EXPLORING CLIMATE CHANGE: WOLVERINE HABITATS

BACKGROUND

Many animals have adapted to specific, harsh environments, like Yellowstone's alpine and subalpine zones. To survive in these unforgiving environments, certain species like the wolverine adopted physical and behavioral characteristics favorable to high sun, wind, and snow levels. Wolverines are scavengers that traverse long distances in snowy landscapes in search of carcasses and large montane prey, such as moose and/or mountain goats. They primarily dig snow dens, and their thick fur and high metabolism are adapted primarily for cooler climates. In this lesson, students will 'become' wolverines fighting to survive in wake of decreasing habitat. As the game progresses, decreased habitat access will beget decreased access to food to meet each wolverine's caloric need to survive and reproduce.

GRADE LEVEL: 3-5th with extension activities for 6-12th SUBJECT: Climate, habitat loss, wolverine adaptations GROUP SIZE: 10+ SETTING: Classroom, gym, field NATIONAL/STATE STANDARDS: NS.K-4.3, and NS.K-4.6; N.S5-8.3; NS.9-12.3 Wyoming Science Standards: HS-LS2-6,7; WY HS-LS4-5-6 NGSS: MS-ESS3, MS-ESS2-5, MS-ESS3-5, MS-ESS3.D;HS-ESS3, HS-LS2.C, LS4.C, LS4.D



Figure 1: Wolverine (Gulo gulo) on Grinnell Glacier, Glacier NP

OVERVIEW

Students will demonstrate an understanding of specific adaptations that have prepared the pika and wolverine to survive in cool climates with harsh winter conditions. Students will additionally demonstrate an understanding of timescales and evolution, and how due to the increased speed of global temperature rise, climate change can have negative effects on these mammals despite their ability to adapt. *This game has been adapted from 'Breathing Boreal' as written by Project WET*.

ESSENTIAL QUESTIONS/OVERARCHING CONCEPTS

- How does climate change effect animals' habitats?
- Which species are most susceptible to the effects of climate change?
- What adaptations and behaviors do wolverines have that allow them to survive in their habitat?

MATERIALS

- Playing Field ("Habitat/Range") Markers
- Start and finish line cards (or anything to indicate playing field, such a rope, sticks, water bottles, etc.)
- Food Tokens need 3 per class member (print-out included)
- ½ Food tokens– need 1/4th number of players (print-out included)
- Death Tokens need 1/4th number of players
- (print-out included)
- Year-in-the-Life Scenario Cards (print-out included)
- Background information and photos (print-out included)

BACKGROUND INFORMATION

Wolverines are the largest member of the weasel family, standing up to 2.5 feet high at the shoulder and weighing, at an average maximum, between 50 and 65 pounds. Wolverines primarily live in alpine areas and are effective scavengers and carnivorous predators when snow slows down other predators and the cold preserves carcass materials. Additionally, adult wolverines can travel up to 40 miles in a day and may call between 100 and 600 square miles their home range or territory. Due to their high activity level and the extreme conditions that they live under, researchers from the University of Nebraska (Lincoln) estimated that a wolverine requires, on average,5096 kJ/day for males and 3645 kJ/day for females; the researchers estimated that a wolverine would need to consume 6-8 mule deer per year to meet this requirement.

Wolverines are well adapted to intense, high-elevation winter corridors with ample expanse for foraging and mating while still leading a relatively solitary lifestyle. However, these powerful mammals are thought to have low species counts in North America due to a variety of factors, including human encroachment and climate change.

INTRODUCTION

- 1. Discussion: What adaptations (behavioral and physical) do wolverines in North America have to thrive in extreme winter conditions?
 - a. Examples: territorial aggression to help acquire and maintain limited food sources; wide, fluffy paws to help with snow travel; multiple layers of fur (guard hairs and ground hair) to stay warm; large heart and lungs relative to body size to help with snow travel and aerobic capacity; muscular body relative to size; sagittal crest on skull to give stronger bite force.
- 2. Define Vocabulary:
 - a. Species a group of living organisms with similar characteristics, capable of interbreeding/reproducing.
 - b. **Population** a group of members of a species within a region that reproduce with one another.
 - c. **Adaptation** an inheritable physical or behavioral change by which an organism or species becomes better able to survive and reproduce in its environment
 - d. **Habitat** the natural home of an organism; four major components of good habitat include food, water, shelter, and space.
 - e. Home Range the area in which an animal lives and moves on a periodic basis
 - f. Geographic range the area in which the collective members of a species live and travel
 - g. **Territory** an area defended by an animal or group of animals; may coincide with the home range of an animal
 - Climate Change a change in global and/or regional climate patterns, especially the accelerated change in the late 20th century onward attributed largely to increased levels of atmospheric carbon dioxide produced by the use of fossil fuels
 - i. Snowpack seasonal accumulation of slow-melting packed snow

3. Introduce Key Concepts

- a. Wolverines are large, solitary mustelids that require high calorie intake and vast habitat extent. They are notably ferocious for their size, and fill an important and challenging niche driven by hunting at high elevations and in snowy conditions. Wolverines are opportunistic eaters, with a diet consisting of: rodents, birds, eggs, beavers, marmots, whitebark pine nuts, and other small to mid-sized creatures; in other regions, wolverines have been documented hunting/eating ungulates such as mountain goats and deer. Wolverines have also been documented eating carcasses of large ungulates and other animals, including bone matter.
- b. **Human Development** can impact wildlife species by cutting off migration pathways; reducing habitat to construct housing, agricultural development, or other industries; and disturbing wildlife through increased human access to wild spaces (including for recreational purposes). This may impact some species' abilities to survive and reproduce in areas formerly part of their geographic range.
- c. Climate Change: The Greater Yellowstone Ecosystem has experienced average temperature increases of approximately 0.3°F/decade since 1894, with increasingly dry conditions (including in the winter) below 6,500 feet. As minimum temperatures rise, winter snowpack is expected to decrease, especially at lower elevations. Summer temperatures, even in alpine areas, are also expected to continually rise in the coming decades. Many scientists are concerned for the survival of wildlife species specifically adapted to high elevation conditions, including the

wolverine. It is expected that by 2050, the spring snowpack needed for wolverine denning and hunting will be limited to portions of the Southern Rocky Mountains, the Sierra Nevada Range, and certain portions of Yellowstone; of these three areas, currently only Yellowstone has a population. Between 2006 and 2009, a total of 7 wolverines were documented in eastern Yellowstone and adjoining National Forest Land.

RULES OF THE GAME

- 1. Walking feet you don't want to use too much energy by running!
- 2. Players should not move or touch start/finish lines.
- 3. No swapping or stealing tokens from other players
- 4. Have a positive attitude 😊

GAME PLAY OVERVIEW

- 1. Set up the playing field (roughly the extent of a small classroom or schoolyard). Place the START line at one end and the FINISH line at the other. Scatter the food tokens in this area *UPSIDE DOWN* (so that in later rounds, students can't tell which cards are ½ food or death tokens) at least one per student!
 - a. **Explain** to students that this space between the start and finish line represents the this space is the wolverine habitat that they can occupy. This habitat provides food, water, shelter, and space (from humans, other wolverines, etc.), and meets the climate requirements that female wolverines will need to dig snow dens for their pups in the winter.

USE "START/FINISH" CARDS

2. **Explain: Students will become wolverines.** Each season, you must traverse your entire range extent (from START line to FINISH line) and gather enough calories to do so. Each season your goal is to collect is **1 food token**. You must cross the finish line to represent that you explored your entire habitat area.

USE FOOD TOKENS/DEATH CARDS (3 PER PLAYER)

- 3. Each YEAR (one full round) will be comprised of two SEASONS (winter and summer). The players' goal is to get the minimum amount of food **(2 food tokens)** by the end of the year. However, each year, more challenges will be introduced.
 - a. Year 1 will provide all wolverines with enough food to survive (everyone should be able to get 2 tokens one in the summer, one in the winter).
 - b. Year 2 will make "summer" more difficult by adding in "death" tokens to replace some food tokens and reduced habitat extent.
 - c. Year three, both winter and summer "habitat" playing fields are reduced, and food tokens are reduced and replaced with both "death" tokens and partial food tokens (to represent limited food availability). *Instructors may choose to count a smaller number of tokens instead of simply replacing them with ½ food tokens, at their discretion.*

SEE "SCENARIO" CARDS FOR TEACHER SCRIPT AND FURTHER DETAILS.

POST-GAME DISCUSSION

- 1. Discussion Questions
 - a. During which season was it easiest to find enough food (two tokens)?
 - b. What habitat changes made acquiring enough food more difficult?
 - c. How did the introduction of human development impact your ability to forage food? How did this differ or compare to the introduction of reduced snowpack and warmer temperatures?
- 2. Review: What adaptations do wolverines have that would help them in a world similar to Year 1 (minimal development, lots of snow, etc.)? How might these adaptations affect the wolverine's ability to survive in Year 3 (development, reduced snowpack, warmer temperatures, different prey behaviors)?
- 3. Key question: If wolverines are so well adapted to their environment as it is, why can't they adapt again to a new climate? Why is this species now listed as Threatened on the Endangered Species List?
 - a. Discuss with students the idea of **populations**. Outside of Alaska and Canada, wolverines live in isolated populations with minimal ability to geographic barriers to access each other. Imagine that each mountain range with suitable wolverine habitat is an island. If there aren't enough wolverines within those "island" sub-populations, they won't be able to reproduce very well, and they might be very susceptible to going locally extinct on that "island" if they lose even just a few members of their population.

OTHER CONSIDERATIONS

• If playing this game in an outdoor setting, please be cognizant of litter, wind, and critters!

Please note that, with the exception of those resources pulled from the National Park Service Website, these articles are
provided exclusively for context and information regarding wolverines and the controversies surrounding their conservation
status over the last few decades, and do not reflect any official policies or opinions of the National Park Service or its
employees.

EXTENSIONS (SUGGESTED FOR 9-12TH GRADERS)

- **Researching the Wolverine:** Have students pursue online research related to wolverine population dispersion and climate vulnerability.
 - As a class, read excerpts from Doulas Chadwick's, "The Wolverine Way," which focuses on wolverine research conducted in Glacier in the 2000's, and answer the following related discussion questions:
 - Pages 23-24: What hazards do wolverine populations face today? Where do wolverines live in North America? What is genetic diversity, and how might wolverine dispersion within the lower 48 states affect sub-population resilience to outside stressors (disease, habitat loss, inbreeding, etc.)?
 - Pages 24-27:
 - Why might wildlife biologists and other scientists be interested in wolverine research, based off the information contained in this excerpt?
 - How can information on wildlife behavior impact wildlife management? Education? Understanding?
 When might information on a species unveil questions or information transferrable to other species or environments?
 - What challenges do scientists and their research technicians encounter when pursuing information about wildlife?
- Judge Gulo: Federal protection of wolverines has been a controversial subject between state, federal, and private agencies. In 2020, the USFWS determined that wolverines did not need to be listed on the Endangered Species List. This decision was revisited, and in November 2023, the wolverine was listed as a "threatened" species on the Endangered Species List by US Fish and Wildlife Service.
 - Have students, as a whole, read different perspectives regarding this issue.
 - Once the class has gained a general understanding of the different interest groups and their perspectives, divide students into 4 groups and assign them to represent an interest group: Scientists/Researchers (Group 1), US Fish and Wildlife (Group 2), and State Fish and Wildlife Agencies (Montana FWS resources provided below).
 - Group 1 (Pro-USFWS Endangered or Threatened Listing) Resources:
 - Podcast on Wolverines featuring former researcher <u>Episode 19 | Wild Wolverines! Greater</u> <u>Yellowstone Coalition</u>
 - <u>Changes in Yellowstone Climate Yellowstone National Park (U.S. National Park Service)</u>
 - Home Climate Change: Vital Signs of the Planet
 - Wolverine Species Profile, Alaska Department of Fish and Game
 - <u>Estimates of Energy and Prey Requirements of Wolverines</u>
 - Group 2 (Defense of former decision to de-list at time, but pro-listing under present day conditions) -Resources:
 - 2013 U.S. Proposes Protecting the Wolverine The New York Times
 - 2016 Judge Prods Wildlife Service on Protection for Wolverines The New York Times
 - 2020- Wolverines Don't Require Protection, U.S. Officials Rule The New York Times
 - 2023 Some U.S. Wolverines to Be Protected by Endangered Species Act The New York Times
 - Group 3 (Anti-listing as Threatened due to insufficient data on wolverines; livelihoods of trappers; sufficient population and climate-viable habitat persists in neighbors Canada and Alaska) - Resources:
 - From the State of Montana Newsroom: <u>Governor Gianforte Issues Statement on Feds Listing</u> <u>Wolverine as a Threatened Species</u>
 - From Montana FWS: <u>Wolverine Tracking | Montana FWP</u>
 - 2020- <u>Wolverines Don't Require Protection, U.S. Officials Rule The New York Times</u> See quotes above
 - Feds: Insufficient data to list wolverine as threatened | Environment | bozemandailychronicle.com

- Students will develop a defense for their assigned group's stance regarding wolverine conservation, considering the lived experiences of constituents that inform their perspectives. Each group will present their arguments before a "judge" (the teacher). The judge may offer critical questions aimed at helping the students develop stronger arguments, not at breaking down the perspectives of the interest group themselves. It is up to the teacher's discretion if they would like to determine a "winner" based on strength of arguments and students' preparedness.
- Follow-Up Questions: What did we learn from these resources? How can interpretation of data lead to different opinions on the same subject? What challenges might wildlife administrators face when balancing public opinion, scientific data or lack thereof, and the potential for extirpation of a species?

ADDITIONAL RESOURCES

- Adapted from: <u>Project WET's Breathing Boreal Lesson and Activity Plan</u>
- Suggested background information: "Chasing the Phantom" from PBS Nature <u>Wolverine: Chasing the Phantom | About |</u> <u>Nature | PBS</u>
- Review U.S. Fish and Wildlife Service's FAQ about Wolverine Conservation here: <u>U.S. Fish and Wildlife Service announces final</u> rule to list North American wolverine as threatened in contiguous United States
- Changes in Yellowstone Climate Yellowstone National Park (U.S. National Park Service)
- Home Climate Change: Vital Signs of the Planet
- Wolverine Yellowstone National Park (U.S. National Park Service)
- Wolverine Species Profile, Alaska Department of Fish and Game
- Estimates of Energy and Prey Requirements of Wolverines
- The Wolverine Foundation A non-profit organization comprised of wildlife scientists with a common interest in the wolverine.
- <u>Wolverine Tracking | Montana FWP</u>
- The Wolverine Way by Douglas Chadwick

YEAR 1

- Season 1: Winter
 - a. Review: Because wolverines' bodies are well adapted to winter travel, hunting, and foraging, they experience significant advantages as predators during this time of year. The snow makes it easier to capture ungulates (hooved animals, like deer) who have to wade through the snow, and the cold provides plenty of carcasses of weak or young animals while also preserving these carcasses as fresher sources of food. Wolverines aren't too picky, but they need as many calories as they can acquire, and the longer a carcass sits available to bears and detritivores, the fewer calories are available for the wolverine to forage. Wolverines, for our purposes, have the greatest habitat extent during the winter, as they are not limited in their ability to cache food and hide their young when snow covers the ground. Their thick fur and high metabolisms are made for cold weather.
 - b. During the "Winter" the playing field is very large (the full classroom, for example). Wolverines will have 1 minute to travel the extent of their range (travel from the start line to the finish line) and collect 1 token. Players will wait on the far side of the "finish" line while the instructor explains the next round.
- Season 2: Summer
 - a. The wolverines' habitat will be more limited; without snow on the ground, some areas of our ecosystem get too hot for carcasses to remain preserved and/or too hot for our wolverines to travel efficiently over long distances to hunt.
 - b. Instructor will reduce the extent of the playing field by moving the finish line 1/3 of the way closer to the start line, reducing the playing field to 2/3 its largest extent. Some tokens will naturally be removed from the playing field because of this change; the instructor may collect these, but should **not** set them out again during this round.
 - c. Students will return to the finish line and hang onto their first token. Now, wolverines have one minute to find a second token and traverse the extent of their territory (get to the finish line).
 Depending on how things shake out, all students may or may not be able to find a second token and "survive" the summer season. Students who do not "survive" can still participate in future rounds.
- Gather the students and collect all food tokens.
- Debrief the first round: Was it easier or harder to find enough food in the winter or summer? Did you encounter more wolverines during your travels in the winter or summer? Would it be more or less difficult for a wolverine to maintain its territory in the summer as opposed to the winter? For this first year, it's alright if there wasn't a huge difference in food availability between seasons.

YEAR 2: Introduction of Human Impacts

- Scenario: Human development has reduced the habitat that wolverines can access in the summertime due to fencing and road construction. The development is relatively minimal, and when there is deep snow, the wolverines are still able to access their full territory.
- Season 1: Winter
 - a. Reset the playing field to its fullest extent and play as normal, each student collecting 1 food token.
- Season 2: Summer
 - a. Reset the playing field to ½ its full extent (smaller than summer in the previous round). Scatter food tokens, with up to ¼ of the tokens replaced with "death" tokens (hide the "death" side so that "1 food" is the only side visible, when placing them and tell students they're not allowed to swap tokens once they pick them up). Students again have 1 minute to acquire 2 tokens and cross the finish line. Have students who obtained "death" tokens raise their hands.
- Debrief: Explain that habitat barriers can impact wolverines in a number of ways. Wolverines may not have been able to find enough food due to car accidents (run-ins with vehicles while searching or eating roadside carrion), negative human interactions (trapping, or repeat run-ins with livestock or human communities that resulted in the wolverine being put down), or inability to effectively navigate fences/farmland/development barriers.
- Collect the tokens, but remain organized! It is easy to mix up "normal" and "death" tokens.

YEAR 3: A Warming World

- Scenario: The Greater Yellowstone Ecosystem has experienced average temperature increases of approximately 0.3°F/decade since 1894, with increasingly dry conditions (including in the winter) below 6,500 feet. As minimum temperatures rise, winter snowpack is expected to decrease, especially at lower elevations. Summer temperatures, even in alpine areas, are also expected to continually rise in the coming decades.
- Season 1: Winter
 - a. With less snowpack, wolverines not only have less "prime" habitat available for winter foraging, but the human barriers imposed in the last round are more difficult to circumvent. Playing field should be set to 2/3 the original space to represent a decrease in available winter habitat. Scatter enough food tokens for 3/4 of the players to obtain a "1 food" token; the last ¼ of tokens should be a medley of "death" tokens and ½ food tokens.
 - b. ½ food tokens represent less food availability in the same habitat, since those creatures (elk, deer, mountain goats, etc.) have also experienced habitat loss from both changing temperatures and increased human encroachment. Additionally, the milder winter has resulted in fewer losses within prey populations (easier for them to survive, fewer carcasses).
 - c. If students collect ½ food tokens, they will need to collect additional tokens to reach the required "1" token (their calorie minimum). There may not be enough for all students to get "1" full token, and so students will either "perish" from their death tokens or have to forage extra the next round.
- Season 2 Summer:
 - Playing field will be ½ as large as the "full" playing field (the smallest field yet) due to combined temperature rise (less viable habitat) and human development. Instructor should again scatter ¾ "1 food" tokens, and ¼ a medley of ½ food tokens and "death" tokens.
- Students unable to procure equivalent to 2 tokens by the end of the year perish.

Additional Variations:

For a busy class, instructors may opt to remove the ½ food tokens and simply reduce the number of tokens available to represent decreased prey populations due to habitat loss and/or decreased carcass availability due to milder winter conditions.

Instructors may play the 3rd and optional fourth round with even more limited food, replacing up to ½ of available tokens with death/partial food tokens or simply removing more "1 food" tokens

1 FOOD	1 FOOD	1 FOOD	1 FOOD
1 FOOD	1 FOOD	1 FOOD	1 FOOD
1 FOOD	1 FOOD	1 FOOD	1 FOOD
1 FOOD	1 FOOD	1 FOOD	1 FOOD
1 FOOD	1 FOOD	1 FOOD	1 FOOD
1 FOOD	1 FOOD	1 FOOD	1 FOOD
1 FOOD	1 FOOD	1 FOOD	1 FOOD
1 FOOD	1 FOOD	1 FOOD	1 FOOD

1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD
1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD
1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD
1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD
1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD
1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD
1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD
1/2	1/2	1/2	1/2
FOOD	FOOD	FOOD	FOOD

DEATH!	DEATH!	DEATH!	DEATH!
DEATH!	DEATH!	DEATH!	DEATH!
DEATH!	DEATH!	DEATH!	DEATH!
DEATH!	DEATH!	DEATH!	DEATH!





From 2016 - Judge Prods Wildlife Service on Protection for Wolverines - The New York Times

"Chief Judge Dana L. Christensen of United States District Court for Montana on Monday rebuked the agency in a <u>lengthy court decision</u>, citing the "immense political pressure that was brought to bear" by Western states on the question of whether to list the wolverine, rather than relying on sound science. The states of Idaho, Montana and Wyoming, along with the petroleum industry and other groups, have opposed granting the wolverine the designation of a threatened species.[...] But Mr. Ashe [USFWS Director], in describing the service's decision in 2014 against protections for the wolverine, said: "We were presented with inconclusive scientific information and decided against the listing. The wolverine is not at risk of extinction, which is different than saying the wolverine is not going to be affected by a changing climate.[...] "It's not just a win for the species, but a win for science," said Matthew Bishop, a lawyer for the Western Environmental Law Center here, which challenged the decision on behalf of 22 groups. "Five papers said there's a significant connection between wolverines and climate change and not a single one suggested there isn't. They chose to disregard the science."

From 2020- Wolverines Don't Require Protection, U.S. Officials Rule - The New York Times

- "The case has pitted the advocates against the federal government and Western states where wolverines are found. Farm bureaus, snowmobile associations and the American Petroleum Institute, the main oil industry lobbying group, have also argued against listing wolverines as threatened or endangered."
- "Settlers all but eradicated the species by the 1920s. Wolverines were killed by poison meant for wolves and coyotes. They were starved when their prey base collapsed because of overgrazing by farm animals. They were trapped for their long, thick fur. After predator poisoning campaigns stopped, wolverines began to make a slow comeback in the Rocky Mountains and the North Cascades, reclaiming territory in Montana, Wyoming, Idaho and Washington."
- "Scientists estimate that the contiguous United States could support perhaps 600 wolverines. Canada and Alaska, on the other hand, are home to robust populations. Over the years, the Fish and Wildlife Service has seesawed on whether wolverines in the lower 48 states should be protected as a threatened population distinct from those north of the border."
- ""Some of the places I worked in the '90s, where I was able to readily capture wolverines, they're gone now," Mr. Copeland said. "These little sub-populations could blink out and be gone without us even knowing.""

Quotes attributed to Catrin Einhorn, The New York Times, October 10, 2020

From 2014 - Feds: Insufficient data to list wolverine as threatened | Environment | bozemandailychronicle.com

"In 2010, biologists estimated the U.S. wolverine population at around 300. That estimate remains unchanged four years later. Ashe said the population was at least stable. A stable population and no proven correlation between reduced spring snowpack and reduced wolverine reproduction were the main reasons Walsh decided protection was unwarranted, Ashe said."This is not about whether we believe the climate is changing because we do. It's not about whether we believe that this may have an impact on wolverine populations in the future because we suspect that it may," Ashe said in a conference call. "We know too little about the ecology of wolverines, and the climate models we have available today don't provide specific information about the effect of climate change on the type of habitat that wolverines prefer for denning." Ashe said listing the polar bear was a clear call because of the strong correlation between dwindling summer sea ice and shrinking polar bear populations and the poorer health of individuals. Without a similar correlation and without a reliable prediction of how climate change could affect wolverine reproduction, Ashe said the legal standard for listing set by the ESA wasn't met."

Quote attributed to Laura Lundquist, Bozeman Daily Chronicle, August 12, 2014.