WOLVES OF YELLOWSTONE

Subject Area: Science

Grade Levels: 7-12

Purpose and Overview: This set of activities was inspired by the Wolves of Yellowstone | EARTH A New Wild video from PBS LearningMedia. The purpose of these activities is to introduce students to the ecological impact of wolf reintroduction, the controversy surrounding the wolves, and finally to have students extend their understanding and apply it to another wolf reintroduction debate that rages on today regarding Isle Royale National Park in Michigan.

Soldiers displaying wolf pelt at Soda Butte Creek patrol station, Yellowstone National Park, 1905. Credit: NPS

The lesson plan is divided into four parts. In Part 1, students will discover how the absence of wolves impacted the Yellowstone National Park ecosystem. They will explore the concept of a trophic cascade through a short video clip and through an in-depth analysis of data from scientific study conducted in the park after wolf reintroduction in 1995.

In Part 2, students will examine the pros and cons of various scenarios that were presented by the U.S. Fish and Wildlife Service during the 1994 decision-making process on whether or not to reintroduce wolves to Yellowstone National Park. Through the use of role-playing, students will learn about the varied opinions regarding wolf reintroduction and will ultimately be forced to compromise and arrive at a final proposal based on the park needs and the public commentary.

In Part 3, students will examine research that describes how wolf reintroduction has impacted the park and compare what we know now to the original public concern. The purpose of this activity is to allow students to examine research to determine the actual impact of the wolves on the park twenty years later and relate it to the initial public concerns that were expressed in the role-play activity in Part 2.

In Part 4, students will extend upon the knowledge they have gained in learning about the trophic cascade that occurred in Yellowstone National Park (YNP) and apply it to a modern problem in Isle Royale National Park.

Time:

- Part 1: One to two 45-minute class periods
- Part 2: Two to three 45-minute class periods
- Part 3: Two 45-minute class periods, with homework
- Part 4: One 45-minute class period plus homework

Introduction

In 1872, the world's first national park, Yellowstone, was born. However, while it protected approximately 3,472 square miles of land (2,221,766 acres), it did not protect the gray wolves that lived inside its boundaries. In fact, in the early years of the park any visitor to the park could hunt and kill any wild game or predator they encountered. Wolves were especially vulnerable because they were seen as an undesirable predatory species.

At least 136 wolves were killed in the park between 1914 and 1926. By the 1940's wolf packs were seldom reported in the park. In fact, by the mid-1900's wolves had been nearly eliminated not just from Yellowstone but from the lower 48 states entirely.

In the 1940's a growing movement of conservationists, environmentalists, biologists, and park officials supported reintroduction of the wolves to Yellowstone. However, it wasn't until 1991 that Congress directed the U.S. Fish and Wildlife Service to develop an environmental impact statement regarding wolf reintroduction and in 1995, the park moved forward with a plan to reintroduce wolves to the park.

Reintroduction was not without controversy as there were, and still are, many stakeholders involved in the Yellowstone area, each with unique concerns. However, in the twenty years since the reintroduction of the wolves, scientists have noticed many positive changes to the park ecosystem. This set of activities seeks to introduce students to the trophic cascade that has occurred in the park and the positive changes in the ecosystem since the reintroduction of a top predator – the wolf.

Part 1: Defining Trophic Cascade

Purpose: The purpose of this activity is for students to discover how the absence of wolves impacted the Yellowstone National Park ecosystem. Students will explore the concepts of a trophic cascade through a short video clip and through an in-depth analysis of data from scientific study conducted in the park after wolf reintroduction in 1995.

Time: One to two 45-minute class periods

Materials:

- Internet, computer, LCD projector
- Copies of student worksheet for Part 1 (located at the end of this document)
- Wolves of Yellowstone | EARTH A New Wild Video
  URL: https://vimeo.com/116273819 (can be downloaded)
- Optional – student access to computers to explore interactive content for the wolf ecosystem
  URL: http://www.pbslearningmedia.org/resource/5aeed659-7f0b-417f-81d9-5f2e9c747644/ecosystem-explorer-earth-a-new-wild/

Objectives:

The student will…

- Describe the conditions of the Yellowstone National Park (YNP) ecosystem in the absence of wolves.
- Explain the trophic cascade that occurred in YNP.
- Predict what would happen to YNP if environmental conditions changed.
- Examine and analyze data on the wolf, elk, and plant populations in YNP and describe how the populations are interdependent.
- Analyze the change in resource availability in YNP and construct an explanation of the subsequent changes in animal populations.

Next Generation Science Standards:

Disciplinary Core Ideas:

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concepts:

- Patterns
- Cause and Effect
- Stability and Change

Science and Engineering Practices:

- Analyzing and interpreting data
- Constructing explanations
- Engaging in argument from evidence

Performance Expectations:

Middle School

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

High School

- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Vocabulary:

Apex predator: a top-level predator with no natural predator of their own; resides at the top of a food chain.

Browser: an organism that eats the shoots, leaves, and twigs of trees or shrubs; elk are browsers (and grazers).

Browsing: the act of eating shoots, leaves, and twigs of trees or shrub.

Cottonwood recruitment: the growth of seedlings or sprouts above the level of browsers. In other words, the trees are able to grow taller than the level at which elk and other browsers can eat them.

Grazer: an organism that feeds on grass; elk are grazers (and browsers).

Habitat: the home or environment of a plant, animal, or other organism.

Keystone species: a species that has a disproportionately large effect on its environment compared to its relative abundance. When a keystone species is removed from a system, the ecosystem may change drastically, even if the species removed was a small part of the entire ecosystem.

Trophic cascade: a trophic cascade occurs when the impact of a predator on its prey affects one or more feeding or trophic level. Predators control the populations of their prey and thus indirectly benefit and increase the abundance of their prey's prey. When the apex predator is removed, the lack of population control at the next trophic level down can affect the populations at the trophic level below. Trophic cascades must occur across a minimum of three trophic levels (e.g. secondary consumer, primary consumer, and producer). Trophic cascades can also happen from the bottom up; for example, the removal of a producer may affect population sizes in the trophic levels above it.

Suggested Lesson Flow Part 1:

1. Discuss the words **habitat, apex predator, keystone species,** and **trophic cascade** with students and have them define these words in their notebooks. This may require a review of the structure of food chains (producer, primary consumer/herbivore, secondary consumer/carnivore, etc.) so that the concept of a trophic cascade can be explained.

2. Distribute the student worksheet for Part 1. Show students the Wolves of Yellowstone | EARTH A New Wild video clip from the beginning and **stop at 2:36 minutes.**

3. While students are watching the video have them start to draw the bubble map on the student worksheet for Part 1. This map charts the changes in the ecosystem of YNP in the absence of wolves. Students should also answer questions 2-4 during or after the video.

4. Go over the bubble maps with the students. The teacher answer key on pages 6-10 of this guide provides one possible bubble map and answers for the other viewing questions and activities.

5. The graphs in the student worksheet for Part 1 were taken from a 2012 scientific journal article by Ripple and Beschta. You may wish to go over some of the labeling on the graphs and the related vocabulary. Students should be able to work through the data analysis on their own or in a small group. The graphs will lead the students to an understanding of the actual trophic cascade that occurred in the ecosystem when wolves were reintroduced.

6. Spend the next class period going over the student worksheet for Part 1 and checking for understanding.

7. At this point you may wish to show the rest of the video and have students draw a bubble map that indicates the changes to the ecosystem when the wolves were reintroduced. This will help to wrap up the activity and illustrate the ecosystem changes that were observed in the study by Ripple and Beschta. A bubble map template and video viewing questions for the remainder of the video can be found on the student worksheet for Part 2. However, if you plan on doing the role-playing activity in Part 2 of this lesson, you may wish to wait to show the conclusion of the video so as not to influence student opinion prior to the role-playing activity.

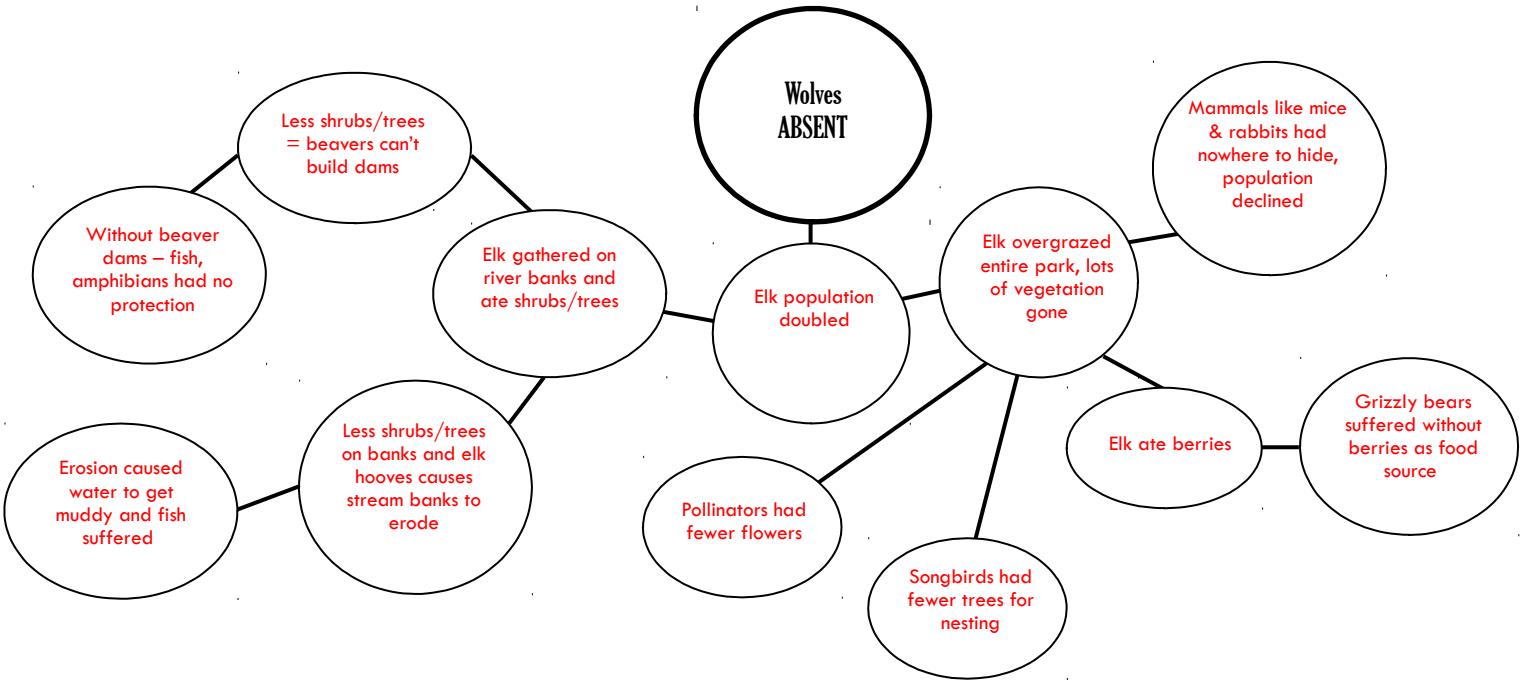
8. Optional activity: It may be useful to provide students with another opportunity to interact with the wolf story in a different way. The "Ecosystem Explorer" was inspired by content from the EARTH A New Wild series and includes a "Wolf World" where students can explore the wolf ecosystem through interactive, multi-media content. You can find the interactive content here: http://www.pbslearningmedia.org/resource/5aeed659-7f0b-417f-81d9-5f2e9c747644/ecosystem-explorer-earth-a-new-wild/.

WOLVES IN YELLOWSTONE

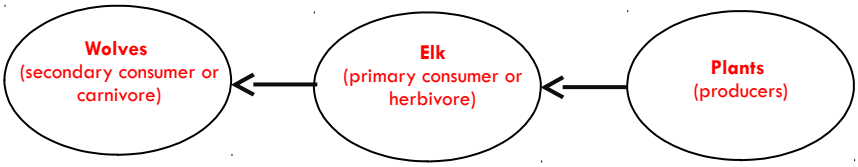
Student Worksheet – TEACHER ANSWER KEY

Part 1: Defining Trophic Cascade

1. Watch the Wolves of Yellowstone | EARTH A New Wild (https://vimeo.com/116273819) video clip from the beginning and **stop at 2:36 minutes**. As you are watching, create a bubble map below that includes all of the things that happened in the Yellowstone ecosystem in the absence of wolves. Add as many lines and bubbles from the center bubble as needed.



2. Using your bubble maps as a guide, create a food chain of the three organisms that are involved in a **trophic cascade** in Yellowstone National Park.



3. With the elimination of wolves from the ecosystem, how was the population of plants (producers) indirectly affected?

   Answer: The population of plants was reduced because of the overgrazing of plants by elk. Overgrazing occurred because the elk population was no longer controlled or checked by the wolves (their predator).

4. Predict what would happen to the wolf and elk populations if there was a drought that caused many of the plant species to dry up and/or die.

   Answer: The elk population would decrease because its food source is decreased. This would also cause the wolf population to decrease because they would have less food (elk).

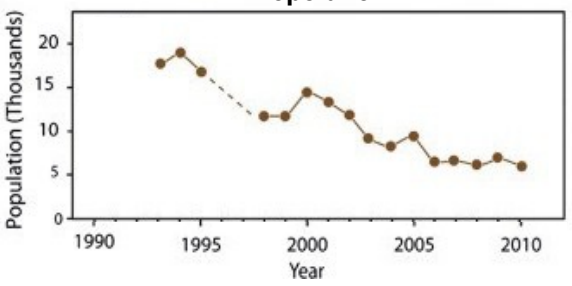
Background:

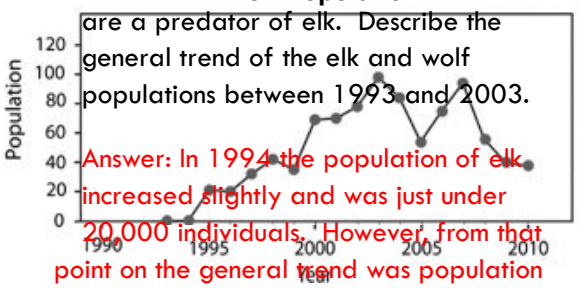
The graphs in the next section were taken from the 2012 study by William Ripple and Robert Beschta on trophic cascades in Yellowstone National Park. Aspen, willow, and cottonwoods are common foods for browsers like elk. Willows are also commonly eaten by beavers. If scientists want to measure trees and shrubs to look for the impact that browsers are having on their growth, they might measure the following things:

- Height
- Recruitment
- # of Rings

A measure of **height** can tell scientists how tall the trees are allowed to grow. If the mean tree height in one area is low compared to another area that could be an indication of heavy browsing by elk. **Recruitment** is the growth of seedlings or sprouts above the level of browsers. In other words, the trees are able to grow taller than the level at which elk and other browsers can eat them. Tree **rings** indicated the age of a tree – the more rings a tree has, the older it is. Increases in these three measurements can indicate an increase in the level of health of the woody plants. Decreases in these measurements could indicate a higher level of browsing pressure on the plants.

Use the graphs below to answer questions 5-8.





5. You have already identified that wolves are a predator of elk. Describe the general trend of the elk and wolf populations between 1993 and 2003.

Answer: In 1994 the population of elk increased slightly and was just under 20,000 individuals. However, from that point on the general trend was population decrease. By 2003 the number of elk was just below 10,000 individuals. During the same period, the wolf population trend was to increase. The wolf population rose from 0 to 100 during that period.

6. Based on the graphs, what year do you think wolves were introduced to Yellowstone? Explain why you think this.

Answer: The wolves were introduced in 1995. The wolf population in 1994 was zero and in 1995 the count was around 20 individuals.

7. Using information from the graphs, describe what happens to the wolf and elk populations in 2005. Indicate what you think might have happened during this year to cause this change.

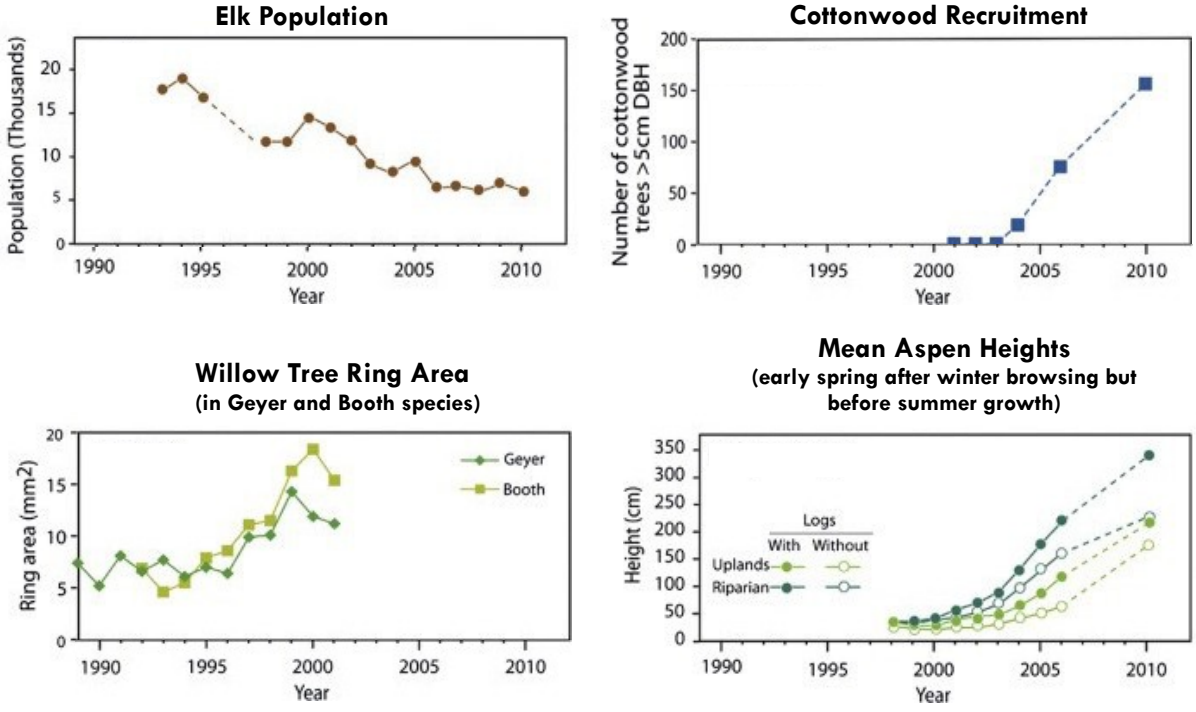
Answer: In 2005 there was a slight uptick in the elk population and a decrease in wolves. Wolves could have died or left the park and the decrease in wolf population allowed for an increase in elk population since there was less predation.

8. In 2010, the wolf population was lower than in previous years. Make a prediction about the elk population in the years beyond 2010 if the wolf population continues to stay at the 2010 level.

Answer: Based on what happened to the elk population when the wolf population decreased in 2005, it is possible that the elk population will increase and continue to increase unless wolf numbers increase. Just like when there were no wolves in the park, the elk population grew unchecked.

Examine the graphs below and use them to answer questions 9 and 10.

Note that the willow tree rings were measured in two different species of willow (Geyer and Booth). The aspen heights were measured in two different habitats – the uplands and riparian (stream side). During the aspen measurements, it was also noted if there were logs in the area since logs could impede browsers from getting to the trees, which would possibly decrease herbivory on those trees. In the cottonwood recruitment graph, the measurement ">5cm DBH" means that the scientists measured the number of trees that had reached a "diameter at breast height" greater than 5 cm.



9. Use information from the graphs to describe the change in the size and growth of the trees and the population of elk during the data collection periods depicted in the graphs.

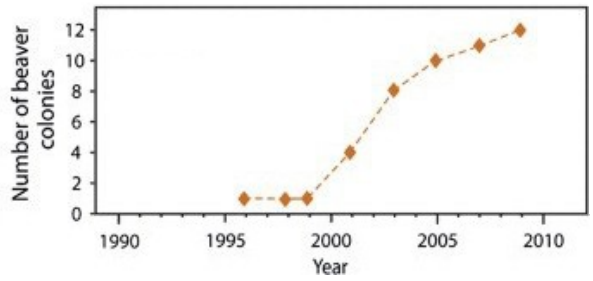
   Answer: As the elk population began a general decline (after 1995), there was an increase in willow tree ring area until around 1999. Between 2003 and 2004 the number of cottonwood that were able to grow to a diameter greater than 5 cm also increased and kept increasing through the end of the data collection period. Additionally, the mean aspen heights of all trees (with and without logs, riparian and uplands) increased from the beginning of the data collection period in 1998 through the end of the data collection period in 2010.

10. What can you infer about the relationship between elk population and tree growth?

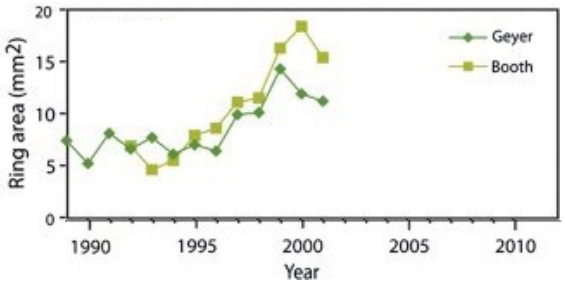
    The decrease in elk allowed for the increase in growth of their preferred browsing plants – cottonwood, aspen, and willow.

Use the graphs below to answer questions 11- 13.

# of Beaver Colonies



Willow Tree Ring Area
(in Geyer and Booth species)



11. Describe what happened to beaver colonies after 1995 (when wolves were reintroduced). Then describe the relationship between the number of beaver colonies and the willow tree ring area.

    Answer: Between 1995 and 1999, there was only one beaver colony counted. Beginning in 2000, the colony count increased and by 2010, the count reached 12 colonies. The data on willow tree ring area doesn't include the entire time period that beaver data was collected. However, you can see that between 1995 and 2000, the general trend was for an increase in tree ring area. This indicates that there must have been less browsing pressure, which may have allowed willows to grow more. At the time willow tree ring area reached its peak measurement in 2000

12. After about 1999, the willow tree ring area started to decrease again. What might account for this decrease?

    Answer: That decrease started about the same time the beaver population started to increase. It's possible the willow population rebounded after the decrease in elk population because of decreased browsing pressures, but the small decrease reflects the increase in beaver herbivory of the willow.

13. Based on what you know about tree growth and elk population, use data from the graphs to make a statement about how the elk population impacts the beaver population. In your answer, address why there was a lag between the change in elk population and the change in beaver population.

    Answer: The elk population impacted the beaver population because when the elk population decreased, the willow population was able to rebound and there was less competition with the elk for woody plants. Even though the elk population dropped soon after the wolves were reintroduced in 1995, the beaver population didn't increase until the vegetation growth was well underway. It took time for the plant communities to get established once there was less browsing by elk.

Other Resources for Part 1:

- For more information and examples of keystone species: http://www.nature.com/scitable/knowledge/library/keystone-species-15786127
- For more information on trophic cascades: http://www.nature.com/scitable/knowledge/library/trophic-cascades-across-diverse-plant-ecosystems-80060347

Part 2: Evaluate Solutions for Maintaining Ecosystem Services and Biodiversity

Purpose: In this activity, students will examine the pros and cons of various scenarios that were presented by the U.S. Fish and Wildlife Service during the 1994 decision-making process on whether or not to reintroduce wolves to Yellowstone National Park. During a role-playing activity, students will represent various stakeholder opinions on reintroduction and will choose a scenario to support that best fits their characters' needs. They will share their characters' opinions during a mock public forum and then students playing the role of U.S. Fish and Wildlife Service Employees with select the best scenario for the park after a thorough review of the benefits and constraints of each proposal. Students will learn that ecological issues are complex and that there are no perfect solutions. This activity forces students to evaluate the alternatives, find the best solution, and learn how to compromise for the best outcome.

Time: Two to three 45-minute class periods

Materials:

- 2 different colors of paper (green and yellow or your choice) for making role-playing cards
- Copies of the role-playing materials described below (all of the materials can be found at the end of this document or click the link to jump to their location in the document):
  - Copies of Role-playing cards (one card per student, see instructions)
  - Copies of Wolf Reintroduction Scenarios Pro and Con Chart (one per student)
  - Copies of Wolf Reintroduction Scenarios Matrix (one per student)
  - 1 copy of the USFWS Employee Prompt Card for Public Meeting
- Copies of student Worksheet for Part 2 (one per student)

Objectives:
The student will…

- Interpret the scenarios proposed by the U.S. Fish and Wildlife Service (USFWS) regarding wolf reintroduction to Yellowstone National Park (YNP).
- Evaluate scenarios based on their ability to maintain or increase ecosystem services for humans and support biodiversity in the park.
- Evaluate the constraints of proposed scenarios.
- Describe the differing viewpoints that existed during the decision-making process to reintroduce wolves to YNP.
- Utilize public feedback when choosing the best solution for wolf reintroduction to YNP.
- Understand the complexity of environmental issues.
- Collaborate with stakeholders to make a decision and propose the decision in a "public forum".

Next Generation Science Standards:

Disciplinary Core Ideas:

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS4.D: Biodiversity and Humans
- ETS1.B: Developing Possible Solutions

Crosscutting Concepts:

- Cause and Effect
- Stability and Change

Science and Engineering Practices:

- Engaging in an argument from evidence
- Obtaining, evaluating, and communicating information

Performance Expectations:

Middle School

- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

High School

- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Vocabulary:

Biodiversity: the existence of a wide range of different types of organisms in a given place.

Ecosystem services: the benefits for humans that arise from heathy ecosystems; these benefits include but are not limited to water purification, crop pollination, and a variety of recreational and cultural benefits.

Suggested Flow for Part 2:

Pre-lesson preparation:

1. Photocopy one copy of each of the Wolf Reintroduction Scenarios Pro and Con Chart and Wolf Reintroduction Scenario Matrix for each student (found at the end of this document – or click the links to jump directly to the handout).

2. Photocopy one set of the 12 role-playing cards found at the end of this document. It might be helpful to photocopy these on colored paper. The 12 cards represent voices from the public. Their attitudes and opinions reflect some of the actual public commentary that occurred during the decision-making process in 1994 (see Environmental Impact Statement). Also at the end of this document, you will find a set of four U.S. Fish and Wildlife Service cards. Photocopy enough of these cards for the remaining students in your class and use a DIFFERENT color of paper than what you used for the first 12 cards. The different color cards will make it easy for you to separate the two groups during the role play.

3. Cut out the role-playing cards.

4. You can assign students to the different roles or hand out the role cards randomly during class.

During class:

5. If your students don't already know what an **ecosystem service** is, use the beginning of class to address this concept. Ecosystem services are the benefits for humans that arise from heathy ecosystems; these benefits include but are not limited to water purification, soil erosion protection, crop pollination, and a variety of recreational and cultural benefits. Recreational benefits can include hunting and fishing as well as hiking and camping. It may be helpful to make a list of ecosystem services on the board that students can reference during the role play. It will be useful when students complete the Wolf Reintroduction Scenarios Matrix.

6. Distribute the Wolf Reintroduction Scenarios Pro and Con Chart and provide the following background to students:

   Prior to the reintroduction of wolves in Yellowstone National Park, the U.S. Fish and Wildlife Service had to examine the feasibility of five different scenarios concerning wolves and Yellowstone National Park. The pros and cons of the scenarios are described on your handout. The classifications "experimental" and "non-experimental" are used in the Endangered Species Act of 1973, which helps to define how endangered or threatened species are managed in the United States.

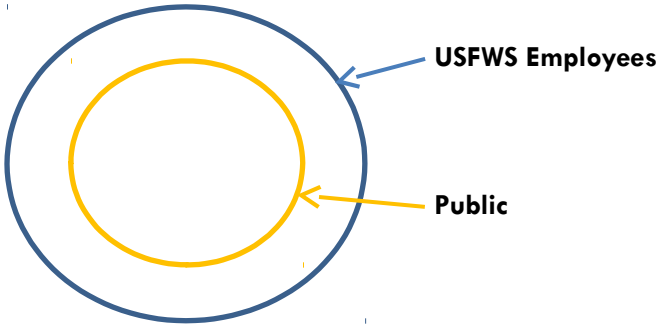
   As of the time of this decision in 1994 there were no known wolf populations in Yellowstone National Park.

   Your job is to read over the pros and cons for each scenario and decide which scenario your character would most likely choose and defend during a public hearing. If you are a U.S. Fish and Wildlife Service (USFWS) employee, you goal is to evaluate the scenarios and listen to the public arguments for and against each scenario. Ultimately, the USFWS will choose one scenario regarding wolf reintroduction. It is possible to modify the scenarios, so keep this in mind as you listen to the public commentary.

7. Let students look over the pros and cons and then ask if there are any questions. Make sure they understand what is being proposed in each scenario before moving on.

8. Once students have looked over the pros and cons have them write a short paragraph in which they state the scenario that their character will support and explain the reasons why they support it. This will be used during the role-play. Both the "public" and the "USFWS employees" should complete this task.

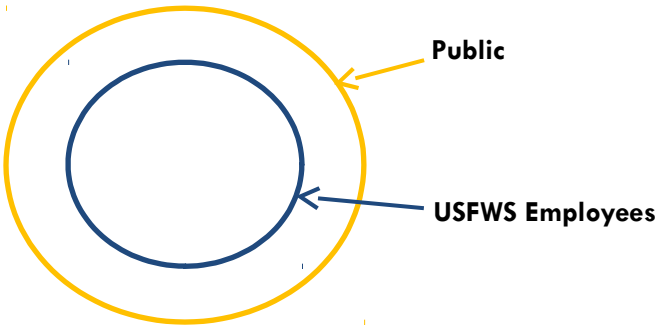
9. In this role play there will be an inner circle and an outer circle. The inner circle will represent 12 voices from the public with regard to the reintroduction of the wolves to Yellowstone National Park. The outer circle will represent U.S. Fish and Wildlife Employees who must ultimately make the decision about wolf reintroduction.



10. Elect a student representative from the USFWS group to begin the discussion and serve as moderator. There is a USFWS Employee Prompt Card at the end of this document. The representative can use to start the public meeting. This prompt card instructs the "public" students what to do during the forum. Students can use their own names for the purpose of introduction during the role play, but otherwise, all students are assuming a completely different role and their attitudes reflect the opinions of their character. This portion should last about 20-25 minutes.

11. Make sure to remind students in the role as USFWS employees that they should be taking notes during the public comment period. USFWS employees may not talk until the question and answer period at the end.

12. When the public forum is over, the inner and the outer circles should switch places, this time the USFWS employees will enter the center circle and the public will move to the outer circle. You can elect another moderator for this round or you can use the same moderator throughout the two rounds. This moderator should make sure that everyone gets a chance to speak.



13. For this round, the USFWS employees will discuss which option seems best considering the views of the public and the desire to maintain **ecosystem services** for humans (e.g. clean air and water, nutrient cycling, prevention of soil erosion, recreational opportunities, ecotourism, etc.) while at the same time maintaining biodiversity in the park.

14. The moderator will guide the discussion and project the Wolf Reintroduction Scenarios Matrix. USFWS employees will volunteer information to help complete the matrix. They will need to decide which **ecosystem services** are promoted by the scenario and also include design **constraints** for each scenario; these could include social, scientific, and economic limitations. It is possible for the USFWS to make modifications to the scenarios to deal with the possible constraints and to support ecosystem services. They should use their notes from the public hearing and the pro/con sheet to guide their discussion.

15. While the USFWS are discussing the best scenario to choose and if there should be any modifications, the students representing the public should be taking notes on the course of the discussion and making note of how their concerns were addressed. They should also complete the Wolf Reintroduction Scenarios Matrix along with the USFWS. The public may not comment during this time. This round should last about 20-25 minutes. The answer key for the Wolf Reintroduction Scenarios Matrix is on the next page this guide.

16. If your class periods are only 45 minutes long, you may wish to start the next round during the next class period. After the USFWS employees have discussed which scenario they feel would best fit, if it seems unanimous, they can propose that scenario to the public. If there are still disagreements, they could do a majority rules vote or however you would like them to come to a decision. This should take about 10-15 minutes.

17. The USFWS employees will then announce their decision and supporting reasons to the public. If they have decided to make any modifications to the alternatives, they should explain how they have modified the initial proposal and give reasons why. This should take about 5 minutes.

18. After the announcement, they can ask the public if they have any remaining concerns and if they have ideas about how to address these concerns.

19. At the conclusion of the role play, have students write a short reflection about the process. If they were on the USFWS side of the role play, they should write about the challenges in coming up with an acceptable proposal that balances the needs of the park and YNP ecosystem with the demands of the public. If the students were members of the public, they should write a reflection on how they felt about the final decision given the needs of their particular character. Students should also include in the reflection if their final decision differs or is similar to the scenario chosen by the USFWS.

20. Collect the reflections and debrief with the class during the next class period.

21. At this point, you may want to share with students that the USFWS service ultimately chose scenario #1 with a few modifications based on public comment.

22. To illustrate to the students the impact that the wolves had on Yellowstone, show the remainder of the Wolves of Yellowstone | EARTH A New Wild video (2 min, 40 sec) and have students do a second bubble map on the conditions in YNP when the wolves are PRESENT. There is a bubble map and two viewing questions on the student worksheet for Part 2 that you can print and distribute to students. Answers can be found on the teacher answer key for Part 2 on page 18 of this guide.

	Scenario #1: Reintroduction of experimental wolves	Scenario #2: Natural recovery	Scenario #3: No wolves – wolf prevention	Scenario #4: Local wolf management committee	Scenario #5: Reintroduction of non-experimental wolves
Ecosystem Services	Ecotourism, hunting, soil erosion, water filtration. However, because wolves can be shot if they impact livestock, it may make it harder to establish a population.	None likely.	None, ecosystem will continue to be degraded.	Ecotourism, hunting (if some states allow that to control wolves), possible soil erosion protection and water filtration.	Wolves will keep the elk population in check and trees and other plants will rebound. Ecotourism, water filtration, prevention of soil erosion.
Constraints	How will the wolves that impact livestock be managed? The wolves aren't as protected, so it might be harder for a population to get establish.	If there are no wolves in Yellowstone now (1994), then the only way they would naturally get there is to migrate into the park. However, wolves have not migrated into the park and been successful since they were eliminated in the 1920's.	Elk population will continue to grow, which will inevitably impact YNP and could extend beyond the park's boundaries to impact other areas	This might make ranchers and other locals happy. But because wolves will be managed differently in every state, what happens if wolf populations migrate from state to state?	This scenario would be the least likely to make ranchers happy. If their livestock are killed, they may want to kill the wolves and there will be conflict with local communities.

Part 2: Wolf Reintroduction Scenarios Matrix – TEACHER ANSWER KEY

WOLVES
IN YELLOWSTONE

Student Worksheet – TEACHER ANSWER KEY

Part 2: Evaluate Solutions for Maintaining Ecosystem Services and Biodiversity

Watch the Wolves of Yellowstone | EARTH A New Wild (https://vimeo.com/116273819) video clip in its entirety and answer the questions below:

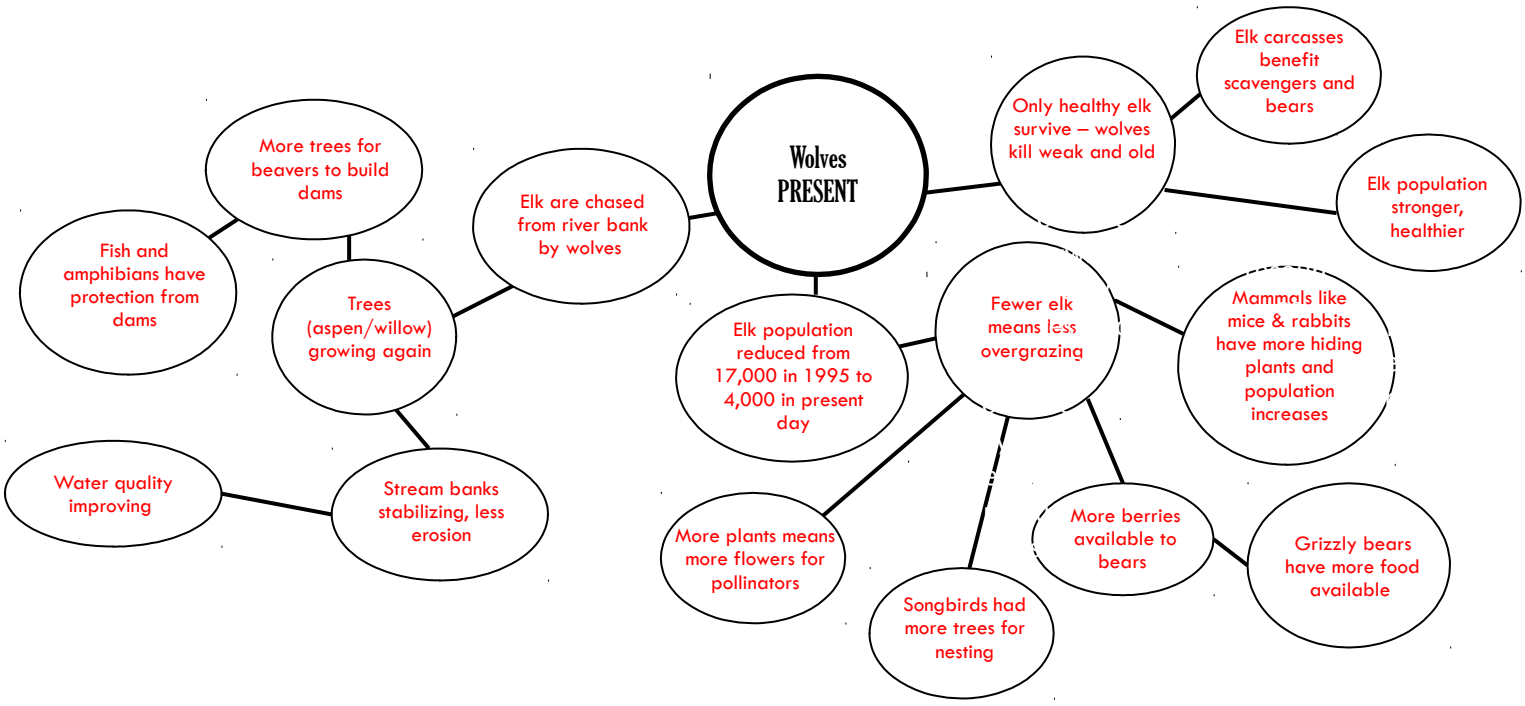
1. How have wolves helped the economy in the Yellowstone National Park area?

   Answer: In 2005, there were over 100,000 visitors to YNP who came to see wolves. This brought about 30 million dollars into the local economy.

2. What are other consequences of wolf introduction that have been good for the humans in the area?

   Answer: For the 106,000 residents of Billings, Montana, the Yellowstone River is cleaner and provides better drinking water for the community.

3. Complete the bubble map below and include all of the changes to the ecosystem AFTER wolves were reintroduced. Add as many lines and bubbles from the center as needed.



Part 3: Twenty Years After Wolf Reintroduction to Yellowstone

Purpose: Nearly twenty years has passed since the reintroduction of the wolves, and there has been a variety of research on the actual impact of the wolves to YNP. The purpose of this activity is to allow students to examine the research and to determine the actual impact of the wolves on the park and relate it to the initial public concerns that were expressed in the role-play activity in Part 2.

Time: Two 45-minute class periods, with homework

Materials:

- computers and internet access for all students

Objectives:
The student will…

- Identify and explore research that documents the changes in YNP since wolf reintroduction.
- Determine if the concerns of the public during the public comment period have been manifested over the last twenty years since the return of the wolves.
- Evaluate if the decision that was made (choosing scenario #1) actually yielded the desired results.

Next Generation Science Standards:

Disciplinary Core Ideas:
- LS2.A: Interdependent Relationships in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS4.D: Biodiversity and Humans
- ETS1.B: Developing Possible Solutions

Crosscutting Concepts:
- Cause and Effect
- Stability and Change

Science and Engineering Practices:
- Engaging in an argument from evidence
- Obtaining, evaluating, and communicating information

Performance Expectations:
Middle School
- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

High School
- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

•

Suggested Flow for Part 3:

1. Assign students to one of the teams below. Have them conduct research to see if the concerns of each role from Part 2 have been manifested in the last 20 years. Place two to three students on each team. Place students on teams as it best suits your class size and access to computers for research.

2. Students can use the hyperlinks provided as a starting point. You can share this page digitally in a Google document or whatever works best for you and your students. They should find at least two additional sources of reliable information (trusted resource) on the internet to support their findings. The groups should prepare their research to share with the class and elect a speaker who will summarize their findings.

   - Team #1: Describe how the wolves have impacted livestock in the area since 1994.
     Start here: http://fwp.mt.gov/fishAndWildlife/management/wolf/history.html
     http://www.fws.gov/mountain-prairie/species/mammals/wolf/wyomingstatus2010/10012010.html

   - Team #2: Describe what has happened with Grey Wolf hunting restrictions since 1994.
     Start here: http://www.nps.gov/yell/naturescience/wolfmgnt.htm
     http://wgfd.wyo.gov/web2011/news-1002256.aspx
     http://wgfd.wyo.gov/web2011/wildlife-1000380.aspx

   - Team #3: Describe how the wolves' status as an endangered species has changed since 1994.
     Start here: http://www.nps.gov/yell/naturescience/wolfrest.htm

   - Team #4: Describe how the Grey Wolves population has changed in the park area (MT, WY, ID) since reintroduction.
     Start here: http://www.fws.gov/mountain-prairie/species/mammals/wolf/

   - Team #5: Describe how many attacks by wolves on people and pets there have been in the Yellowstone National Park area (Wyoming, Idaho, Montana) since 1994.
     Start here: http://en.wikipedia.org/wiki/List_of_wolf_attacks_in_North_America

   - Team # 6: Describe how the reintroduction of wolves has impacted the local economy.
     Start here:
     http://www.cnn.com/2010/WORLD/americas/02/02/wolves.ecosystem.control.climate/,
     https://www.wildlifemanagementinstitute.org/PDF/11Social%20and%20Ecological....pdf

3. After completing their research and summarizing their findings, students can share their information with the class through short presentations. Have a class discussion on how the wolf introduction has impacted YNP over the last twenty years and how it has impacted the people that live in the area.

4. To conclude this activity, have students write a statement in which they analyze the cost and benefits to the park and the community. They should include evidence from their research, the research of the other groups, and any other relevant parts of this lesson.

Part 4:
Extend Knowledge – Isle Royale National Park

Purpose: The purpose of this activity is to extend upon the knowledge students have gained in learning about the trophic cascade that occurred in Yellowstone National Park (YNP). Because the reintroduction of wolves in YNP occurred 20 years ago, there is already data that illustrates the effects of the reintroduction. By investigating the situation on Isle Royale, students can use prior knowledge to evaluate a modern situation in a different ecosystem with different constraints in order to propose a unique management decision.

Time: One 45-minute class period plus homework

Materials:

- Student access to computers and internet for research (can be done as homework)
- Student copies of http://news.nationalgeographic.com/news/2014/04/140427-wolves-isle-royale-animals-science-nation/ (or can be read online)
- Student copies of http://blog.nature.org/science/2013/10/10/should-we-let-the-wolves-of-isle-royale-disappear/ (or can be read online)
- 50 Years of Wolf and Moose Dynamics on Isle Royale graph – on page 24 of this guide (to project or provide students with copies)

Objectives:
The student will…

- Examine and analyze data on wolf and moose dynamics on Isle Royale.
- Describe the relationship between wolves and moose based on data.
- Predict how future populations of wolves and moose will change based on evidence.
- Propose management solutions for Isle Royale National Park that will ensure biodiversity, maintain a healthy ecosystem, and maintain genetic diversity in the park.

Next Generation Science Standards:

Disciplinary Core Ideas:
- LS2.A: Interdependent Relationships in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS4.D: Biodiversity and Humans
- ETS1.B: Developing Possible Solutions

Crosscutting Concepts:
- Cause and Effect
- Stability and Change

Science and Engineering Practices:
- Engaging in an argument from evidence
- Obtaining, evaluating, and communicating information

Performance Expectations:

Middle School

- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

High School

- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Suggested Flow for Part 4:

1. Before beginning this activity, it may be useful to share with students some information regarding Isle Royale National Park.
    - A detailed map of the park can be found here: http://en.wikipedia.org/wiki/Isle_Royale_National_Park#mediaviewer/File:IsleRoyaleMap.jpg
    - Information about the park can be found here: http://www.nps.gov/isro/index.htm

2. After introducing students to the park, have them compare and contrast the park with Yellowstone. You could have students make a T-chart and compare the two. Because Isle Royale is on an island and the park takes up the entire island, the situation is drastically different from Yellowstone. Animal movement to and from the island can only happen via ice bridge in the winter and ice bridges don't form every year. Because the park is on an island, there aren't the same issues with ranching and hunting. The two articles will give more information on the park and they can add to their T-charts as needed.

3. The graph on the page 24 of this guide represents 50 years of wolf and moose dynamics on Isle Royale National Park in Michigan State. Share this with the class and have them describe the wolf and moose population dynamics over time. For example, what happens to the moose population when the wolf population increases? What happens to the wolf population when the moose population increases? If you would like students to create their own graphs, the data can be downloaded as an Excel spreadsheet at: http://www.isleroyalewolf.org/data/data/home.html

4. Ask students to speculate what might happen to the moose population after 2011 based on the data in the graph and based on what they have learned about Yellowstone National Park.

5. Given their knowledge of what happened to Yellowstone National Park, have them describe what might be the consequences to the ecosystem if wolves disappeared from the island permanently.

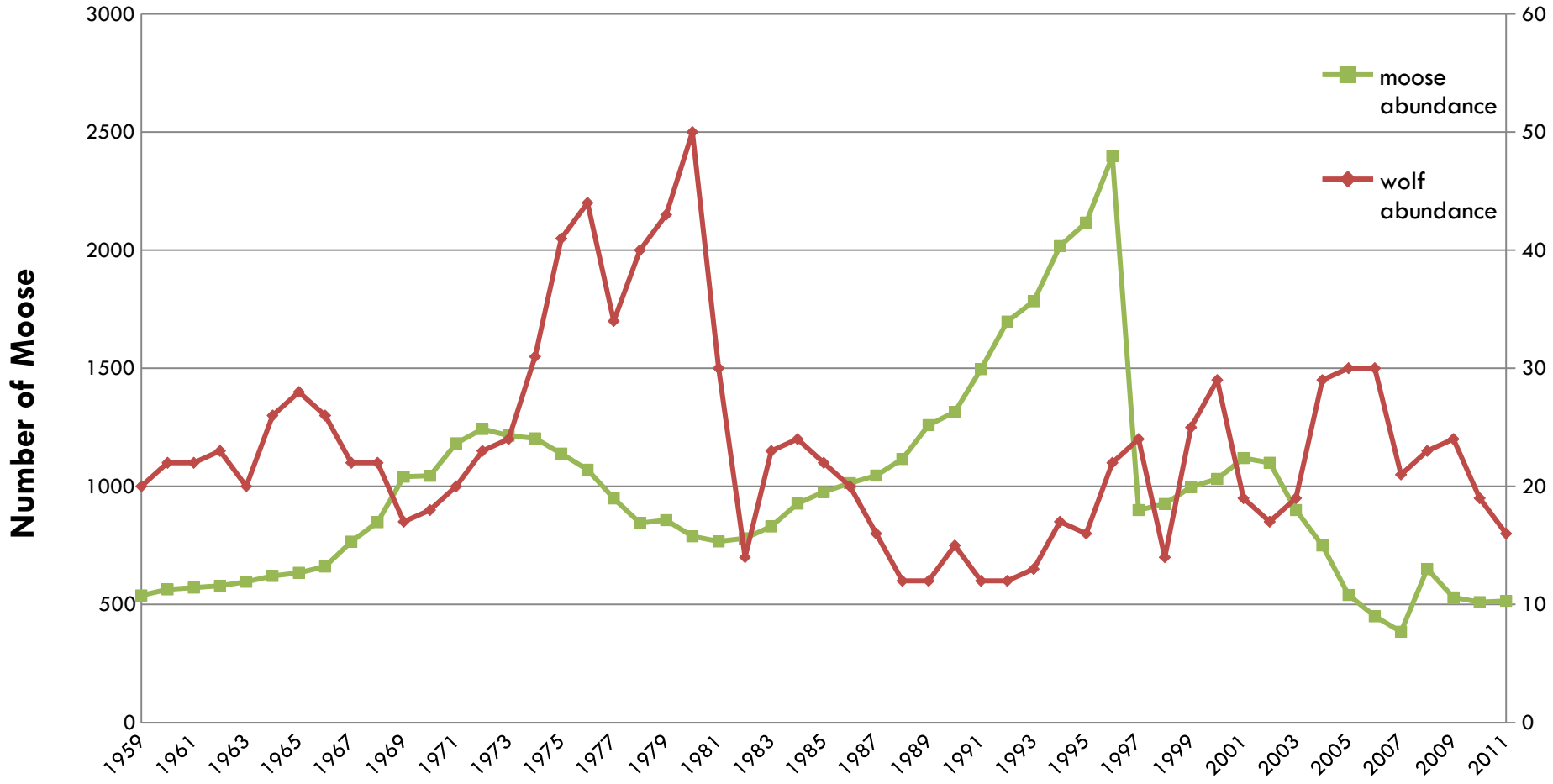
6. Have students read this article from National Geographic, which gives details about the plight of the wolves on Isle Royale: http://news.nationalgeographic.com/news/2014/04/140427-wolves-isle-royale-animals-science-nation/

7. Also have students read this opinion on the Cool Green Science Blog about wolves on Isle Royale: http://blog.nature.org/science/2013/10/10/should-we-let-the-wolves-of-isle-royale-disappear/

8. After reading both sources, have students develop their own opinions and write a position paper about what should happen with the wolves on Isle Royale. They should cite evidence from the National Geographic article and any other sources to support their management decision. They should specifically address the following points:

    - Ensuring the biodiversity of the park
    - Maintaining a healthy ecosystem
    - Maintaining genetic diversity in the park

50 Years of Wolf and Moose Dynamics on Isle Royale



Wolf and moose data obtained from: http://www.isleroyalewolf.org/data/data/home.html

Additional Resources:

- Graph of wolf population trends from 1979-200 in NW Montana, Yellowstone, and Central Idaho: http://www.fws.gov/mountain-prairie/species/mammals/wolf/annualrpt00/html/fig5.GIF
- For more information on the wolves in Yellowstone story, check out this video by KQED: http://www.pbslearningmedia.org/resource/20c3b7fd-080b-4c70-a9fa-72c35899d815/wolves-the-ecology-of-fear/
- For more information on trophic cascades in salmon ecosystems, check out this video by WNET: http://www.pbslearningmedia.org/resource/nat11.sci.living.eco.salmeco/salmon-in-the-ecosystem/
- For another example of species reintroduction, check out this video by WNET on beaver reintroduction in Alberta: http://www.pbslearningmedia.org/resource/nat14.sci.lifsci.results/unexpected-results/

Bibliography:

Ripple, William J., and Robert L. Beschta. "Trophic Cascades in Yellowstone: The First 15 Years after Wolf Reintroduction."*Biological Conservation* 145 (2012): 205-13. Web. 14 Jan. 2015. <http://www.greateryellowstone.org/uploads/RippleBeschtaYellowstone_BioConserv.pdf>.

United States. National Park Service. "Wolf Restoration." *National Parks Service*. U.S. Department of the Interior, 05 Jan. 2015. Web. 14 Jan. 2015. <http://www.nps.gov/yell/naturescience/wolfrest.htm>.

U.S. Department of the Interior, and Fish and Wildlife Service. *The Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho: Summary of Final Environmental Impact Statement*. Helena, MT: Fish and Wildlife Service, U.S. Dept. of the Interior, 1994. Web. 14 Jan. 2015. <http://www.fws.gov/mountain-prairie/species/mammals/wolf/eis_1994.pdf>.

Vucetich, John A., and Rolf O. Peterson. "The Population Biology of Isle Royale Wolves and Moose: An Overview." *Wolves & Moose of Isle Royale*. N.p., 2012. Web. 15 Jan. 2015. <http://www.isleroyalewolf.org/data/data/home.html>.

Standards:

National Governors Association Center for Best Practices & Council of Chief State School Officers. Common Core State Standards. Washington, DC: Authors, 2010.

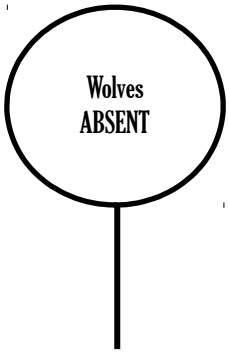
NGSS Lead States. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press, 2013.

WOLVES IN YELLOWSTONE

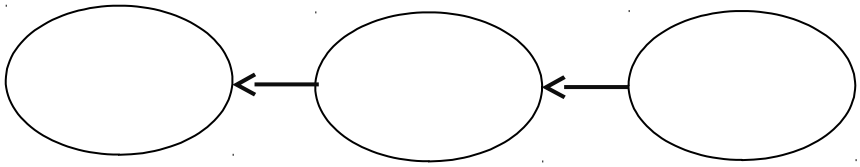
Student Worksheet

Part 1: Defining Trophic Cascade

1. Watch the Wolves of Yellowstone | EARTH A New Wild (https://vimeo.com/116273819) video clip from the beginning and **stop at 2:36 minutes.** As you are watching, create a bubble map below that includes all of the things that happened in the Yellowstone ecosystem in the absence of wolves. Add as many lines and bubbles from the center bubble as needed.



2. Using your bubble maps as a guide, create a food chain of the three organisms that are involved in a **trophic cascade** in Yellowstone National Park.



3. With the elimination of wolves from the ecosystem, how was the population of plants (producers) indirectly affected?

4. Predict what would happen to the wolf and elk populations if there was a drought that caused many of the plant species to dry up and/or die.

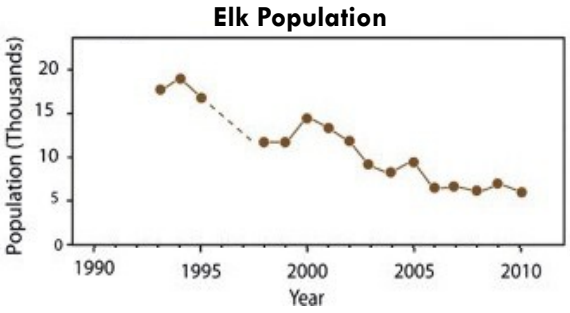
Background:

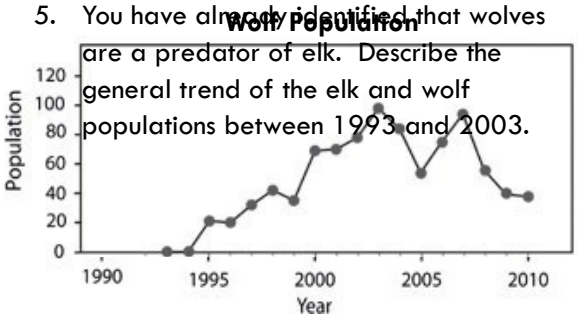
The graphs in the next section were taken from the 2012 study by William Ripple and Robert Beschta on trophic cascades in Yellowstone National Park. Aspen, willow, and cottonwoods are common foods for browsers like elk. Willows are also commonly eaten by beavers. If scientists want to measure trees and shrubs to look for the impact that browsers are having on their growth, they might measure the following things:

- Height
- Recruitment
- # of Rings

A measure of **height** can tell scientists how tall the trees are allowed to grow. If the mean tree height in one area is low compared to another area that could be an indication of heavy browsing by elk. **Recruitment** is the growth of seedlings or sprouts above the level of browsers. In other words, the trees are able to grow taller than the level at which elk and other browsers can eat them. Tree **rings** indicated the age of a tree – the more rings a tree has, the older it is. Increases in these three measurements can indicate an increase in the level of health of the woody plants. Decreases in these measurements could indicate a higher level of browsing pressure on the plants.

Use the graphs below to answer questions 5-8.





5. You have already identified that wolves are a predator of elk. Describe the general trend of the elk and wolf populations between 1993 and 2003.

6. Based on the graphs, what year do you think wolves were introduced to Yellowstone? Explain why you think this.

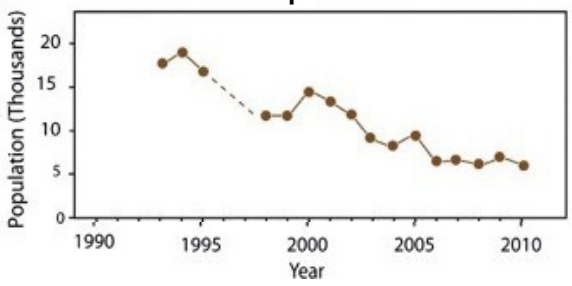
7. Using information from the graphs, describe what happens to the wolf and elk populations in 2005. Indicate what you think might have happened during this year to cause this change.

8. In 2010, the wolf population was lower than in previous years. Make a prediction about the elk population in the years beyond 2010 if the wolf population continues to stay at the 2010 level.

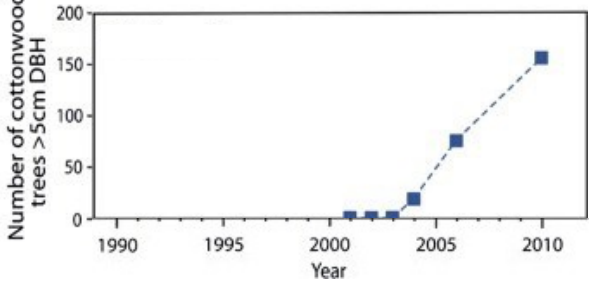
Examine the graphs below and use them to answer questions 9 and 10.

Note that the willow tree rings were measured in two different species of willow (Geyer and Booth). The aspen heights were measured in two different habitats – the uplands and riparian (stream side). During the aspen measurements, it was also noted if there were logs in the area since logs could impede browsers from getting to the trees, which would possibly decrease herbivory on those trees. In the cottonwood recruitment graph, the measurement ">5cm DBH" means that the scientists measured the number of trees that had reached a "diameter at breast height" greater than 5 cm.

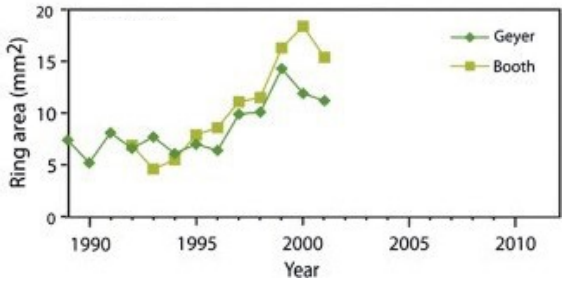
Elk Population



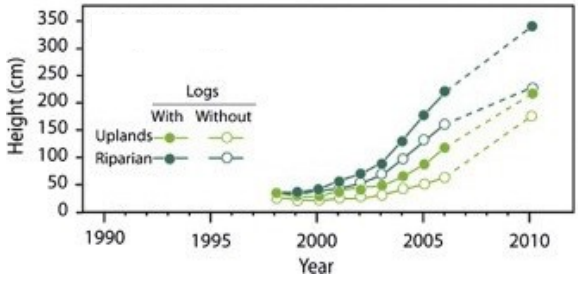
Cottonwood Recruitment



Willow Tree Ring Area
(in Geyer and Booth species)



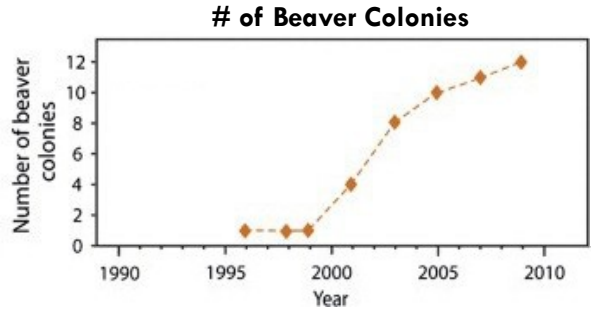
Mean Aspen Heights
(early spring after winter browsing but before summer growth)

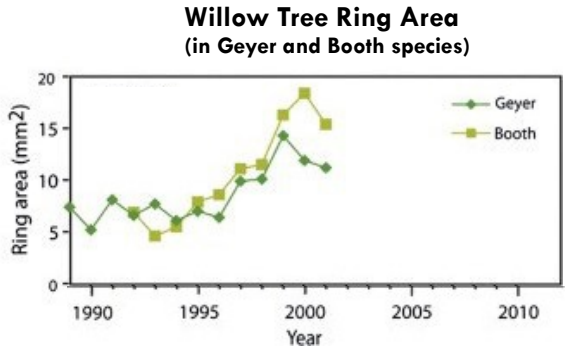


9. Use information from the graphs to describe the change in the size and growth of the trees and the population of elk during the data collection periods depicted in the graphs.

10. What can you infer about the relationship between elk population and tree growth?

Use the graphs below to answer questions 11- 13.





11. Describe what happened to beaver colonies after 1995 (when wolves were reintroduced). Then describe the relationship between the number of beaver colonies and the willow tree ring area.

12. After about 1999, the willow tree ring area started to decrease again. What might account for this decrease?

13. Based on what you know about tree growth and elk population, use data from the graphs to make a statement about how the elk population impacts the beaver population. In your answer, address why there was a lag between the change in elk population and the change in beaver population.

WOLVES IN YELLOWSTONE

Student Worksheet

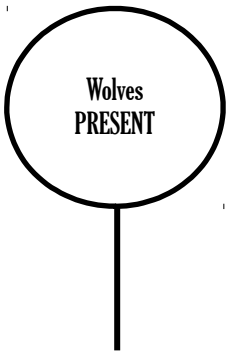
Part 2: Evaluate Solutions for Maintaining Ecosystem Services and Biodiversity

Watch the Wolves of Yellowstone | EARTH A New Wild (https://vimeo.com/116273819) video clip in its entirety and answer the questions below:

1. How have wolves helped the economy in the Yellowstone National Park area?

2. What are other consequences of wolf introduction that have been good for the humans in the area?

3. Complete the bubble map below and include all of the changes to the ecosystem AFTER wolves were reintroduced. Add as many lines and bubbles from the center bubble as needed.



Scenarios	Pro	Con	$ for Livestock Loss
<u>Scenario 1:</u> Reintroduction of experimental populations of wolves The designation "experimental wolves" gives the people who manage wolf populations more freedom in decision making and gives the wolves less protection.	In this scenario, wolves get reintroduced and that could mean better health of the park's ecosystem as it is restored to a more natural state with a top predator to check the population growth of elk and other animals If wolves are designated as experimental, decision-makers have more freedom in figuring out how to deal with problem wolves that kill livestock. Wolves in the act of wounding or killing livestock on private land could be killed by livestock owners. Under this scenario, any wolf presenting a threat to human life or safety would be removed from the wild.	The experimental designation doesn't protect wolves as much as it could. If people think the wolves are trouble, it seems that they could be removed. The people in charge of wolf management would constantly have to evaluate claims of livestock interference and make difficult decisions about the wolves. The private fund for livestock loss compensation might not have enough money to adequately compensate owners. Additionally, it may be hard to prove that wolves killed the livestock. This scenario will probably be met with resistance from portions of the public who are concerned about the wolves interfering with their homes and livestock. People against wolf reintroduction may argue that there's no data that proves wolf reintroduction will benefit the park and the risk to their livelihoods is too great to try it.	Private fund
<u>Scenario 2:</u> Natural recovery (no action taken or current management strategy) Encourage wolf populations to naturally expand into Idaho and Yellowstone	This solution is a "business as usual" approach that may appeal to people who don't want wolves to be introduced because of threats to their livelihood. People who are opposed to more human interference may prefer this scenario.	The scenario makes it sound like the expectation is that wolves will "naturally" expand. But it seems that if wolves have been gone from the park since the mid 1900's, then it's not likely that they will naturally come back. Additionally, this scenario doesn't make any provisions to protect wolves, so if they did return, they might not be able to establish a population large enough to make any difference in the Yellowstone ecosystem.	Private fund

Wolf Reintroduction Scenarios Pro and Con Chart

Scenarios	Pro	Con	$ for Livestock Loss
Scenario 3: **No wolves** Change laws in order to prevent wolf recovery. Congress would pass legislation to remove wolves in Montana, Wyoming, and Idaho from the list of Endangered Species.	This scenario provides the greatest protection to livestock owners since existing wolves that interfere with animals could be killed. The lack of a top predator (the wolf) would mean more game animals like elk for hunting. More hunters could also mean an increase in tourism to the area as hunters might be invited in to help cull the elk herds. States may generate money through the sales of hunting licenses.	The states of ID, MT, and WY would remove wolves from the protection of state law. Unregulated killing of wolves by the public would prevent wolf recovery. No wolves in Yellowstone means continued pressure on the ecosystem from grazers like elk. Top predators keep other populations healthy by culling the old, sick, and/or weak animals. The Fish and Wildlife service would stop all funding toward wolf management, education, research, and control (this could also be a pro since it saves money). Changing laws to prevent wolf recovery could make it even harder to revisit this issue in the future.	No compensation
Scenario 4: **Local wolf management committee** Turn wolf recovery management over to individual states and limit federal government involvement. Local approach vs. national issue.	Under this approach, the federal government would not be "interfering" with local problems. The local wolf management committee would be more aware of local issues and could make decisions based on local concerns, rather than having people in Washington, DC, who might be out of touch, making the rules.	It's feared that a local committee would side with livestock owners and that could lead to mismanagement and perhaps the extermination of wolves that were reintroduced. Taxpayers may not appreciate their tax dollars being used to pay for the livestock losses of ranchers. The park's lands lay in 3 different states – MT, ID, and WY. With 3 different committees making management decisions, it's possible the decisions could contradict each other and the wolves would face different types of protection as they move to different areas of the park.	Federal fund (taxpayer dollars)
Scenario 5: **Reintroduction of non-experimental wolves** By designating the wolves as "non-experimental" they are given much more protection.	This scenario gives wolves the most protection because "problem" wolves that interfere with livestock could not be eliminated. Key wolf habitat would be protected at all costs.	This scenario does the least to address concerns about wolf interference to livestock because there would be no wolf control of wolves that impact livestock. If the communities around Yellowstone don't support this, there is concern that wolves may be killed out of protest. People against wolf reintroduction may argue that there's no data that proves wolf reintroduction will benefit the park and the risk to their livelihoods is too great to try it.	Private fund

USFWS Employee Prompt Card for Public Meeting

Hello everyone and thank you for coming today. The Fish and Wildlife Service has convened this meeting to hear the public opinion regarding the 5 scenarios we are proposing regarding wolf reintroduction to Yellowstone. You have been invited because you represent a diverse group of Americans who have varied interests with regard to the reintroduction of wolves to Yellowstone National Park.

As a reminder, the following scenarios are being examined by the U.S. Fish and Wildlife Service.

- Scenario 1: **Reintroduction** of **experimental** populations of wolves. The designation "experimental wolves" gives the people who manage wolf populations more freedom in decision making and gives the wolves less protection.

- Scenario 2: **Natural recovery** (no action taken). Encourage wolf populations to naturally expand into Idaho and Yellowstone.

- Scenario 3: **No wolves**. Change laws in order to prevent wolf recovery.

- Scenario 4: **Local wolf management committee**. Turn wolf recovery management over to individual states and limit federal government involvement.

- Scenario 5: **Reintroduction** of **non-experimental** wolves. By designating the wolves as "non-experimental" they are given much more protection.

It is our goal to hear your concerns and try to come up with a solution that will help protect your interests and balance the needs of the Yellowstone ecosystem.

Let's begin the forum by going around the circle and having each one of you introduce yourselves by stating your name and your role in the community. Then state which scenario you support and explain why you support it. Also express any concerns you may have about other scenarios.

After everyone has spoken, we will open up the discussion for clarifying questions from members of the public and from USFWS employees who may want to better understand your concerns.

During this meeting USFWS employees will be observing and making notes on your concerns for use in their deliberation.

Please remember to be courteous to each other and to respect each other's opinions even if they are vastly different from your own. Yelling, arguing, and emotional outbursts are grounds for dismissal from this public forum.

Thank you and let's begin. (Choose a member of the public to begin).

Part 2: Wolf Reintroduction Scenarios Matrix

	Scenario #1: Reintroduction of experimental wolves	**Scenario #2: Natural recovery**	**Scenario #3: No wolves – wolf prevention**	**Scenario #4: Local wolf management committee**	**Scenario #5: Reintroduction of non-experimental wolves**
Ecosystem Services					
Constraints					

Tourist

I've never seen a wolf before; I think I'd make a special trip to YNP just to see wolves! I'd bring my whole family and make a vacation out of it.

© Blake Gordon for The Nature Conservancy

Rancher #2

I don't think that people who aren't from this area should have a say in the matter. They don't know what's going on, they aren't familiar with the land, and they don't understand how it will impact our way of life.

© Ami Vitale for The Nature Conservancy

Rancher #1

If wolves are released in YNP, very few people are ever going to see them and landowners and ranchers would continuously have to deal with wolves killing their livestock. If wolves are introduced, I feel like the federal government should compensate me for any livestock losses due to wolves.

© Ami Vitale for The Nature Conservancy

Hunter #1

I think the people that want to introduce wolves to the park are the same people that want to ban hunting, trapping, fishing, and other recreational activities. Eliminating livestock from public lands is just one more thing they want to take away. I can't get behind this.

© Simon Williams for The Nature Conservancy

Hunter #2

I'm concerned that if wolves are reintroduced to the park, the big game like elk and other species that I hunt will be killed off by the wolves and there won't be anything left for me to hunt.

Scientist #1

The ecosystem of YNP has been so degraded in the absence of wolves, wolf reintroduction is necessary if we are ever going to restore the park. If ranchers don't properly manage their animals, it's not taxpayers' responsibility to compensate them for their losses.

© Janet Haas for The Nature Conservancy

Homeowner

I'm afraid that wolves will leave the park and kill my dogs and cats. I'm also worried that my life and my children's lives will be endangered by the addition of wolves to the park. What's to stop them from attacking my family?

Adrian Moy via Flickr Creative Commons

Citizen

Public land is for everyone and everyone deserves a say in what happens on that land. Western ranchers have grazed on federal lands for years. Since we taxpayers are subsidizing the livestock industry, we should have the right to demand that the wolves be part of the landscape.

© Janet Haas for The Nature Conservancy

© Dylan Rorabaugh for The Nature Conservancy

U.S. Government Official

A private program exists that can pay ranchers for livestock losses due to wolf predation. The U.S. government should not compensate for livestock losses due to wildlife.

© Breana Taylor for The Nature Conservancy

Local Restaurant Owner

I'm really excited about the idea of reintroduction of wolves. My business could really benefit from having more tourists in the park.

Holly Hayes via Flickr Creative Commons

Nez Perce Tribe Member

I'm concerned that by reintroducing wolves to the park, the status of the naturally occurring populations of wolves will be in jeopardy. For example, if hunting the introduced wolves is a management strategy, will the safety of the native wolves be in jeopardy?

© Janet Haas for The Nature Conservancy

Scientist #2

Wolves were once part of this ecosystem. Until we can bring the wolves back, the ecosystem of Yellowstone will always be disturbed. Wolves aren't going to come back to the park on their own, or they would have done so already.

© Dylan Rorabaugh for The Nature Conservancy

U.S. Fish and Wildlife Service Employee

My job is to listen impartially to those who will be affected by the proposed scenarios regarding reintroduction of wolves to Yellowstone and to make an informed decision that will be the best for maintaining biodiversity and providing the most ecosystem services for humans.

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