GENETIC DIVERSITY AND FRAGMENTATION (Part I)

GRADE Grade 9

PART 1 of 3

TOPICS Biodiversity, conservation, habitat

CURRICULAR CONNECTIONS

Grade 9 Science

Unit A – Biological Diversity

2. Investigate the nature of reproductive processes and their role in transmitting species characteristics
    - Identify examples of dominant and recessive characteristics and recognize that dominance and recessiveness provide only a partial explanation for the variation of characteristics in offspring
4. Identify impacts of human action on species survival and variation within species, and analyze related issues for personal and public decision making.
    - Describe ongoing changes in biological diversity through extinction and extirpation of native species, and investigate the role of environmental factors in causing these changes
    - Evaluate the success and limitations of various local and global strategies for minimizing loss of species diversity

OVERVIEW

Students begin this lesson by exploring the importance of biodiversity at different scales, including genetic, species and ecosystem diversity. Through an interactive activity students will understand how increased genetic diversity contributes to the resiliency of a population. Students will then investigate a number of case studies to better understand how a loss of genetic diversity within wild and domesticated animal populations has negatively affected those populations' fitness.

OBJECTIVES

- Students will understand that biodiversity exists at multiple scales
- Students will understand why biodiversity is vital for the survival of life on Earth
- Students will understand how genetic diversity can be lost in populations with small numbers of individuals through inbreeding depression

KEY TERMS

- **Alleles** – different variations of the same gene, which may result in distinct observable traits (e.g. the gene that determines hair colour)
- **Biodiversity** – the variability of living organisms in a particular habitat or ecosystem. This includes the diversity within species, between species and of ecosystems
- **Deleterious alleles** – an allele of a gene whose effects when expressed are likely to result in reduced fitness
- **Fitness** – the ability to survive to reproductive age, find a mate, and produce offspring
- **Genetic diversity** – the number of different alleles within and among individuals of a population and the frequency with which they appear
- **Inbreeding depression** – a reduced biological fitness in a population as a result of breeding with related individuals
- **Phenotype** – the observable physical properties of an organism, including appearance, development and behaviour

GUIDING QUESTIONS

- Why is biodiversity conservation important?
- What problems can arise within a population and for ecosystems at large when genetic diversity declines?

BACKGROUND ESSAY

Biodiversity conservation has been highlighted as one of the most pressing conservation challenges of our time, so much so that the United Nations General Assembly declared the period 2011-2020 as United Nations Decade on Biodiversity. Conserving biodiversity involves much more than protecting the different species on Earth. **Biodiversity** refers to the variability of living organisms in a particular

habitat or ecosystem, including the diversity within species (e.g. different breeds of domesticated dogs) between species (e.g. the diversity of plants and animals that live in the Canadian Rockies) and of ecosystems (e.g. desert, tundra and montane ecosystems).

Biodiversity is critically important for the survival of life on Earth. Some of the benefits of biodiversity include ecosystem services such as nutrient cycling and protection of water resources, biological resources such as food, timber and medicines, and social benefits such as cultural values and recreation. The loss of a single species from a food web can have far reaching effects on the entire ecosystem. This effect is likely to be more pronounced if the species that is lost is a large carnivore like a wolf, which could result in an increase in prey numbers and subsequent deterioration of the habitat due to increased herbivory.

Every single individual, from grizzly bears to snails to humans, possesses a unique set of genes that are the source of its features. **Genetic diversity** refers to the number of different alleles *within* and *among* individuals of a population and the frequency with which they appear. **Alleles** are different variations of the same gene, which may result in distinct observable traits. For example, one gene – or more likely a combination of genes – may be responsible for the fur colour of black bears, and different alleles of that gene could be expressed as white, black, brown or golden coloured fur. The observable physical properties of an organism – in this case fur colour – are known as the **phenotype**. Phenotype is not limited to the appearance of an organism and also includes its development and behaviour. Genetic diversity is *high* when there are many different alleles of all genes.

Species need a variety of genes in order to ensure that they are able to successfully survive and reproduce. Greater genetic diversity increases the resilience of wildlife populations to environmental change, therefore minimizing the risk of collapse of the population. Genetic variation is beneficial to a population because it allows some individuals to adapt to the environment and maintain the survival of the population in the event of a sudden stressor like disease or an environmental change. Once genetic diversity has been lost within a population, it can take a very long time for a population to increase its genetic variation even if population numbers are able to rebound. This means that in order to ensure the long-term survival of species, it is important to consider not just how many individuals make up a population but also the genetic diversity within those populations.

DURATION 15-20 minutes

MATERIALS

- 15-20 index cards with characteristics

ACTIVITY – STUDENT CHARACTERISTICS

In this activity students will participate in a demonstration that illustrates why genetic diversity is so important to the survivability and resiliency of a population.

1. Divide students into two teams. Explain that you have a stack of index cards and that each one has a characteristic that will represent a genetic trait (see list of possible characteristics below). Because it may be challenging to come up with enough truly genetic-based traits, you will need to use other traits in the demonstration such as clothing colour or shoe brand.

2. Explain to the students that once the game starts they are not able to change anything about themselves (e.g. take off shoes, put on a sweater). When you read a characteristic from an index card, any students that has that characteristic will "die" by sitting down. The team with the last person standing is the winner.

3. Repeat Step 2 for 3 or 4 cards. Instruct the students that if there is anyone on their team who is still standing after 4 of 5 cards have been played, the entire team can regenerate and join back in. If both teams have players still standing, play another round of 3 or 4 cards.

4. Discuss the demonstration. Consider if there were characteristics that eliminated more of the students than others. Did one team do better than another? Why or why not?

5. Shuffle the cards and repeat the demonstration with everyone rejoining the game. Tell the students that before you begin, they can make any adjustments they want (e.g. removing shoes, adding or removing layers of clothing). At this point in the game, students should recognize that the more characteristics they exhibit, the more resilient their team will be.

6. Lead a final discussion of the activity. Did the changes that the teams made allow more of their team to survive? What helped or hurt their survival? How could what they learned in this activity be applied to genetic diversity of plant or animal populations? Students should arrive at an understanding that a population that is more genetically diverse will be more resilient to change.

Characteristics

- Light-coloured eyes
- Bent little finger
- Attached ear lobes
- Widow's peak
- Not able to curl tongue
- Wearing a hat
- Not wearing red
- Wearing glasses
- Wearing earring(s)
- Wearing a sweater
- Wearing hair clips
- Wearing a watch
- Shoes laced and tied
- Shoes without laces

This activity has been adapted from "The Gene Scene" from the Illinois Department of Natural Resources, Chicago Wilderness and World Wildlife Fund. View the original lesson plan and other activities for teaching about genetic diversity at www2.illinois.gov/dnr/education/Documents/BioBasics_Activity_1-4.pdf

CASE STUDY

The Florida Panther is the only known population of cougar found east of the Mississippi River. Due to hunting and habitat loss through the 20th century, their numbers had dwindled to fewer than 30 panthers by the 1990s.

The panthers fell victim to inbreeding depression because their numbers were so low, resulting in numerous health issues. These included heart failure, undescended testicles, pathogenic diseases and parasites.

In the mid-1990s, biologists introduced eight female Texas pumas to South Florida in an attempt to save the population and increase genetic diversity. As of 2019, the South Florida panther population had risen to at least 230 panthers.

Read more at www.sciencedaily.com/releases/2019/10/191003111755.htm

DURATION 60+ minutes

MATERIALS

- Computer with Internet connection

BACKGROUND ESSAY

What happens when genetic diversity in a population declines? A **deleterious allele** is an allele of a gene whose effects when expressed are likely to cause a reduction in biological **fitness** (i.e. the ability to survive to reproductive age, find a mate, and produce offspring) when it is expressed. In large, healthy populations, the deleterious recessive allele is present in a very small number of individuals and expressed in even fewer numbers. Dominant traits are expressed when one copy of an allele is present, while recessive traits require two copies of an allele in order to be expressed. When the dominant allele is present, the recessive allele will be essentially *'hidden.'* Individuals that carry a single recessive deleterious allele will be healthy and can easily pass this gene on to their offspring.

Inbreeding depression is the reduced biological fitness in a population that results from breeding between related individuals. As population size shrinks, the likelihood of an individual receiving two recessive deleterious alleles increases. Close relatives might end up mating with one another and these two relatives may carry the same two recessive deleterious alleles (Figure 1). The offspring of those relatives may receive two copies of the recessive deleterious alleles and suffer the consequences of expressing the associated phenotype. Examples of phenotypes that have been seen as a result of inbreeding depression include reduced fertility, reduced birth rate, higher infant and child mortality, smaller adult size, reduced immune function and increased risk of genetic disorder. When there are fewer individuals in a population, the likelihood of inbreeding depression occurring is higher.

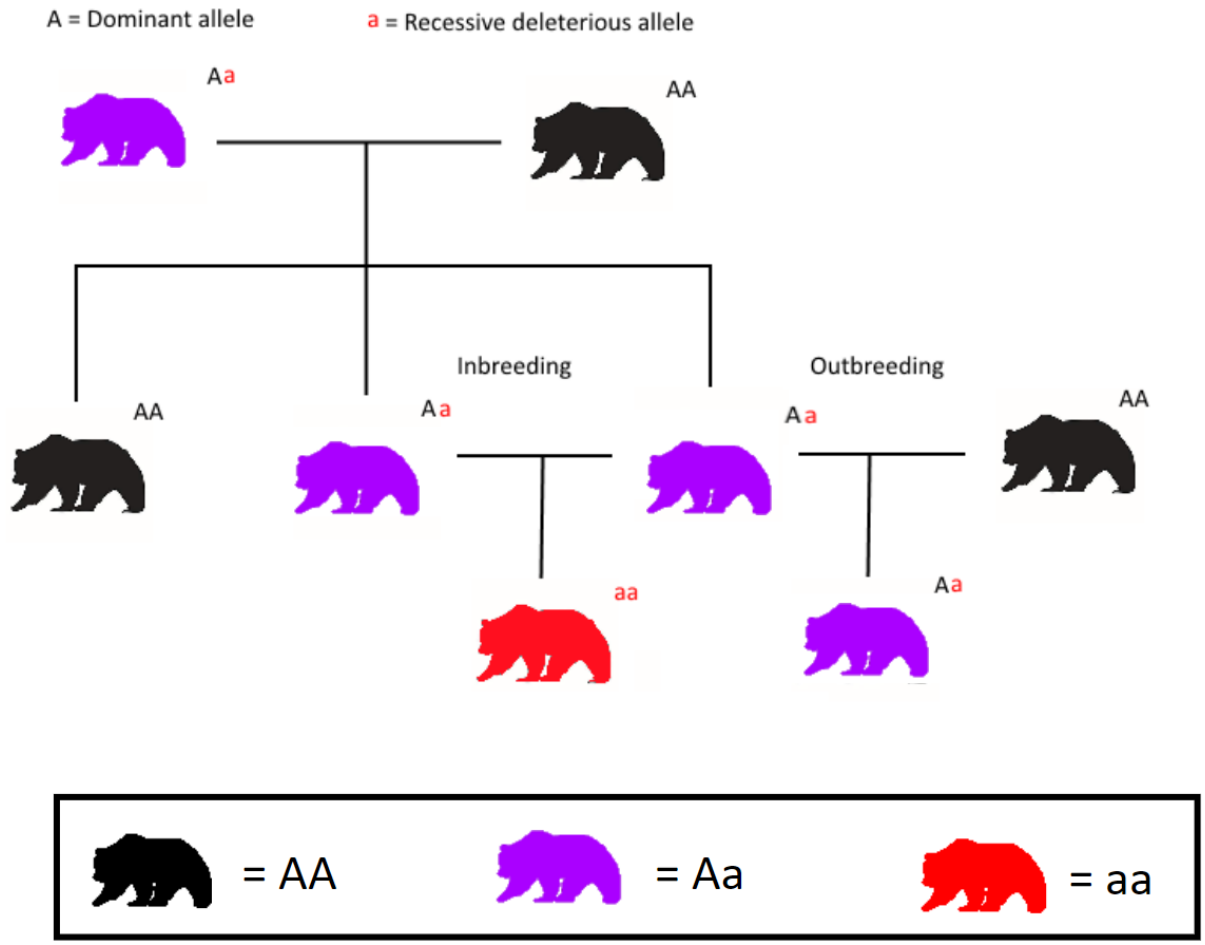
ACTIVITY – INVESTIGATION

Students will investigate and summarize one case study where inbreeding is known to have occurred. Students will investigate the factors that led to inbreeding as well as any interventions that occurred to reverse the effects of inbreeding depression.

1. Assign students to small groups to investigate and summarize one inbreeding case study from the following list.
   a. Florida Panther (*Puma concolor coryi*)
   b. Swedish Adders (*Vipera berus*)
   c. Domestic Dogs (*Canis familiaris*)
   d. Thoroughbred Horses (*Equus ferus caballus*)
   e. Holstein Friesian Cattle (*Bos taurus*)

2. Ask students to consider the following questions:
    a. Is the case study a wild or domestic population?
    b. Why has inbreeding occurred?
    c. What are the related health problems?
    d. What was done (if anything) to reverse the health problems?

Figure 1: Example of inbreeding depression among a grizzly bear population



GENETIC DIVERSITY AND FRAGMENTATION (Part II)

GRADE Grade 9

PART 2 of 3

TOPICS Biodiversity, conservation, habitat, fragmentation, connectivity

CURRICULAR CONNECTIONS

Grade 9 Science

Unit A – Biological Diversity

2. Investigate the nature of reproductive processes and their role in transmitting species characteristics
   - Identify examples of dominant and recessive characteristics and recognize that dominance and recessiveness provide only a partial explanation for the variation of characteristics in offspring
4. Identify impacts of human action on species survival and variation within species, and analyze related issues for personal and public decision making.
   - Describe ongoing changes in biological diversity through extinction and extirpation of native species, and investigate the role of environmental factors in causing these changes
   - Evaluate the success and limitations of various local and global strategies for minimizing loss of species diversity

OVERVIEW

Following an investigation of biodiversity and more specifically genetic diversity in Part I, students will begin to look at some of the mechanisms that may threaten biodiversity within the Bow Valley. The focus of this lesson will be on the grizzly bear, a keystone species which has been at the forefront of research efforts and conservation interventions for many decades. Finally students will get to imagine what it takes for a grizzly bear to navigate this complex landscape through an interactive game.

OBJECTIVES

- Students will understand how habitat fragmentation impacts grizzly bears and other wildlife species
- Students will be able to explain the importance of wildlife corridors
- Students will explore considerations for designating effective wildlife corridors

KEY TERMS

- **Fragmentation** – the process during which a large expanse of habitat is transformed into a number of smaller habitat patches that are isolated from one another
- **Habitat connectivity** – the degree to which separate habitat patches are connected
- **Habitat patch** – a discrete area with a definite shape that is used by a species for breeding or obtaining other resources
- **Keystone species** – a species on which other species in an ecosystem largely depend, such that if it were removed the ecosystem would change drastically
- **Wildlife corridor** – physical links that connect two or more large areas of a similar habitat

GUIDING QUESTIONS

- What are some of the major barriers to wildlife movement in the Bow Valley?
- How are animals able to overcome the barriers that you identified?

BACKGROUND ESSAY

Imagine that you are a grizzly bear living in the Canadian Rocky Mountain Parks, a massive 23 600 km^2 network of protected areas. Your territory spans two provinces, seven national and provincial parks, and three numbered Treaties (Treaty 6, 7 and 8). The rugged mountain peaks, vibrant green forests, alpine meadows, glaciers and turquoise lakes supply all the food, water, shelter and space necessary for you to survive and thrive. This space is crucial, because the home range of a grizzly bear in the Central Rockies can be up to 200-500 km^2 for females and an enormous 1000-2000 km^2 for males.

However instead of the huge expanse of comparatively undeveloped wilderness that your relatives once knew, your home now looks more like a collection of much smaller islands of habitat. These habitat "islands" are also called **habitat patches**. Your ability to travel between them has been compromised by a virtually impassible network of roads, fences, settlements, trails and railway tracks, making it very challenging for you to acquire the resources that you need to survive. The process during which a large expanse of habitat is broken up into smaller, isolated habitat patches is called **fragmentation**. As the remaining habitat patches become smaller, they are likely to support smaller populations. As we learned in Part I, the likelihood of inbreeding depression is higher among smaller, more isolated populations.

Highways act as barriers to wildlife movement directly through vehicle-wildlife collisions or indirectly by wildlife avoiding these areas, thus preventing interaction between different populations. In addition to the added difficulty of acquiring seasonal food resources, roads, railways and towns restrict the ability of bears to find mates and access breeding opportunities. This in turn can lead to decreased genetic diversity, which can have massive repercussions for the population as a whole.

DURATION 10-15 minutes

MATERIALS

- Whiteboard & projector
- Scrap paper
- Writing utensils
- Post-It® Notes

ACTIVITY – QUESTION FORMULATION

This activity is designed to get students to start thinking critically about the topic. Asking good questions is a key part of scientific inquiry, participation in democracy, advocating for oneself and community and holding elected officers accountable.

1. Divide the students into groups of 3 or 4. Explain to students that you will be showing them an image or phrase related to the topic (e.g. an image of a bear trying to cross a road).

2. Explain the rules of the activity:
    a. Ask as many questions as you can
    b. Do not stop to discuss, judge, or answer the questions
    c. Write down every question exactly as it is stated
    d. Change any statement into a question

3. Once the students have had ample time to ask questions, tell them to stop. Tell the group to select the question(s) that they consider the most important, that they would most like to learn about, or would be the most helpful for finding a solution to a problem. Students can circle, underline, or write their chosen questions on a Post It note.

4. Ask the groups to share these questions with the group. As an extension, task the groups with organizing their questions together based on similarities. You may choose to revisit these

questions later on and ask students how they could turn their questions into scientific research questions.

Source: The Right Question Institute (RQI). The Question Formulation Technique (QFT) was created by RQI. Visit www.rightquestion.org for more information and free resources.

KEEP WATCHING

"Living with Wildlife" (Run Time – 23:18) is the story of how communities in the Bow Valley have come together over the past 20 years to live with grizzly bears and other wildlife. vimeo.com/214597705.

BACKGROUND ESSAY

Bears have been extensively studied as they are considered to be a **keystone species**. The loss of carnivores from the landscape can result in far reaching impacts across the food chain, and these megafauna are susceptible around the world to population declines owing to human causes. Bears have low population densities and low reproductive rates to begin with, as well as large territorial requirements. In the Bow Valley, research has found little evidence of female movement across human settlement and transportation corridors. Female movement is most restricted by these corridors, while male movement appears to be reduced in some areas.

Not only do wildlife need to move from habitat patch to habitat patch in order to find mates and exchange genetic information, but they also need to access land for food and other needs. Wildlife tend to move along similar pathways. These pathways are called **wildlife corridors**. In towns like Canmore, the best corridors for wildlife are already often taken up by development which competes for the flat areas in the valley bottoms which are preferred by wildlife. Developing communities, especially those which are constrained by topography as is the case in the Bow Valley, must take wildlife corridors into effect in their design if they are to maintain ecosystem function and minimize human-wildlife conflict. They must take into account not just how much land will be set aside for wildlife corridors, but also where and what type of land is being set aside.

The pressing need for wildlife corridors is only expected to increase over time as climate change forces species to move from their present-day ranges to new, more favourable habitats. A key consideration in our efforts to maintain habitat connectivity must be to build more climate resilient landscapes. In Part III, we will look at some strategies for protecting biodiversity and maintaining habitat connectivity in landscapes that have already been fragmented.

DURATION 20-25 minutes

MATERIALS

- Pylons (optional)
- Coloured cards, x4 different colours
- Sheet
- Rope x2 or 3
- Plank of wood

ACTIVITY – BEARS OF BANFF SIMULATION

In this simulation of the flow of genetic material between grizzly bears, students – the grizzly bears – will have to survive increasing development pressures in order to pass their genes on to successive generations.

1. Create a playing area for the students that has defined boundaries. Achieve this by moving the desks aside and placing

the chairs in a circle, by using rope or pylons, etc. The area should be large enough that students can freely move around.

2. Tell the students that they are grizzly bears and the area that you have created represents a protected area. They are not allowed to leave the boundaries of the protected area.

3. Recap the basic needs that all animals have to meet in order to survive (food, water, space and shelter). Tell the students that for this activity, these needs are all met. Their only responsibility will be to find mates and pass their genes on to future generations of grizzly bears.

4. Each student will receive four cars, each one a different colour. Explain to the students that the cards represent genes. At your signal, the students must trade cards with each other until they have four of the same colour card.

5. Ask who was able to collect four cards of the same colour. Were there any barriers to them passing their genes on?

6. Next ask students if there was anybody who was unable to collect four cards of the same colour. Explain that these students were victims of inbreeding. Any bear that interbreeds for three rounds in a row will be eliminated from the game. *Note: Students may point out that having four of the same colour card is akin to having the same genes. You may need to provide additional clarification that in this activity, the cards simply illustrate the passing of genes through generations. The colours do not represent different genes.*

7. Continue with successive rounds, each time changing the game slightly. In the second round, the goal will be to obtain four different coloured cards. Have students alternate between rounds from collecting four different coloured cards to four identical coloured cards.

8. At the end of each round, ask for a show of hands to see who has been a victim of inbreeding. Create a story of gradual development and fragmentation of the protected area in which the grizzly bear population has a harder and harder time finding mates. Remind students how much time actually occurs between successive generations of cubs that are born by the same mother, about 5 years. What challenges could this present?

This activity has been adapted from the “Bears of Banff Simulation” activity from *Teaching Green: The Middle Years*. For additional background information and the complete activity description, including a description of the different round variations, view the

original lesson plan at http://www.earthrangers.org/wp-content/uploads/2016/08/habitat_fragmentation1.pdf.

REFERENCES

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GENETIC DIVERSITY AND FRAGMENTATION (Part III)

GRADE Grade 9

PART 3 of 3

TOPICS Human-wildlife conflict, biodiversity, habitat

CURRICULAR CONNECTIONS

Grade 9 Science

Unit A – Biological Diversity

2. Investigate the nature of reproductive processes and their role in transmitting species characteristics
   - Identify examples of dominant and recessive characteristics and recognize that dominance and recessiveness provide only a partial explanation for the variation of characteristics in offspring
4. Identify impacts of human action on species survival and variation within species, and analyze related issues for personal and public decision making.
   - Describe ongoing changes in biological diversity through extinction and extirpation of native species, and investigate the role of environmental factors in causing these changes
   - Evaluate the success and limitations of various local and global strategies for minimizing loss of species diversity

OVERVIEW

Wrapping up what students learned in Parts I and II, this lesson will look at strategies that are used to maintain genetic diversity and connectivity in fragmented landscapes. Students will evaluate different strategies before delving into their own community education action projects designed to improve human-wildlife coexistence in the Bow Valley.

OBJECTIVES

- Students will critically explore several strategies that are employed to maintain genetic diversity among bear and other wildlife populations
- Students will understand the role that they can play in preventing human-wildlife conflict

KEY TERMS

- **Crossing structure** – structures that allow animals to cross human-made barriers safely
- **Human-wildlife conflict** – the interaction between wild animals and humans that the resulting negative impact on people, animals, resources and habitats
- **Translocation** – the movement of something from one place to another (e.g. wildlife)

GUIDING QUESTIONS

- What are the main threats to biodiversity in the Bow Valley?
- What are some ways to overcome threats to biodiversity?
- How can individuals help to conserve biodiversity and healthy wildlife populations?

BACKGROUND ESSAY

Biodiversity is under threat due to human activities. What the main threats are largely depends on the habitat and species in question. They include population growth and resource consumption, climate change, habitat conversion and urbanisation, invasive alien species, and environmental degradation. As we learned in Part II, one of the most persistent challenges to biodiversity in the Bow Valley is habitat fragmentation. While this can be remedied by good planning and design of wildlife corridors, often we are forced to work within the confines of already fragmented landscapes. Land managers have a number of strategies at their disposal to maintain biodiversity in fragmented landscapes. These strategies include translocation, wildlife crossing structures, and community education.

Translocation

In very extreme cases – such as in the example of the Florida panther from Part I – **translocation** has been proposed and sometimes used to maintain biodiversity and ecosystem function. Translocation involves the movement of one or more individuals from one place to another.

This introduces additional genetic variation from one population into another and may reverse the detrimental effects created by recessive gene versions.

Rates of success for translocations are low however, while the process itself is highly disruptive and potentially dangerous for the wildlife being translocated. This solution is also reactive, meaning that it is responding to the symptoms of the problem rather than addressing the root causes themselves such as habitat fragmentation. Without addressing the circumstances that led to the problem in the first place, it is entirely possible that the population will decline again. It is greatly preferable to use a preventative intervention strategy that avoids a population's number falling so low that inbreeding depression occurs in the first place.

With bears in the Canadian Rockies, translocation has *only* been used to move so-called "problem bears" to new locations where conflict with humans is less likely. Translocation has *not* been used to bolster bear populations in the Rockies.

CASE STUDY

Researchers in Banff conducted a three-year investigation of the effectiveness of crossing structures in Banff National Park in facilitating the movement of genes between different populations of bears. They obtained genetic information by collecting hair samples from grizzly and black bear populations both on highway crossing structures and in surrounding areas. The study provided evidence that bears are able to share their genetic information via crossing structures, thus preventing the complete isolation of populations of both grizzly and black bears.

Among the findings from the study was the discovery that breeding black bear females prefer overpasses, while males prefer underpasses. Furthermore, the researchers were able to determine that the Trans-Canada Highway did not completely isolate grizzly bear nor black bear populations on either side of the highway.

Wildlife Crossing Structures

Maintaining a physical connection between large habitat patches allows genes to flow across the landscape and between subpopulations. Wildlife **crossing structures** such as overpasses and underpasses have been extensively studied and have been shown to be an effective strategy for maintaining habitat connectivity.

In Banff National Park, six overpasses and thirty-eight underpasses facilitate the movement of wildlife across the Trans-Canada Highway. These structures comprise the most extensive network of crossing structures anywhere in the world. The crossing structures were designed to prevent vehicle-wildlife collisions and to maintain habitat connectivity.

When paired with wildlife fencing alongside transportation corridors and the work being done by organizations that prevent **human-wildlife conflict** such as Bow Valley WildSmart and the Bear Conflict Solutions Institute, wildlife crossing structures are a great tool for maintaining genetic diversity.

Community Education

Community education takes many forms but in all cases requires the commitment of local residents to coexisting alongside wildlife. Just as human activities can lead to biodiversity loss, they can also lead to biodiversity conservation and enhancement. Education initiatives promote an awareness of the impacts that people's action may have on wildlife and the adoption of practices that keep wildlife and people safe, both at home and on the trails.

Ultimately the best approach to conserving biodiversity will be some combination of the strategies discussed here, as well as others such as additional legal protections and the establishment of more protected habitat.

DURATION 15-20 minutes

MATERIALS

- Scrap paper
- Writing utensils

ACTIVITY – PROS AND CONS

Students are tasked with evaluating a variety of strategies that can be used to enhance or maintain genetic diversity, considering the strengths, weakness and limitations of each.

1. Divide students into small groups. Introduce some of the possible strategies that can be used to maintain or enhance genetic diversity and explain how they accomplish this goal. Strategies to consider: *translocation*, *crossing structures*, and *community education*. Students may also want to explore a strategy that is not included here.

2. Ask each group to brainstorm and record as many advantages and disadvantages of these strategies as they can think of. If the students require additional direction, ask them to consider cost, animal behaviours, effectiveness or practicality for the local region.

3. Once the students have had a chance to brainstorm options, partner groups together who were looking at the same strategy. Ask students to share with each other what they have written and to create a comprehensive list of all their ideas.

4. Invite one or two students from each group to share their thoughts with the entire class.

BACKGROUND ESSAY

As wildlife and people compete for a finite amount of space, numerous interactions between humans and wildlife occur. Although most are harmless, some can pose a serious threat to both people and wildlife, resulting in human injury, property damage, and/or dead or relocated animals. While populations may be resilient to the death of a single bear, the loss of numerous individuals from the landscape could jeopardize that population. People can help to maintain genetic diversity of bears near high human use areas like the Bow Valley through their choices. For this to happen, the cooperation and participation of every single resident and visitor is necessary.

Bow Valley WildSmart leads diverse education and outreach efforts to raise public awareness and empower citizens to coexist safely with wildlife. These education efforts include bear spray training sessions, wildlife awareness talks, and interactive booths for youth, families, outdoor educators, outdoor recreationalists and people employed in the recreation and tourism industry. These events arm participants

with the knowledge and skills to be WildSmart in the Bow Valley and beyond.

WildSmart also trains enthusiastic volunteers to share their knowledge with their peers by becoming Wildlife Ambassadors and they undertake attractant management to help keep wild animals out of areas heavily used by humans. There are many ways that students can help to reduce negative human-wildlife interactions. The ideas listed below are just a few but students and teachers may want to put their own spin on these or come up with entirely new ideas. You can reach out to WildSmart for additional information or support by email at info@wildsmart.ca.

ACTIVITY – GET INVOLVED!

Students share what they have learned about the importance of protecting wildlife in order to maintain biodiversity and ecosystem function through a variety of different action projects.

Community Attractant Audit

Communities in the Bow Valley have made huge strides to manage their wildlife through bear-proof garbage bins, voluntary fruit removal programs and birdfeeder bylaws. Despite these successes, there still remain many garbage bins in the Bow Valley that don't meet these standards and residences with fruit trees in their backyards. Students can perform an audit of attractants in their neighbourhood or community, then share what they have learned and come up with strategies to address the problems.

Weekly Bear Report

WildSmart publishes a weekly summary of bear activity between the Banff Park East Gate and Bow Valley Provincial Park. The information in the Bear Report is intended to help the public make informed decisions about where and how to recreate based on recent wildlife movement patterns. Students can contribute to this bear report by sharing stories, photography, lessons, artwork, or success stories for the *"Paws-itive News"* section. Brainstorm other ways to create a Bear or Wildlife Report at your school such as through a school newspaper or morning announcements.

Junior Wildlife Ambassadors

Each year WildSmart and Alberta Parks staff train a number of dedicated volunteer Wildlife Ambassadors in wildlife ecology, how to avoid and handle wildlife encounters and effective public engagement. Ambassadors use animal artifacts and other educational resources to engage people in conversations about wildlife habitat needs and safe trail use. Adopting the same strategies used by the Wildlife Ambassadors, students can work with WildSmart staff to develop presentations for younger students in local elementary schools. Students may even want to pursue becoming Junior Wildlife

Ambassadors, joining the team to share their knowledge on local trails throughout the summer.

Public Service Announcements

Students can explore different creative ways to share what they have learned about biodiversity conservation and how people can participate in meaningful solutions through a newsletter, podcast, radio spot or video. The Biosphere Institute has audiovisual equipment that students can use to record and edit their projects as well as a platform to host this work at www.biosphereinstitute.org/student-work.

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