efauna/amphibians.html

South Coast Conservation Program (SCCP) and SCCP Fact Sheets
http://www.sccp.ca, http://www.sccp.ca/species-and-habitat

Protect Biodiversity http://www.protectbiodiversity.ca/species/solution/

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"Northern Leopard Frog" by Yun Jae Min, Grade 10 Honours Art Class, Lord Byng Secondary School

Student Fact Sheet

Amphibians (frogs, toads and salamanders) are vertebrate animals that have a two-stage life cycle. The name "amphibian" comes from the Greek *amphi*, meaning "two," and *bios*, meaning "life." Most amphibians have an aquatic, gill-bearing larval stage (for example, the tadpole stage for frogs) and an air-breathing adult stage during which they may live on land. Amphibians are ectothermic – that is, their body temperature is dependent on the temperature of their environment. The skin of most amphibians is delicate and can absorb water and oxygen. Most amphibians breathe partially through their skin. Because of this, water-borne pollutants and pathogens can cause serious damage to amphibian populations.

Amphibian Life Cycle

Aquatic-breeding amphibians lay their eggs in spring in shallow areas of wetlands, lakes, ponds and slow-moving streams. For most, the young develop and undergo metamorphosis in aquatic habitats and then move onto the land as adults in late summer. Most adult amphibians live near wetlands, streams or in upland forest areas, but some can travel far from the breeding habitat – some travel up to a few kilometres into upland areas! Most amphibians in BC become dormant during winter by moving underground or underwater away from freezing temperatures. A few species stay active through a mild winter on the south coast.

Pacific tailed frog (Jared Hobbs)

A "Tail" of Two Sisters

The closest living relative of BC's at-risk **Pacific tailed frog** (*Ascaphus truei*), is a species found only in New Zealand. The tailed frog that is native to BC shares certain characteristics with some primitive frogs native to New Zealand, which has led scientists to believe they may be evolutionary "sisters."

The New Zealand frogs are considered some of the most ancient of all living amphibians. They are almost indistinguishable from the fossilized remains of frogs that lived 150 million years ago – leading to their description as "living fossils."

(Green et al. 1989; Hay et al. 1995).

http://www.edgeofexistence.org/amphibians/species_info.php?id=546

Who are the BC amphibians?

There are 13 species of frogs and toads (two of which are invasive species) and nine species of salamanders in British Columbia. While a few species are widely distributed within the province, many of our amphibian populations occur at the northern edge of their range – which means these species are also found further south in the United States.

Most amphibians live in valley bottoms near wetlands, lakes or ponds or next to streams. However, there are species of both frogs and salamanders that are adapted to live in, or nearby, fast-flowing mountain streams – like the Pacific tailed frog and Coeur d'Alene salamander. There is also one desert-adapted frog, the Great Basin spadefoot, which occurs in dry southern interior areas, particularly within the Thompson, Okanagan and Similkameen Valleys.

Why should we care about amphibians?

Amphibians often blend in with their surroundings, and are secretive in their habits so many people do not know that they live in their town or city. However, amphibians are an important component of global biodiversity. They eat a lot of insects and, because they are very sensitive to changes in their environment, they are indicators of ecosystem health. Today, the need to address the decline in amphibian populations represents one of the greatest species conservation challenges in human history.

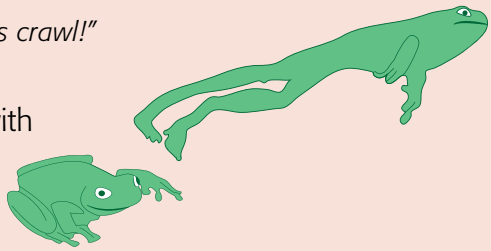
Why do some amphibian species become at risk?

Scientists first began to notice a decline in the numbers of amphibians, especially frogs, about thirty years ago. Currently, in British Columbia, the main threats to amphibian species are habitat destruction

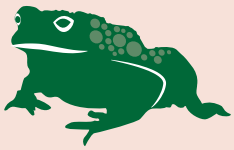
Frogs…Toads…Salamanders – What's the difference?

Think of it this way: "Frogs jump, toads hop and salamanders crawl!"

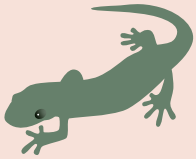
Frogs have smooth, wet skin with long legs for jumping up to 20 times their body length.



Toads have dry skin with "warts" (actually glands) and short legs for hopping.



Salamanders have tails and short legs with fleshy toes at the end of each foot, which are ideal for crawling.



Photos top to bottom:
Pacific treefrog (Jakob Dulisse), western toad (Isabelle Groc), tiger salamander (Wayne Lynch).

and range fragmentation. The reason for this is partly that many species require both an aquatic and a terrestrial habitat, so the loss or damage of either habitat can destroy a population. Recently, amphibian populations worldwide have been found to be infected with chytridiomycota fungi, which causes skin damage and death. Another fungus (*Saprolegnia ferax*), which is introduced into bodies of water during fish stocking, also has been linked to mortality in amphibian eggs.

How can we help amphibians at risk?

Governments, organizations and institutions have identified the many amphibian species that are at risk in BC. While the federal government has the *Species at Risk Act* (SARA), which applies to a small subset of the species at risk in the province, the BC provincial government has no stand-alone endangered species act that provides legal protection for at-risk amphibians.

Today, many people are taking action to help amphibians at risk in communities across the province. For example, Oregon spotted frogs are bred in captivity to produce eggs. In 2014, close to 1,600 tadpoles and juvenile frogs were released into natural habitats near existing populations. In addition to breeding programs, volunteers and conservation organizations complete habitat management, monitoring, research, restoration and citizen science activities to aid in the recovery of amphibian populations at risk.

Bullfrogs are invasive species that may compete with native amphibians for habitat, shelter and food. (Isabelle Groc)

Amphibian invaders!

Non-native bullfrog populations are increasing and invading BC's wetlands, while the population numbers of native species of frogs – including northern Pacific treefrog and Northern red-legged frog populations – are decreasing. Since the early 1900s, bullfrogs (*Lithobates catesbeiana*) have been introduced to southern BC regions multiple times by unsuccessful frog farmers, unknowing gardeners and pet owners. In both adult and tadpole stages, bullfrogs are much larger than any native frog species and outcompete them for space, shelter and food.

As voracious eaters, adult bullfrogs are predators of most any wetland animal, including other frogs! In addition, bullfrogs carry and spread a fungal infection that kills native species.

Green frogs (*Lithobates clamitans*) are also an introduced species, but their distribution and abundance is not well known – nor is their impact. While there are complex factors involved in the decline of native amphibian species, invasive plant and animal species, including bullfrogs, have potentially contributed greatly.

"Oregon Spotted Frog" by Una Flego, Grade 10 Honours Art Class, Lord Byng Secondary School

ACTIVITY 1:

Where Have All the Frogs Gone?

ACTIVITY SUMMARY: Using case narrative methodology, students are introduced to challenging and provocative issues about species at risk that confront conservation biologists, landowners, land-use planners and others concerned with species at risk. After reading the story *Where Have All the Frogs Gone?* (p. 25), students analyze and develop possible solutions to the situation presented in the case narrative. To conclude, students investigate how to find out more about amphibian populations at risk.

GRADE LEVEL: 8-12

SUBJECT AREA(S): Science, Social Studies

LEARNING OUTCOMES:

It is expected students will…

- Read and analyze the case narrative *Where Have All the Frogs Gone?*
- Work as a group to formulate possible solutions to avoid putting amphibian populations at risk and determine ways to research information required to analyze possible solutions

TIME REQUIRED: One to two periods (approx. 2-3 hours)

KEY WORDS: Decision-making, investigative questions, critical habitat

MATERIALS:

- *Student Fact Sheet: British Columbia's Amphibian Species at Risk* (p. 17)
- Case narrative: *Where Have All the Frogs Gone?* (p. 25)
- *Exhibit A (Rana aurora Fact Sheet)* and *Exhibit B (Map)* (p. 30)
- *Student Discussion Guide to Where Have All the Frogs Gone?* (p. 31-32)
- *Student Worksheet – Researching Solutions* (p. 33)
- Internet and other information resources

Oregon spotted frog (Isabelle Groc)

Did You Know?

The **Oregon spotted frog** (*Rana pretiosa*) is a member of the family Ranidae ("true frogs"). Most members of this family have smooth, moist skin, large, powerful legs and extensively webbed feet. It is estimated that Oregon spotted frog populations have declined 70% to 90% across their entire range (Oregon, Washington and extreme southwest of BC).

In BC, this species is restricted to a handful of distinct populations on the Coast Region, with 50% to 90% of populations having become extirpated (locally extinct). Captive breeding programs have been underway for a number of years in Vancouver and Aldergrove, with goals to establish 10 populations in BC.

From: *BC's Coast Region: Species & Ecosystems of Conservation Concern,* "Oregon Spotted Frog (*Rana pretiosa*) Fact Sheet"

SETTING: Classroom, indoors or outdoors

SKILLS: Processing and analyzing data/ information, questioning, predicting, planning and conducting, gathering information

PROCEDURE/STEPS:

1) Prior to class, ask students to read the *Student Fact Sheet: British Columbia's Amphibian Species at Risk,* which outlines general amphibian biology and ecology, as well as all threats to amphibian populations. (Note: also see *Primer for Teachers*, p. 7).

2) Introduce the concept that protecting populations of amphibian species from continued decline is complex. Taking action to protect these species requires adequate laws before planning, involvement from multiple stakeholders with varying value systems, while addressing multiple conservation threats. The consequences for inaction can be further population declines as a result of human impacts, putting these species at ever-increasing risk.

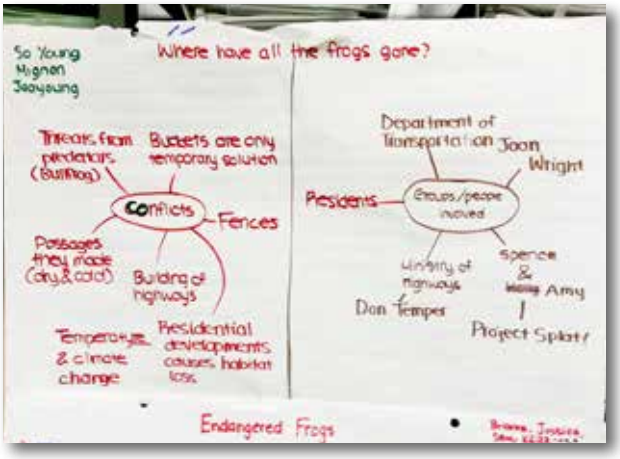
3) Introduce the case narrative. While the characters are fictional, the information in *Where Have All the Frogs Gone?* is based on a real-life situation in BC. In 2010, an amphibian population was covered in the news when their habitat was threatened by a new residential development and highway upgrade project. Use the case narrative to challenge students to analyze, critique, wonder, express reasoned opinions and make decisions about the situation presented in the case.

4) Ask students to read and then analyze the case narrative by discussing in small groups, using the guiding questions provided in the *Student Discussion Guide*.

5) Lead a class discussion on the big ideas, stakeholders and types of issues that needed to be resolved in the case narrative. Explain that in many areas in BC, many small wetlands are not adequately protected from damage or destruction and therefore important amphibian habitat can be at risk – much like the situation described in the case narrative. However, many land-use issues can be resolved, in part, with sufficient planning and decision-making based on input by qualified environmental professionals (QEPs), other land-use professionals, conservation groups, landowners and concerned citizens.

6) Encourage students to brainstorm possible solutions as to how to avoid putting amphibian populations at risk (e.g. with sufficient planning and decision-making based on input by QEPs, other land-use professionals, conservation groups, landowners and concerned citizens).

7) Using the *Student Worksheet – Researching Solutions,* have students determine and record information that is required for solutions (e.g. need full understanding of biology and ecology of species, level of impact of various threats, cumulative impact, etc.)



Student brainstorm about conflicts and possible solutions to protect endangered frogs. (Sarah Bacon)

EVALUATION:

Have students…

- Record and share their understanding of the big ideas in the case narrative
- Analyze and record possible solutions to protect the amphibians described in the case narrative

EXTENSION:

Have students…

- Write a newspaper article set five years in the future, reporting on the outcomes of the solutions suggested for the case narrative

"Northern Red-legged Frog" by Debbie Wang, Grade 10 Honours Art Class, Lord Byng Secondary School

REFERENCES (used to create the case narrative)

Beasley, Barbara A. "Roads and Herpetofauna: The Learning Curve". Association of Wetland Stewards for Clayoquot and Barkley Sounds, Ucluelet, BC, 2011. http://www.env.gov.bc.ca/wld/frogwatch/docs/2011/Herpetofauna_and_RoadsWorkshopProgram_Feb222011.pdf

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Malt, Josh. "Assessing the Effectiveness of Amphibian Mitigation on the Sea to Sky Highway: Population-level Effects and Best Management Practices for Minimizing Highway Impacts". BC Ministry of Forests, Lands and Natural Resource Operations, 2012. http://www.carcnet.ca/english/news/docs/FINAL%20S2S%20Monitoring%20Report_1_Oct_2012.pdf

Matas, Robert. "Sea to Sky Highway frogs still croaking too soon". Globe and Mail, Aug. 23, 2012. http://www.theglobeandmail.com/news/british-columbia/sea-to-sky-highway-frogs-still-croaking-too-soon/article1461851/

Sielecki, Leonard E. "On the Road Ahead: Herpetofauna and British Columbia Highways". BC Ministry of Transportation and Infrastructure, 2011. http://www.env.gov.bc.ca/wld/frogwatch/docs/2011/Herpetofauna_and_RoadsWorkshopProgram_Feb222011.pdf

OTHER RESOURCES

"Amphibians at the Edge of the Road: Testing the Effectiveness of Fencing". (Video) https://www.youtube.com/watch?v=kY5BKjRX8Ac

"Amphibian Crossing Project Gives Frogs, Toads and Salamanders a Helping Hand". (Video) https://www.youtube.com/watch?v=fbeOswYnmNE

South Coast Conservation Program (SCCP) and SCCP Fact Sheets http://www.sccp.ca http://www.sccp.ca/species-and-habitat

"Treefrogs at the Side of the Highway". (Video) https://www.youtube.com/watch?v=tIY2PtJ_ysQ

Where Have All the Frogs Gone?

The following case narrative is based on a true story.

"Did you hear the one about why the red-legged frogs crossed the road? Well, probably not, because they never made it to the other side! With the addition of a new highway within its habitat, a rare species of frog is ending up as roadkill all too frequently, a new study in Canada finds. This species is already endangered due to habitat loss, introduced predators like the bullfrog, climate change and other factors. If you add the threat of cars on the highway whizzing along, it may just contribute to their decline, researchers speculate."
(adapted from Globe and Mail, 2010)

"They should never have put that highway in there," Eagle Heights resident, Joan Wright, said in an interview with Globe environment reporter, Justin Wood. "If I could wave a magic wand, I would ask them to actually tear those houses down and rip up that highway completely – or better yet, leave the land the way it was so the frogs could live in peace."

Ms. Wright, 47, an artist and carpenter, as well as local conservation activist, has been pushing the government to protect the frogs and their habitat located near the community of Eagle Heights. The expanded highway to the community also leads to a nearby ski resort.

The frogs' wetland habitat has numerous little ponds separated by ancient volcanic lava rock and trees, Ms. Wright explained. "During spring and fall migration, the frogs move between their wetlands and their forested habitats."

Northern red-legged frog (Isabelle Groc)

Ribbit, Ribbit, Croak

The **northern red-legged frog** (*Rana aurora*) is listed under the federal *Species at Risk Act* (SARA), is "Identified Wildlife" in BC and is subject to limited protections and prohibitions under the BC *Wildlife Act*. Habitat for this species may also be governed under provincial and federal regulations including the *Fish Protection Act* and federal *Fisheries Act* as well as regional and local municipal bylaws.

The new residential development and the highway were built right through the area.

"Of course," she said, "the frogs are naturally still trying to get from the ponds to the forest or back. Now they have to cross backyards and a major highway – with disastrous consequences."

The Situation

The species at the center of the controversy is the northern red-legged frog (*Rana aurora*). The northern red-legged frog is distributed from Baja, California to southwestern British Columbia. In BC, it is found on Vancouver Island, the Gulf Islands, the lower Fraser Valley and the mainland coast of the Strait of Georgia.

The species usually breeds and lays eggs in masses in quiet, cool, vegetated pools at least 50 cm deep. These pools are found in a wide variety of lowland aquatic habitats, such as ponds and wetlands. After hatching, the tadpoles feed on algae as they grow and then metamorphose to adult form. They then move to upland forested habitat, where as adults they will spend the majority of their time eating a variety of invertebrates. The preferred habitat for adults is in areas with mature deciduous trees near streams or ponds and fallen logs. (See *Exhibit A: Rana aurora Fact Sheet,* link on p. 30)

A new residential development, Singing Woods, is located at the edge of Eagle Heights along the road to the Pine Tree ski resort. The development was named "Singing Woods" in part because of the chorus of frogs and other wildlife sounds heard in the spring.

Spence Holly recently moved into the neighbourhood along with his sister, Amy, and their parents. Spence and Amy are keen skiers and snowboarders, and urged the family to move when the opportunity arose for their mom to be an accountant at the local mountain ski resort. Amy especially wanted to be nearby so she could volunteer at summer ski camps offered by the "Canadian Cowboys," while Spence wanted to work part-time at the resort to help pay for his snowboarding.

Last year, during their first spring at their new house, they were amazed at the noise coming from the wetland area just beyond their backyard. The area was filled with lots of small ponds. Later in the spring, they noticed brown frogs with flashes of red showing as they hopped from the wetland, across their yard, over the road and into the forest area beyond. Spence and Amy wondered, "What is that all about? Weird, huh?"

Little did they know that the area was known by conservation biologists to have habitat for northern red-legged frogs, a species at risk. Because of this, a number of things had been done before the highway was upgraded and the Singing Woods development could start. Scientific studies and an environmental assessment were done. Plans were drawn up to accommodate the frogs' habitat with input by government transportation experts, the Singing Woods developer, environmental specialists and with community consultation. By the time Spence and Amy moved into their new house, everyone thought that any possible issues had been resolved and that the frog population was protected. (See *Exhibit B: Map of Area,* p. 30)

This endangered red-legged frog ended up as roadkill. (Photo: Josh Malt, BC Ministry of Forests, Lands and Natural Resource Operations)

What Happened

During the construction planning for Singing Woods and the highway upgrade, the developer and the government's Ministry of Transportation all agreed to minimize the effect on northern red-legged frog habitat. They determined that a portion of the highway upgrade would be relocated, and new houses would not be built within 30 metres of the closest wetlands. Approximately 1,500 northern red-legged frogs were captured and moved to adjacent wetlands by environmental specialists. The Ministry of Transportation built 11 underpasses to help frogs reach the other side of the road safely. Large culverts or passageways of one, two and three metres in diameter were put under the highway. Contractors then put up fencing to direct frogs to the safest passage along their migration route.

Families moved into their new homes in Singing Woods. The highway upgrade meant increased speed and number of cars using the highway to get to Pine Tree ski resort for a day or weekend of outdoor activity.

Unfortunately, things weren't so good for the frogs.

Sadly, many amphibians are killed by vehicles while attempting to cross roads and highways. (Photo: Barb Beasley, http://splatfrogtunnel.blogspot.ca)

Many of the northern red-legged frogs in the Singing Woods wetlands didn't use the new underpasses – they climbed over the fences and onto the road. Up to 50% of frogs that tried to cross the road were killed. They were especially vulnerable due to their small size, slow and erratic movements, and because they migrated during darkness, making them very hard to see. Efforts to find a solution were substantially increased after concerned community residents noticed the large number of squashed frogs on the road.

Red-legged frogs and other amphibians were able to climb up mesh fences. (Photo: Barb Beasley, http://splatfrogtunnel.blogspot.ca)

A reassessment by an amphibian specialist then showed that the abundance of habitat with large red-legged frog populations that occurred in the area had not been documented properly in the original environmental plans. Also, the underpasses were not being used by the frogs. Rather, the Environment Ministry reported that "apparently coyotes, American mink, short-tailed weasels, snowshoe hares, raccoons, squirrels and ducklings all use the underpasses more than frogs."

An example of a frog tunnel, built by the Association of Wetland Stewards for Clayoquot and Barkley Sounds. (Photo: Barb Beasley, http://splatfrogtunnel.blogspot.ca)

Don Temper, chief environmental officer with the Ministry of Transportation, said the ministry was looking for ways to save the frogs, based on the best advice it could find.

"It is very much a learning experience," Mr. Temper said in an interview. "It's hard to figure out what frogs are thinking, and a lot is speculation, but we are talking to amphibian experts...we're trying to figure it out."

A noted amphibian expert, Brenda Bird, noted, "it is well accepted that roads have direct and indirect effects on frogs and other amphibians." She explained that to understand situations at a particular site, there are all sorts of questions that need to be answered. Many are relatively easy, such as, "Which species are going to be affected by the road or proposed development?" Other questions are much more difficult. For instance, "Will road kill cause a population decline?"

Also, very little work has been done to test whether passageways under roads are used by amphibian species occurring in BC. Ms. Bird noted that in the case of new developments and highways, proactive planning should be completed to avoid important habitats, such as wetlands and surrounding areas, rather than assuming that passageways will suffice as connectors.

There are two theories to explain why the frogs do not use the passageways more often. The passageways may be too cold for frogs, as they do not like sudden changes of temperature, or maybe they are too dry, so the frogs avoid them.

A salamander climbs a barrier constructed to lead amphibians to an underpass. (Photo: Barb Beasley, http://splatfrogtunnel.blogspot.ca)

Taking Action

Spence and Amy were upset at seeing all the frogs squashed nearby their house. So they decided that they would like to do something to directly help the frogs until a long-term solution was found.

They joined with a community organization called Project Splat! They worked with other volunteers and amphibian specialists to monitor northern red-legged frog habitat. Also, they helped erect temporary fencing that directed the frogs to buckets. Safe in the buckets, the frogs could then be gently taken across the road during their annual migrations. Their crew of volunteers saved some 167 frogs and seven newts from ending up as roadkill over seven nights. But, the organizers of Project Splat! recognized that carrying the frogs across the road was only a temporary solution to a complex problem.

Volunteers and amphibian specialists work to improve frog tunnels and other community initiatives to protect endangered species. (Photo: Barb Beasley, http://splatfrogtunnel.blogspot.ca)

Looking Back

Everyone involved has come away with a new understanding that one of the challenges in protecting amphibians, especially frogs, is that their habitats are part of extremely complex ecosystems. Consequently, initiatives to protect frog habitat require effective laws that have a collaborative, multi-disciplinary approach – utilizing expertise from numerous fields including biology, ecology, hydrology, land-use planning and engineering.

Don Temper of the Ministry of Transportation said the residential development project followed "best practices" recommended by many experts. Special attention was paid to planning, materials, workmanship, location and construction. All environmental protection measures required by the federal and provincial regulators were implemented, but the efforts still receive mixed reviews.

And unfortunately, the frogs are still roadkill.

Exhibit A: *Rana aurora* Fact Sheet

Download from South Coast Conservation Program:
http://bit.ly/1pK5noc

Exhibit B: Map of Area

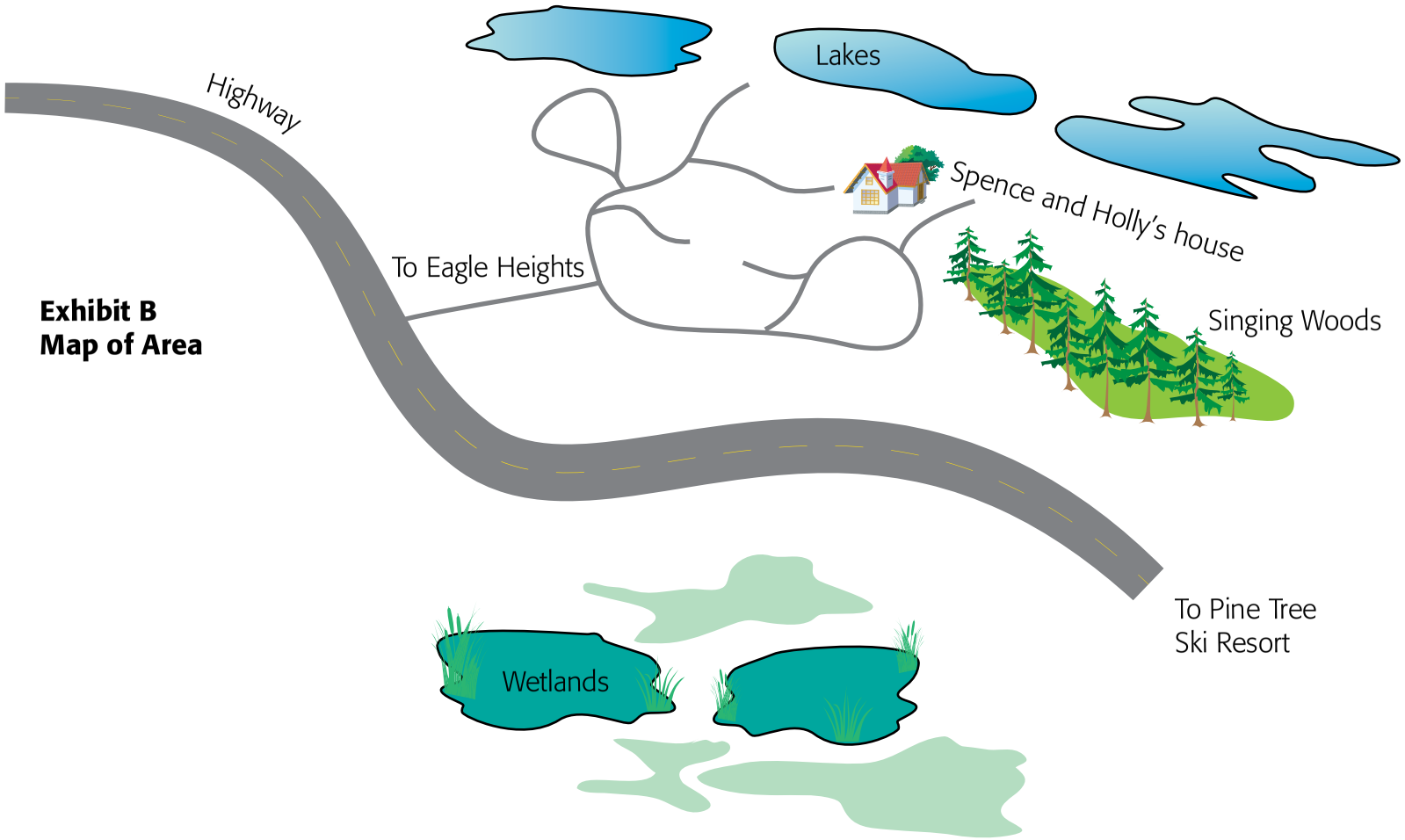

Exhibit B
Map of Area

Print this page

Student Discussion Guide to *Where Have All the Frogs Gone?*

1) What do you see as the important issues or big ideas in this case narrative? Discuss with your group and decide on the significant issues raised. List them in order of importance.

2) Who are the main stakeholders or players in this case? Write a short description of each, including the underlying values these stakeholders may have based on their actions.

3) What are the main issues that the stakeholders agree or disagree on?

4) Based on the information presented in the case narrative, how would you describe the situation for Spence and Amy – are they doing the right thing? What other actions might they take?

continued over...

5) The information in the case narrative indicates that the developer and Ministry of Transportation "did everything right." What were the best practices that were implemented?

6) In your view, to what extent can the situation with the frogs be turned around? Who needs to be involved? What actions should be taken?

7) Would these actions have been necessary if BC had an endangered species law that legally required actions to protect species at risk?

8) Based on the data in the case, if you worked for the Ministry of Transportation what questions would need to be answered before a road or housing development goes into an area that has known habitat for a species at risk like the northern red-legged frog? List the questions, or make a mind map of questions or issues that need to be addressed.

Student Worksheet – Researching Solutions

Name: _____

Date: _____

Formulate possible solutions to avoid putting populations of amphibian species at risk. Also, determine ways to research the information required to analyze the proposed solution.

Possible solutions you have identified	**Questions that may need to be answered in order to evaluate this solution**	**Some ways to answer questions**
Example solution: Move the road to a different location to avoid frog migration route(s)	• Type of amphibian species present • Migration routes currently used • Current plans for road development and other options available	• Identify species through field sampling data collection • Identify habitat suitable for frogs • Observe frogs at migration • Contact organizations such as BC Frogwatch for species information

Print this page

"Roughskin Newt" by Christina Kim, Grade 10 Honours Art Class, Lord Byng Secondary School

ACTIVITY 2:

Amphibians in Your Backyard: Preparation for Field Investigation

ACTIVITY SUMMARY: In preparation for conducting a field investigation as "citizen scientists," students develop appropriate field investigative questions and plan by going through an inquiry and discovery (research) process. Using accessible databases and resources, students learn how to identify local species and appropriate habitat for amphibians in their own community. A guided inquiry process helps familiarize students with the skills associated with field investigations, in other words, conducting social and scientific research as citizen scientists.

GRADE LEVEL: 8-12

SUBJECT AREA: Science, Social Studies

LEARNING OUTCOMES:

It is expected students will...

- Develop appropriate field investigative questions
- Design a suitable field investigation action plan
- Research information to answer questions regarding the basic biology and ecology of local amphibian species, including classification and distinguishing characteristics
- Become aware of local threats to native amphibian species and their habitat, including non-native amphibian species
- Learn survey techniques appropriate for amphibian species

TIME REQUIRED: One period, more if research is done in class (min. 1.5 hours)

KEY WORDS: Field investigation, investigative questions, citizen science

Great Basin spadefoot (Squamatologist)

Did You Know?

The **Great Basin spadefoot** (*Spea intermontana*) is a toad found in the dry interior valleys of the Okanagan, Similkameen, Kettle, Nicola and Thompson Rivers in British Columbia. Spadefoots can be found in a range of dry grassland and open forest habitats, but they also require deep, soft soils for burrows as well as temporary or permanent bodies of shallow water for breeding and tadpoles. Adults forage for insects and earthworms at night and spend daylight hours in a burrow, where they also hibernate during the winter months.

This species is threatened by habitat loss due to urban and agricultural development, road kill, invasive species and livestock trampling.

From: Species at Risk: A Primer for British Columbia

MATERIALS:

- *Student Worksheet – Developing Field Investigation Questions* (p. 42-43)
- Internet and other information resources

SETTING: Classroom

SKILLS: Accessing and interpreting scientific information, researching information, questioning and predicting, planning

PROCEDURE/STEPS:

Part 1 – Setup of Field Investigation

1) Determine an appropriate field site and date(s)* for the class field investigation (Activity 3) in consultation with a conservation biologist associated with the Wilderness Committee, local government or research institution and/or conservation group familiar with your local area. If needed, arrange for their support in the field.

*NOTE: If possible, the ideal field investigation consists of a preliminary trip to the field site to introduce the students to local amphibian species and habitats as well as appropriate field investigative techniques, followed by the second trip in which the students conduct their student research plan with the biologist's assistance. This may be two separate trips or a morning and afternoon session on the same day. Discuss this possibility with the conservation biologist or other person supporting you and your students in the field. Alternatively, consider visiting a local stream or wetland area with students as an introduction to amphibians, their habitat and threats.

2) Discuss with the conservation biologist the intention to engage students in the process of conducting a field investigation as citizen scientists.

3) Determine the species of amphibians most likely to be at the field site and whether or not any species will likely be breeding at the time of the class visit, as this will determine the nature of the students' field investigation action plan. If needed, use the resources suggested below, as well as the *Breeding Table for Common Amphibian Species in BC* (Appendix I, p. 58). Note that outside of the breeding season, students can investigate amphibian habitat and ecology, human impact and possible presence of species.

4) If working with students in a social studies course, adapt the following instructions so that students develop questions regarding human activities and interactions with the local environment, the impacts these may have (positive and negative) on non-human species and the environment, and our social and environmental responsibilities.

5) Review the BC Frogwatch program for citizen science:
http://www.env.gov.bc.ca/wld/frogwatch/

Become familiar with the possible field investigations supported by BC Frogwatch, including the data sheets for observation and monitoring surveys.

Students are introduced to a local ecosystem during a field trip. (Isabelle Groc)

Discuss with the biologist supporting the field investigation the protocols to be followed (e.g. those set out by BC Frogwatch or other appropriate established protocols for amphibians).

6) Make arrangements for the field investigation, including permission, transportation, appropriate field gear and materials for students. For tips and checklists for preparing to take students on a field trip, see "Get Outdoors! An Educator's Guide to Outdoor Classrooms" (in Resources section p. 41).

Part 2 – Instruction

1) Inform students they will have an opportunity to conduct a field investigation focusing on local amphibian species in their habitat. Share the location and date of field investigation.

2) To initiate the development of questions suitable for their field investigation, lead students in a brainstorm of what they know and general questions they have about local amphibian species and their habitat. Ask if any local species are at risk and why.

3) Record initial questions in step one of the *Student Worksheet: Developing Field Investigation Questions* (p. 42-43). The intention of this process is to promote inquiry by engaging students directly with their own community, and to assist them in becoming familiar with the skills associated with field investigations (e.g. conducting scientific research as citizen scientists).

4) View the video "Precious Frog": https://vimeo.com/59766587

Challenge the students to note clues as to why Oregon spotted frogs are a species at risk and what is being done to protect them while watching the video. Then lead a discussion, connecting information in the video to student knowledge and questions. Following the discussion, ask students to refine their field investigative questions and record. Possible guiding questions for the discussion include:

- Where do Oregon spotted frogs live?
- Why is this species at risk?
- How is information about the species collected?
- What are the challenges?
- Why are amphibians important?

5) Ask students to seek answers to their questions (research) using information available in web and print resources and databases, including BC Frogwatch, E-Fauna, Species at Risk Primer, BC Species and Ecosystem Explorer, Canadian Herpetological Society and guidebooks (see Resources section on p. 40 for links and references).

Students should be able to readily determine what species are located in your region (most regions of BC have 5 to 10 amphibian species, including non-native species), as well as the following for each species:

- range
- how to identify each species visually and aurally (listening to frog calls!)
- basic biology and ecology
- threats to populations
- current status

If available, supplement the above resources with information from local sources (e.g. South Coast Conservation Program database, Sunshine Coast Wildlife Project).

OPTION: Assign one species per group of students and have them prepare research and give a short presentation.

6) Review the initial questions recorded in step one of the *Student Worksheet*. Which questions have been answered? Which questions remain unanswered? Help students to focus their questions on their immediate community and/or the field site they will be visiting. Students should record these questions in step two of the *Student Worksheet.*

7) Describe types of field investigations (descriptive, comparative and correlative), what constitutes appropriate research or field investigative questions (questions that can be answered by quantitative or qualitative observations or measurements) and appropriate methodologies (e.g. transect surveys; see BC Frogwatch for examples). An excellent educator's guide to field investigations with students, including lesson plans, is available to download from the Pacific Education Institute (see Resources section).

8) Working in groups, ask students to determine one or two questions suitable for their field investigation and discuss possible methods to answer the questions. Have students record these in step three of the *Student Worksheet*. See Table 1 for possible questions during and outside of breeding season.

9) Share questions, then decide as a class the most suitable field investigative question(s) and record.

10) Determine the method(s)* that will be used for answering the question(s), taking into consideration of the constraints of time of year, the field site and behavior of amphibians. Record these in step four of the *Student Worksheet*.

*NOTE: You may wish to consult with the conservation biologist supporting your students during their field investigation as to suitable methodologies.

11) Share the final class field investigation plan with the conservation biologist who will be supporting or leading the field investigation.

EVALUATION:

Have students…

- Record notes for their research on regional amphibians at risk
- Describe types of field investigations (descriptive, comparative, and correlative)
- Describe the steps of a plan to do a "citizen science" field investigation

"Tiger Salamander", Artist Unknown, Grade 10 Honours Art Class, Lord Byng Secondary School

EXTENSION:

Have students…

- Identify the amphibians local to your community using photos from BC Frogwatch (http://www.env.gov.bc.ca/wld/frogwatch/) or the Species at Risk Primer (www.speciesatriskbc.ca). See list in Primer for Teachers (p. 7) for amphibians in three major areas in BC.
- Have students use a dichotomous key to identify amphibian species. (See http://www.env.gov.bc.ca/wld/frogwatch/whoswho/key.htm)
- Download species fact sheets from South Coast Conservation Program (http://www.sccp.ca/species-and-habitat)

Amphibian habitat (Jakob Dulisse)

Table 1: Possible Questions for Field Investigation

During Breeding Season	Outside of Breeding Season
• Where are the amphibians breeding? (habitat description) • What signs are there of breeding? (presence of individuals, egg masses, calling) • Are there disturbances to amphibian breeding? (e.g. human activities such as biking, boating, adding pollutants, removing vegetation)	• What are the amphibians eating? • What is eating them? • Where do frogs live? What is needed for a quality habitat? • What other species share the habitat with amphibians? How do amphibians use the habitat? • What impact is there on amphibians? (e.g. human-built features and activities)

RESOURCES FOR STUDENTS

Web links:

BC Frogwatch Program http://www.env.gov.bc.ca/wld/frogwatch/whoswho/

BC Species and Ecosystems Explorer: Species and Ecosystem Search
http://www.env.gov.bc.ca/atrisk/toolintro.html

BC Wildlife Federation Wetlands Education Program
http://www.bcwf.net/index.php/wetlands

Canadian Herpetological Society: British Columbia
http://www.carcnet.ca/english/amphibians/tour/province/amphBC.php

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
http://www.cosewic.gc.ca/

E-Fauna BC: Electronic Atlas of the Wildlife of British Columbia: Amphibians
http://ibis.geog.ubc.ca/biodiversity/efauna/amphibians.html

Guide to Amphibians: Frogs, Toads and Salamanders of British Columbia North of 50° http://www.env.gov.bc.ca/wld/frogwatch/publications/docs/brochures/AmphibianBroch-web-split.pdf

Precious Frog: Oregon Spotted Frog Recovery Team http://www.preciousfrog.ca

"Precious Frog: Symbol of a Vanishing Wetland". (Video) - Wilderness Committee
https://vimeo.com/59766587

South Coast Conservation Program (SCCP) and SCCP Fact Sheets
http://www.sccp.ca, http://www.sccp.ca/species-and-habitat

Species at Risk: A Primer for British Columbia www.speciesatriskbc.ca

Guidebooks:

Corkran, Charlotte. Amphibians of Oregon, Washington and British Columbia. Lone Pine Publishing, 2006.

Matsuda, Brent, David M. Green and Patrick T. Gregory. Amphibians and Reptiles of British Columbia. Royal BC Museum, 2006.

Citizen science organizations and apps:

iNaturalist https://www.inaturalist.org/

Project Noah http://www.projectnoah.org/

South Coast Endangered Species Finder (Android Mobile App)
http://www.sccp.ca/blog/now-google-play-store-species-identification-go

RESOURCES FOR EDUCATORS

Amphibians:

Carnrite, Olivia. Species at Risk in the Classroom: A Guidebook for Educators. "Module 1 – Amphibians and Reptiles". South Coast Conservation Program, 2013.
http://sccp.ca/sites/default/files/species-habitat/documents/GuidebookSARitc_MODULE%201_Final_single%20pages.pdf

Koval, Terra Brie Stewart. "The Frog Files: An Educator's Guide to Frogs (K-6)". Nature Canada & Ecological Monitoring and Assessment Network Coordination Office.
https://www.naturewatch.ca/wp-content/biguploads/junior_guide_k6.pdf

MacDonald, Neala. "Amphibial Pursuits: FrogWatch Teachers' Guide to Frogs as Indicators of Ecosystem Health". Nature Canada, 2002.
https://www.naturewatch.ca/wp-content/biguploads/senior_guide_712.pdf

Inquiry and field investigations:

BC Frogwatch Program: Citizen Science Frogwatching (and monitoring)
http://www.env.gov.bc.ca/wld/frogwatch/frogwatching/

Rothstein, Dane and Luz Santana. Make Just One Change: Teach Students to Ask Their Own Questions. Harvard Education Press, 2011.

Staniforth, Sue. "Get Outdoors! An Educator's Guide to Outdoor Classrooms in Parks, Schoolgrounds and other Special Places". Activities and Support Materials for K-12 Teachers and Other Educators. WildBC and BC Ministry of Environment, 2009.
http://hctfeducation.ca/product-category/books-and-guides/

Tudor, Margaret and Lynne Ferguson. "Field Investigations: Using Outdoor Environments to Foster Student Learning of Scientific Processes". Pacific Education Institute, 2009.
http://www.pacificeducationinstitute.org/workspace/resources/field-investigation-guide-updated-april-2009.pdf

Student Worksheet – Developing Field Investigation Questions

Use this worksheet to help formulate the question(s) you want to investigate while at the field site and to determine possible ways to answer the question.

Name: _____

Date: _____

Guiding Questions	Your Response
Step One: What is a topic about a local amphibian species that interests you? What questions to do you have? Why is it important to know about this?	*Example: Impact of invasive bullfrogs on native frogs* *What frog species are found around here? Are there bullfrogs? How can we protect native species from disappearing?*
Step Two: After researching available information about local amphibian species, what questions remain unanswered? What questions came to mind as you did the research?	*Example: Are there bullfrogs here? How many Oregon spotted frogs are in our community? Are there other threats to Oregon spotted frogs?*
Step Three: What is an investigative question(s) related to this topic that you want answered?	*Example: How many Oregon spotted frogs are at our field site? How many bullfrogs are at our field site? What other species are here?*

Record the class question(s) for field study	*Example: How many Oregon spotted frog egg masses are in the pond behind the school?*
Step Four: How will you gather evidence to answer your question? (e.g. making observations, taking measurements) What materials do you need to complete your investigation?	*Investigation Plan (number tasks in order of priority)*
Step Five: How will you share this information? (graphs, tables, narrative observations, etc.)	

"Western Toad" by Olivia Brocklehurst, Grade 10 Honours Art Class, Lord Byng Secondary School

ACTIVITY 3:

Getting Your Feet Wet! Conducting Field Investigations in Your Community

ACTIVITY SUMMARY: Students conduct a field investigation as "citizen scientists" of local amphibian populations and habitat, with the support of a conservation biologist. Prior to going into the field, students review appropriate field protocols and methods for collecting data, and they prepare data forms. Following the field investigation, students analyze and share data, as well as reflect on the role of citizen science in protecting amphibian species and habitats.

GRADE LEVEL: 8-12

SUBJECT AREA: Science, Social Studies

LEARNING OUTCOMES:

It is expected students will...

- Describe the role of citizen science in protecting amphibian species
- Use a dichotomous key or other guides to identify amphibian species
- Conduct a field investigation, including collecting data
- Collate and analyze data
- Report results

TIME REQUIRED:

Part 1 (field investigation preparation, including creating data collection form) - one period (approx. 1.5 hours)

Part 2 (field investigation) - one half to full day

Part 3 (debrief) - one period (approx. 1.5 hours)

KEY WORDS: Field protocol, survey methods, citizen science, field investigation, species at risk

MATERIALS:

- Data collection forms (supplied by biologist, provided example or created as part of activity)

Western toad (Jakob Dulisse)

Did You Know?

The **western toad** (*Anaxyrus boreas*) is a member of the family Bufonidae (true toads), and the species is also referred to as the "boreal toad." True toads are toothless and generally dry and bumpy in appearance, and have two "parotoid" glands that excrete an alkaloid poison called "bufotoxin" when the animal is stressed.

In North America, toads are grouped into seven species, with *Anaxyrus boreas* and its subspecies *Anaxyrus boreas boreas* being the main form found in the Pacific Northwest. Western toad juveniles and adults are opportunistic predators, and eat a range of invertebrates – including annelids (worms), terrestrial and aquatic insects and spiders, along with small crayfish and mollusks.

Each year, western toads undertake a spectacular mass migration from their breeding habitat to their summer range – sometimes more than 1 million toadlets travel across habitats.

From: *BC's Coast Region: Species & Ecosystems of Conservation Concern,* "Western Toad (*Anaxyrus boreas*) Fact Sheet"

- *Student Worksheet – Amphibian Observation Data Form* (p. 50-51)
- Clipboards and pencils
- Digital cameras and/or smartphones
- Sunglasses, sunscreen, hats, water bottles
- Water shoes, rubber boots or hip waders
- Dip nets and containers for temporary collection and viewing of organisms
- Survey equipment, which may include the following:
  - Identification key and/or field guides
  - Thermometer
  - GPS
  - Tape measure or rope for line transects
  - Binoculars

  (check to see what will be supplied by conservation biologist)

SETTING: Classroom, outdoor field site

SKILLS: Preparing for field investigation (including creating data form), conducting scientific survey of amphibian species, analyzing data

PROCEDURE/STEPS:

Part 1 – Preparation

1) Discuss the students' field investigation plan developed in Activity Two with the conservation biologist* who will be supporting the field excursion. Refine and establish protocols and methods for the class as necessary (e.g. students working in groups along different survey transects).

*NOTE: if it is not possible to have a conservation biologist assist you and/or the focus is social studies, consider visiting a local park or natural area that has a wetland or stream to observe natural and human impacts on potential amphibian habitat.

2) Determine how field data will be recorded. Check if a data collection form will be provided by the biologist. If not, review the data forms at BC Frogwatch and select one to use (note that there are different forms depending on the type of survey). Alternatively, use the *Student Worksheet – Amphibian Observation Data Form*. If desired, students can create their own data collection form based on the BC Frogwatch or provided example (see step 7 below).

3) Review questions and field investigation plan with students. If necessary, share revised plan based on input from conservation biologist.

4) Review appropriate and safe field behaviour with students (see "Safe Frogwatching" on BC Frogwatch website).

5) Check with the biologist if a hygiene protocol will be followed. If so, review with students (see Resources list on p. 49 for examples).

6) Provide students with copies of the data collection form (see step 2). Review the form so that students are familiar with how to obtain and record data while in the field (protocol and methods for field investigation).

Students photograph a salamander during a field investigation. (Sarah Bacon)

7) Alternatively, create a data form for recording field observations and measurements that will help them answer the field investigative questions developed in Activity Two. Involve students if appropriate and if time permits.

Data form should include:

a) General information, including:

- project leader (name of biologist and/or teacher) with contact information,
- observer (name of student),
- date and time,
- study area name, and
- general description of study area;

b) Study site information (specific transect or quadrant number) including:

- UTM Zone (Universal Transverse Mercator zone), GPS coordinates and/or other way to specifically indicate and relocate the site,
- detailed description of habitat,
- human activity,
- weather;

c) Presence of amphibians, including:

- species,
- number of individuals,
- life stage,
- behaviour,
- sign (e.g. body parts, carcass)
- comments

8) Use cameras and smartphones to take photographs of habitat and organisms found in the field for identification in the field or classroom. See Resources on p. 49 for links to online field guides and apps.

9) Gather materials required for field investigation in collaboration with biologist. Remind students to come prepared to be in the field for at least half a day. You may wish to stress the value of wearing clothing that deters biting insects and reduces sun exposure, as opposed to using insect repellants and sunscreen that may wash off into the amphibians' habitat.

Students participate in a field investigation in amphibian habitat. (Sarah Bacon)

Part 2 – Field Investigation

1) At the field site, orient students and remind them of appropriate behavior.

2) Organize students to collect and record qualitative and/or quantitative data to answer field investigative question(s) using the data form and cameras.

3) Prior to leaving the field site, gather students together to collect data forms and debrief. Ask students to share one thing they learned during the field investigation. Check the site to ensure all equipment, personal items and any garbage is gathered.

Part 3 – Data Analysis and Debrief

1) In the classroom, ask groups of students to collate data collected during the field investigation. Analyze and summarize data using appropriate methods.

Students explore amphibian habitat during a field investigation. (Sarah Bacon)

2) Share data with the biologist and/or BC Frogwatch, as well as with other classes.*

OPTION: Students could create a Facebook group or other social media page to share data and observations.

*NOTE: See Activity 4 for further communication of field investigation results.

3) Discuss the field investigation with the students. Were the field investigation questions answered? Discuss the value of repeating the field investigation (building a more complete picture over time in order to detect variation in population). Develop questions for further investigation.

4) Review the role of citizen science in providing detailed information on amphibians, which is essential for informed conservation efforts to protect species and ecosystems at risk in British Columbia and beyond.

EVALUATION:

Have students…

- Prepare a data sheet that is appropriate for the specific field investigative questions developed by the class in Activity Two
- Write a formal scientific report based on their field investigations, including the following sections: introduction (background and field investigative questions), materials and methods, results, discussion, and conclusion
- Create a poster or other form of media that summaries the field investigation, including a summary of findings

RESOURCES FOR EDUCATORS

Examples of Data Forms

Visual Survey:

"Visual Survey Protocol and Data Form". BC Frogwatch http://www.env.gov.bc.ca/wld/frogwatch/frogwatching/docs/Visual-survey-protocol-and-data-sheet-Oct312014.pdf

"Data Sheet – Amphibian Observation Form". Nicola Naturalist Amphibian Project http://www.nicolanaturalists.ca/files/Nicola-DATASHEET-19-May-2011.pdf

Call Survey:

"Call Survey Protocol and Data Form". BC Frogwatch http://www.env.gov.bc.ca/wld/frogwatch/frogwatching/docs/Call-survey-protocol-and-datasheet-Oct312014.pdf

"Amphibian Call Survey Datasheet". Nicola Naturalist Amphibian Project http://www.nicolanaturalists.ca/files/Amphibian-Call-Survey-dataform-18-May-2011.pdf

Field Guides and Apps for Identifying Amphibians in the Field:

"Identification Key to BC Frogs and Toads" (dichotomous key). BC Frogwatch http://www.env.gov.bc.ca/wld/frogwatch/whoswho/key.htm

Sielecki, Leonard. "Wildlife Identification Field Guide: Red and Blue Listed Amphibians and Reptiles in British Columbia". BC Ministry of Transportation and Infrastructure, 2010. http://www.th.gov.bc.ca/publications/eng_publications/environment/AmphibianReptileGuide.pdf

iNaturalist (online/mobile app) https://www.inaturalist.org/

Fieldwork tools, Precious Frog website: http://www.preciousfrog.ca/resources/publications

OTHER RESOURCES

"Safe Frogwatching". BC Frogwatch http://www.env.gov.bc.ca/wld/frogwatch/frogwatching/safety.htm

"Hygiene Protocols for Field Staff Working in Aquatic Environments". Ecosystems Branch, BC Ministry of Environment, 2008. http://www.env.gov.bc.ca/bcparks/partnerships/ltem/docs/protocols/wetland/BC-DisinfectionProtocol-AquaticFieldResearchers-2008.pdf

"BioBlitz: Field Investigations". (Video) National Geographic Education. http://education.nationalgeographic.com/activity/field-investigations/

Student Worksheet – Amphibian Observation Data Form

Observation Date:_____

Project Leader: _____

Group Members: _____

Name of Site: _____

Weather: _____

Site Information*: _____

**Include UTM Zone (Universal Transverse Mercator zone), GPS coordinates and/or other way to specifically indicate and relocate the site)*

HABITAT: Describe the dominant plants or any special features at the location

LANDOWNER TYPE: Circle as appropriate

Federal Govt.	Parks Canada	Provincial Govt.	Local Govt.
Municipal	Private Organization	Unknown	First Nations
Private Individual	Estate	Trust	Partnership (legal)
Corporation	Other (specify in comments below)		

Comments:

LANDSCAPE CONTEXT: Describe the surrounding land, signs of human disturbance (e.g. logging, brush clearing, water level management structures), habitat fragmentation (e.g. road cutting across a wetland, clearcuts, paved parking lots), distance to nearest road, proximity to urban areas or industrial development, agricultural area, etc.

CONDITION: Condition is a measure of the quality of the habitat or area (e.g. habitat degradation, pollution, cattle trampling, feral house cats, presence of exotic species).

LIFE-STAGE AND COUNT: Indicate number of individuals at each life-stage					
Adult Males		Juvenile Males		Larvae or tadpoles	
Adult Females		Juvenile Females		Eggs	
Adult Unknown Sex		Juvenile Unknown Sex		Egg masses	
Unknown Age and Sex					

ACTIVITY: What was it doing, or what does the habitat indicate about activity? Circle one and add others to comments)				
Basking	Carcass	Courting	Denning	Excreting
Feeding	Fleeing	Hibernating	Hunting	Migrating Seasonally
Security and Thermal habitat	Security habitat	Territorial habitat	Thermal habitat	Travelling
Reproducing	Other (specify):			

ACTIVITY DESCRIPTOR: Was the animal "seen" or "heard"? (Choose one – If the animal was seen and heard, please pick "seen" and note in the comments below that it was also heard)

OTHER COMMENTS ABOUT THE SITE AND OBSERVATION:

OTHER COMMENTS ON ANIMAL CONDITION: (Be descriptive)

Please take photographs of significant animal, habitat and human use features.
Data form adapted from BC Frogwatch.

"Pacific Giant Salamander" by Olivia, Grade 6, École Rose-Des-Vents

ACTIVITY 4:

Local Amphibians at Risk: Creating a Case Narrative

ACTIVITY SUMMARY: Students analyze and synthesize the information gained during the previous activities – including the field investigation – by creating an outline for a case narrative regarding local amphibian species at risk. The final discussion explores possible actions that the students can take to protect species at risk in their community.

GRADE LEVEL: 8-12

SUBJECT AREA: Science, Social Studies

LEARNING OUTCOMES:

It is expected students will...

- Describe how amphibians are an integral component of ecosystems (e.g. indicator species of habitat and ecosystem health)
- Describe how past and current human activities have impacted local amphibian species
- Determine a variety of ways people can act to protect and conserve local amphibian species, especially those at risk
- Create and share outlines of case narratives of local amphibian species

TIME REQUIRED: One period (approx. 1.5 hours)

KEY WORDS: Case narrative, mind map, concept map, species and ecosystem health, taking action

MATERIALS:

- Large sheets of blank paper (flip chart paper or newsprint)
- Coloured markers
- Completed *Student Worksheet – Researching Solutions* (p. 33)
- Completed observation data form (p. 50-51)
- *Student Fact Sheet: British Columbia's Amphibian Species at Risk* (p. 17)

Pacific giant salamander (The Wandering Herpetologist)

Did You Know?

The **Pacific giant salamander** (*Dicamptodon tenebrosus*) is a member of the family Dicamptodontidae ("giant salamanders"), a family whose only genus is Dicamptodon. Originally widespread in the Pacific Northwest, the family was grouped with Ambystomatidae, the "mole salamanders."

The Pacific giant salamander is one of the few vocal salamanders, and is capable of issuing a low barking or croaking sound when startled. Larger adults can also deliver a painful bite!

From: *BC's Coast Region: Species & Ecosystems of Conservation Concern*, "Coastal Giant Salamander *(Dicamptodon tenebrosus)* Fact Sheet".

SETTING: Classroom, outdoor field site

SKILLS: Analyzing evidence (data), drawing, conclusions, critical thinking, taking personal responsibility, taking action

PROCEDURE/STEPS:

1) Review data collected during the field investigation, focusing on the observations of human activities in and around the field site as well as the indications of amphibian species (e.g. number of individuals, calls and/or egg masses).

2) Discuss the possible implications of human activities on the health of the amphibian populations in the area, noting possible amphibian habitat alteration and/or enhancements. Draw in other information, if available (e.g. information from databases, long-term monitoring data, knowledge shared by biologist), as to the health of the amphibian populations at the study site.

3) Ask the students what other human activities they did not directly observe that may also impact and threaten amphibian populations (e.g. alteration in water table level due to change in drainage pattern, water pollution, increased UV radiation exposure due to ozone depletion, climate change impacts on ecosystem, disease and other pathogens, invasive amphibian and other species).

4) Discuss how amphibians are an integral component of ecosystems (e.g. role in ecosystem, indicator species of habitat and ecosystem health). If needed, review *Student Fact Sheet: British Columbia's Amphibian Species at Risk* (p. 17).

5) Ask students to review the *Student Worksheet – Researching Solutions* from Activity 1. Discuss challenges observed at the field site and identify stakeholders. Identify local and regional organizations that are working to conserve amphibian species in the community, and the action(s) being taken by these groups (see Resources p. 56).

6) Explain to students that they will be summarizing their accumulated in-depth knowledge of local amphibian species in their community by creating an outline for a case narrative. The outline can be in the form of a traditional hierarchical essay outline, a concept map, a mind map, storyboard or any other device that allows ideas and connections to be identified and organized. See Activity 1 for an example of a fully written case narrative (*Where Have All the Frogs Gone?* p. 25). The intent of this activity is to have students begin to organize all information collected during the past activities, as well as to identify connections and relationships.

7) Ask the students what information should be included in the outline for the case narrative (e.g. biology and ecology of the species, historical and current population numbers, past and current threats, stakeholder actions and perspectives, what is being done to protect the species, how they can be involved in protecting and conserving species at risk). For examples of stories about successful recovery of species at risk, see Parks Canada's "Species at Risk Success Recovery Stories": http://www.pc.gc.ca/eng/nature/eep-sar/itm11.aspx

8) Select the species for the case narrative outlines. Divide students into groups assigning one species per group, if possible. Encourage groups to consider and decide upon the format the completed case narrative may

take (e.g. text story, picture storybook, video, skit, Facebook or other social media format) and develop their outline accordingly (e.g. traditional essay outline, storyboard, concept map, etc.). Give the groups adequate time to discuss and create the outline.

9) Have groups share their case narrative outlines. Debrief by asking what information was still needed in order to complete the case narrative.

10) Conclude the module with a discussion about the possible actions students can take as individuals and as a group to help protect and conserve amphibian species at risk, including continuing to be citizen scientists. Remind students that BC has no species at risk legislation. See *Primer for Teachers* (p. 7) for other actions individuals can take.

EVALUATION:

Have students…

- Describe how amphibians can be indicator species of local habitat and ecosystem health
- Summarize ways people can act to protect and conserve local amphibian species
- Create an evaluation rubric for the case narrative outlines and complete peer evaluations in pairs or small groups

EXTENSION:

Working with the students' Language Arts, English, Drama and/or Media Arts teacher(s), have students write or create a full case narrative. Publish in the class, school newspaper and/or community newspaper.

Northern red-legged frog and Oregon spotted frog (Isabelle Groc)

RESOURCES

Conservation organizations:

Habitat Conservation Trust Foundation
http://hctf.ca

South Coast Conservation Program
http://www.sccp.ca/

Wilderness Committee
https://www.wildernesscommittee.org/BCSpecies

Canadian Herpetological Society, BC
http://www.carcnet.ca/english/amphibians/tour/province/amphBC.php

BC Frogwatch
http://www.env.gov.bc.ca/wld/frogwatch/

Nicola Naturalist Society
http://www.nicolanaturalists.ca/projects/amphibian-monitoring/

What is being done:

"Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia". BC Ministry of Environment, 2014.
http://www.env.gov.bc.ca/wld/documents/bmp/HerptileBMP_complete.pdf

"Species at Risk Success Recovery Stories". Parks Canada
http://www.pc.gc.ca/eng/nature/eep-sar/itm11.aspx

"Species at Risk Public Registry". Government of Canada
http://www.registrelep-sararegistry.gc.ca

GLOSSARY

Amphibian: Vertebrate organisms belonging to the class Amphibia. Main characteristics are: 1) permeable skin that functions as a second respiratory system and 2) a two-stage life cycle that includes a larval form with gills and an adult form that has lungs.

Citizen Science: Scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions.

Community *(Ecology)*: A group of interacting populations of different species living in the same area at the same time.

Ectothermic: Of or relating to an organism that regulates its body temperature largely by exchanging heat with its surroundings.

Herpetology: The scientific study of amphibians and reptiles; batrachology is the study of only amphibians.

Larva: The juvenile form in the larval phase of an organism's life cycle, before metamorphosis to the adult phase. Tadpoles are the larva of frogs and toads, and they hatch from eggs.

Metamorphosis: The biological process of abruptly changing form (physical structure) during an organism's life cycle. Often metamorphosis is associated with a change in habitat. For example, aquatic, swimming tadpoles lose their tails and grow legs relatively quickly, allowing them to move into terrestrial habitats as adult frogs.

Population *(Ecology)*: A group of individuals of one species living in a geographical area at the same time; populations of a species may be physically separated temporarily or permanently.

Riparian: The zone or area between flowing water (e.g. streams, rivers and wetlands) and the surrounding land, often with a distinctive association of organisms that require or tolerate frequent water-saturated soil.

Species *(Biology)*: A group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding. The species is the principal natural taxonomic unit, ranking below a genus and denoted by a Latin binomial, e.g. *Homo sapiens.*

Wetland: A land area where the soil is permanently or seasonally saturated with water but there is little or no water on the surface of the soil – such as marshes, bogs and swamps. Wetlands are generally considered distinct from standing bodies of water (e.g. ponds, lakes or sloughs), though these may be surrounded by wetlands.

APPENDIX I: Breeding Table for Common Amphibian Species in BC

Lower Mainland/Fraser Valley

Species	Where found in breeding season	Breeding season	What to look for	Other notes
Northern Pacific Treefrog	Shallow wetlands where there is a lot of plant cover	Mating takes place in the spring (April). After laying the eggs, the embryos develop rapidly, hatching two or three weeks after the eggs are laid. The tadpoles metamorphose in approximately two months.	The females lay small clusters of eggs, attaching them to bits of vegetation in quiet, shallow water. The egg clusters are loose, irregular in shape and may contain 10 to 70 eggs.	
Western Toad	Wetlands	Mating is in spring (April-May). Once laid, the eggs quickly develop into tadpoles that hatch and swarm in groups of hundreds or thousands of individuals through the warmest, shallowest water available. By the end of the summer, the tadpoles transform into toadlets and leave the water. Dense aggregations of toadlets are often found hidden along the shores of breeding sites, and clustered in piles when the weather turns cool. These toadlets grow to maturity in two to three years, and may live 10 years or more.	Eggs look like small black pearls laid single file in long strings in the water.	Western toad metamorphosis will respond to shrinking water bodies, and tadpoles will transform earlier if their habitat is drying up.
Oregon Spotted Frog	Warm, shallow edges of marshes where they lay their eggs	Mating is in early spring (February-April). Females lay egg masses communally, or in groups, in shallow water. The tadpoles metamorphose into small froglets after about three months, and take two or three years to reach breeding age.	Large jelly-like clusters of 600 to 1,200 eggs, usually laid directly on top of or beside another egg mass in shallow (<15cm) water. Not attached to aquatic plants.	Single egg masses look very similar to red-legged frog and are challenging to differentiate.
Northern Red-legged Frog	Shallow ponds or slow streams that are well shaded.	They mate and lay their eggs very early in spring – as early as February in coastal areas. Embryos develop and hatch in about four weeks, then spend four to five months in the tadpole stage. Tadpoles metamorphose into tiny hopping froglets only a couple of centimetres long, in midsummer.	Females lay eggs in large, jelly-like clusters of 750-1,300 eggs, attaching the clusters loosely to stems of aquatic plants just below the surface of water that is 20 to 100 cm deep.	
Northwestern Salamander	Wetlands, ponds, lake edges, ditches and slow-moving streams	Early spring mating (March-April). The eggs take anywhere from two to eight weeks to hatch, depending on water temperature. Larvae transform to a terrestrial form in one to two years.	Firm grapefruit-sized mass of up to 270 eggs laid around a piece of vegetation or stick, about 5 - 20 cm below the surface of the water.	Very distinctive egg mass – looks like a jelly softball with a stick through the center.

Lower Mainland/Fraser Valley

Species	Where found in breeding season	Breeding season	What to look for	Other notes
Roughskin Newt	Ponds, lakes, wetlands or slow-moving streams	Spring mating (April). Newt eggs hatch three to four weeks after being laid, and the larvae metamorphose into the terrestrial form in the summer of either the first or second year, depending on the local climate. The newly metamorphosed newts head into upland forests, not returning to the pond to breed until a few years later.	Newts lay single eggs attached to the stems of vegetation and scattered throughout the breeding habitat.	
Long-toed Salamander	Large, shallow lakes and ponds with boggy edges	Mating begins before the ice has completely disappeared (February). Shortly after breeding, up to 400 eggs are laid underwater close to shore. Hatching usually takes place two to three weeks later, although this depends on water temperature and can take longer at higher elevations.	Eggs are laid one by one or in small clumps of up to 30, on the bottom of the pond or attached to plants. Each egg is brown on top and cream-coloured below, and has a double membrane and a thick coat of jelly.	
Pacific Tailed Frog	Clear, cool mountain streams	Mating takes place in the early fall (September-October), but eggs are not laid until the following summer. Hatchlings emerge six weeks or so later, and overwinter in the quieter waters.	Strings of colourless, pea-sized eggs are attached to the base of a large stone underwater.	

"Long-toed Salamander" by Elodie Doumenc, Grade 6, École Rose-Des-Vents

Okanagan/Similkameen/Thompson

Species	Where found in breeding season	Breeding season	What to look for	Other notes
Columbia Spotted Frog	Lakes, ponds and marshes	Courtship and egg-laying take place in the water (mid-March). Larvae usually metamorphose (become adults) in a single year, but in northerly populations, larvae will overwinter as tadpoles and mature into adults the following year. Males may take up to two to four years to reach sexual maturity, while females may not breed until their fifth or sixth year.	Eggs are laid in the vegetated shallows at depths of 3 to 30 cm. Deposited in spherical clusters of jelly about 15 cm in diameter, these clusters float freely in the water and can contain up to 1,500 eggs!	A typical lifespan of the Columbia spotted frog may be 10 years or more.
Great Basin Spadefoot	Ponds	Spadefoots hibernate in snug burrows, but emerge from mid-April to early May to breed. Males gather and call at small ponds. The females join the males at the ponds to mate. The eggs hatch within a week in cool weather, or as quickly as two days if it is warm. The tadpoles transform into spadelets six to eight weeks after hatching. Great Basin spadefoots become mature in their second or third year, and may live up to 10 years.	Females lay 10 to 100 eggs in a cluster, which they attach to sticks and pebbles underwater.	
Northern Pacific Treefrog	Shallow wetlands where there is a lot of plant cover	Mating takes place early in the spring (mid-April to late May). After laying the eggs, the embryos develop rapidly, hatching two or three weeks after the eggs are laid. The tadpoles metamorphose in approximately two months.	Females lay small clusters of eggs, attaching them to bits of vegetation in quiet, shallow water. The egg clusters are irregular in shape and may contain 10 to 70 eggs.	
Western Toad	Wetlands	Mating is in early spring (mid-April to late May). Once laid, the eggs quickly develop into tadpoles that hatch and swarm in groups of hundreds or thousands of individuals through the warmest, shallowest water available. By the end of the summer, the tadpoles transform into toadlets and leave the water. Dense aggregations of toadlets are often found hidden along the shore of breeding sites, and clustered in piles when the weather turns cool. These toadlets grow to maturity in two to three years, and may live 10 years or more.	Eggs look like small black pearls laid single file in long strings in the water.	

Okanagan/Similkameen/Thompson

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Wood Frog	Seasonal pools, shallow ponds, marshy lake edges, flooded meadows, and quiet stretches of streams	Wood frogs emerge early from hibernation, moving to breeding sites as snow and ice begin to melt. Males congregate in shallow clear ponds (early April to early May) and will call day and night as long as the temperature remains above freezing. Mating pairs join together to deposit and fertilize the eggs.	Densely packed soft masses of jelly the size of a plum or orange. Masses from several females are usually laid together, attached to submerged sticks and plants or lying freely in the water. Each mass may have as many as 2,000 to 3,000 eggs.	Only found in the northern parts of the Thompson region, including areas such as Clinton or Clearwater.
Long-toed Salamander	Large, shallow lakes and ponds with boggy edges	Mating begins before the ice has completely disappeared (mid-February to early May). Shortly after breeding, up to 400 eggs are laid underwater close to shore. Hatching usually takes place two to three weeks later, although this depends on water temperature and can take longer at higher elevations.	Eggs are laid one by one or in small clumps of up to 30, on the bottom of the pond or attached to plants. Each egg is brown on top and cream-coloured below, and has a double membrane and a thick coat of jelly.	
Blotched Tiger Salamander	Shallow ponds and lakes	Blotched tiger salamanders gather at breeding ponds in early spring (early March). Hatchlings emerge two to three weeks later and quickly develop into four-legged larvae. Unlike frog tadpoles, blotched tiger salamander larvae develop their front legs first. Larvae stay close to shore where there are lots of aquatic plants and algae to hide in. After three to four months, they transform into juveniles with a new set of lungs and no gills. After a few days or weeks by the pond edge, juveniles set off at night during wet weather to begin their life on land. Larvae can also delay development and remain in wetlands for a number of years before transforming.	Up to 120 eggs are laid shortly after breeding, attached singly or in small clumps to stones, twigs and plants in shallow water.	

Vancouver Island

Species	Where found in breeding season	Breeding season	What to look for	Other notes
Northern Pacific Treefrog	Shallow wetlands that have sun exposure and a combination of some open water and some shoreline plant cover	Mating takes place in late winter to late spring (February-May). After laying the eggs, the embryos develop rapidly, hatching two or four weeks after the eggs are laid. The tadpoles metamorphose in approximately two to three months (the timing of hatching and metamorphosis is dependent on water temperature).	The females lay small clusters of eggs, attaching them to bits of vegetation in quiet, shallow water. The egg clusters are irregular in shape and may contain 10 to 70 eggs. They can be confused with long-toed salamander eggs, but treefrogs lay more eggs that are more tightly clustered together.	
Western Toad	Wetlands and lakes	Mating is in early spring (March-April). Once laid, the eggs hatch quickly (two weeks), developing into tadpoles that swarm in groups of hundreds or thousands of individuals through the warmest, shallowest water available. By the mid to late summer, the tadpoles transform into toadlets and leave the water. Dense aggregations of toadlets are often found along the shore of breeding sites, clustered in piles. These toadlets grow to maturity in two to three years, and may live 10 years or more.	Eggs are laid singly in long strings in the very shallow water. Toads lay eggs communally, so that their eggs are often tangled together amongst the vegetation.	
Northern Red-legged Frog	Ponds, wetlands and lakes with some sun exposure	Northern red-legged frogs mate and lay their eggs in late winter or early spring – as early as January or February in coastal areas. Embryos develop and hatch in about four to six weeks, then spend four to five months in the tadpole stage. Tadpoles metamorphose into tiny hopping froglets only a couple of centimetres long, in midsummer.	Females lay eggs in large, jelly-like clusters of 750-1,300, attaching the clusters to stems of aquatic plants up to 100 cm below the surface.	

Vancouver Island

Species	Where found in breeding season	Breeding season	What to look for	Other notes
Northwestern Salamander	Wetlands, ponds, lake edges, ditches and slow-moving streams	Mating takes place in late winter or early spring (February-April). The eggs take anywhere from four to eight weeks to hatch, depending on water temperature. Some larvae transform to a terrestrial form in one to two years, while some remain aquatic.	A grapefruit-sized mass of up to 270 eggs may be attached to vegetation or sticks up to 100 cm below the surface of the water. The very dense egg masses have an association with an algae that turns the colour of the mass whitish-green and makes it easier to spot below the water surface.	
Roughskin Newt	Ponds, lakes, wetlands or slow-moving streams	Mating is in spring (April-June). Newt eggs hatch three to four weeks after being laid, and the larvae metamorphose into the terrestrial form in the summer of either the first or second year, depending on the local climate. The newly metamorphosed newts head into upland forests, not returning to the pond to breed until a few years later.	Newts lay single eggs attached to the stems of vegetation and scattered throughout the breeding habitat. Eggs are very difficult to find, so searching for eggs is not a good survey method for this species.	
Long-toed Salamander	Ponds, wetlands and lakes, with or without shading.	Mating is in late winter (January-March). Shortly after breeding, eggs are laid in shallow water close to shore. Hatching usually takes place three to five weeks later, although this depends on water temperature and can take longer at higher elevations.	Eggs are laid singly or in small clumps of up to 30, on the bottom of the pond or attached to plants. They can be confused with treefrog eggs. However, treefrogs lay more eggs that are more tightly clustered together.	

Information sources:

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