

Peregrines in Peril

See how populations naturally fluctuate, and what happens when things go wrong.

Grade Level: 6-12

Subject Areas:
science, math

Activity Duration:
2 - 50 minutes

Setting:
Classroom

Group Size:
any size group

Materials:

- dice (1 per student)
- data sheet (1 per student)
- graph paper or graphic software

Skills Used:
critical thinking,
graphing

Vocabulary:
individual
population
population dynamics

OBJECTIVES

- Students will identify and describe the differences between “Threatened,” “Endangered” and “At-Risk.”
- Students will understand what factors influence natural population fluctuations and how environmental modifications - both natural and human-produced - impact wildlife populations.
- Students will model peregrine falcon population dynamics through a dice game.

BACKGROUND

When a species is officially extinct, it means that across the world, there are no more living individuals of a specific species. This permanent designation is concerning for multiple reasons, but especially because the role the species played in the ecosystem is lost forever. Examples of North American extinct species include Passenger Pigeon, Carolina parakeet and Rocky Mountain locust.

Species can also be listed a Endangered which means all or a significant portion of



Peregrine Falcon, Roy L. Lowe, U.S. Fish and Wildlife Service

the species population is in danger of going extinct. A Threatened species is one that is in danger of becoming Endangered in the near future. Both terms - Threatened and

Endangered - are legal terms outlined in the Endangered Species Act of 1973. North American Endangered Species include: Whooping Crane, Pallid Sturgeon, Blowout Penstemon and Black-footed Ferret. Examples of North American Threatened species include: Piping Plover, Northern Long-eared Bat and American Burying Beetle.

Other non-legal terms have been created to indicate species that are at-risk of becoming Threatened. Terms often used for this designation include at-risk, vulnerable or imperilled.

The Endangered Species Act of 1973 is a monumental piece of legislation which provides a clear framework for the protection of Threatened and Endangered species and the legislative power to implement multiple tools to ensure species do not become extinct. Among other things, the Act provides for the protection of habitat and ecosystems on which Threatened and Endangered species depend. Additionally, the Act prohibits the take, possession, transport or sale of Endangered species and establishes penalties for violating the Act’s regulations.

There are two ways for a species to be listed a Threatened or Endangered:

1. Petition process: any interested person

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may petition the Secretary of the Interior, or the Secretary of Commerce (marine life) to add a species or remove a species; or

2. Candidate Assessment Process: U.S. Fish and Wildlife Service biologists identify species to be listed as a candidate. Examples of current North American candidate species include: Monarch butterfly, Shortfin Mako shark and Gopher Tortoise.

Once a species is officially listed as a “candidate” species, the U.S. Fish and Wildlife Service will evaluate multiple factors to determine if the species meets the requirements for listing as a Threatened or Endangered species. The factors influencing this decisions include:

1. Is there present or threatened destruction, modification, or curtailment of the species’ habitat or range;
2. Is there over utilization for commercial, recreational, scientific, or educational purposes of the species;
3. Is there significant or increased disease or predation of the species;
4. Is there inadequacy of existing regulatory mechanisms for the species;
5. Are there natural or man-made factors affecting its continued existence.

Following this assessment, there is also a public comment period for any individual to provide comments regarding the potential listing. Following this lengthy process, a final decision is made as to list or not list a species.

Once a species is listed a Threatened or Endangered, the U.S. Fish and Wildlife Service (USFWS) determines a critical habitat designation for the species. This critical habitat is then protected from being destroyed or adversely modified.

Most causes of wildlife population decline can be attributed to three main causes: habitat loss, habitat degradation and over harvesting or over hunting.

- Habitat loss - the land is lost to being used by wildlife species (building cities/towns, converting land to agriculture production, construction of roadways, draining wetlands, etc.)

- Habitat degradation - the land is still able to be used by wildlife species, but it has been degraded or is now of poor quality (pollution, invasive species, broken into small parcels, etc.)

- Over hunting or over harvesting - due to lack of regulations to prevent overharvesting or due to poaching, too many individuals of a species are taken.

DDT is a pesticide first developed in the 1940’s to kill insects (most often mosquitos). It was used (with great success) to combat insect-borne diseases such as malaria, typhus and lice. It was also used to prevent insects in agriculture production, homes and gardens.

In the 1950’s and 1960’s the U.S. Department of Agriculture (who regulated pesticides before the



Peregrine flying, Matti Suopajavi, Flicker

formation of the Environmental Protection Agency in 1970) began to limit the use of DDT due to increased research showing the toxic nature of the chemical. It was not until 1972 when the newly formed EPA officially banned the use of DDT in the United States. Still today, DDT is used by other nations.

The impacts of DDT on wildlife were varied. For some species, the impacts were minimal. For other long-lived species that are higher on the food web, the impacts were immense. Species greatly impacted by DDT include many birds such as bald eagles, peregrine falcons, California condor and brown pelican.

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Contamination of DDT is an example of bioaccumulation. Bioaccumulation is the gradual build-up of a substance in a living organism. When DDT was sprayed, the insects impacted would likely have been eaten by a primary consumer such as a mouse, shrew, small bird or fish. As these species ate more and more of the insects, the DDT accumulated in their bodies. As secondary consumers (larger animals) ate these primary consumers, they would accumulate even more DDT. As the DDT worked its way up the food chain, more chemical was accumulated in the tertiary consumers bodies. This way, the species at the top of the food chain were more impacted by DDT than lower level species.



Peregrine Falcon nest on cliff, Diego Johnson, National Parks Service

Adult individuals of many bird species were not drastically impacted by DDT, but rather their reproduction rate was greatly decreased due to DDT causing thinning of their eggs shells. When an adult bird would sit on the eggs for incubation, the eggs would break preventing successful reproduction. Over time, the overall population of the species would decline because naturally occurring deaths of individual adults were not offset by new young.

Prior to the 1940's, it is estimated that there were about 3,800 active peregrine falcon nests (7,600 individuals). By the mid-1970's, there were only an estimated 324 nests (648 individuals). That is a decline of nearly 92%

in total population in only 35 years. Peregrine Falcons were gone from the eastern United States and nearly gone from the western U.S. The Peregrine Falcon was listed as Endangered in 1970 under the Endangered Species Conservation Act of 1969 (the precursor to the Endangered Species Act of 1973).

Today, there is estimated to be over 70,000 Peregrine Falcons in the United State and Canada (approximately 35,000 pairs). The Peregrine Falcon was removed from the Endangered Species List in 1999 after considerable conservation work and reintroductions.

The conservation work undertaken by the U.S. Fish and Wildlife Service, the Peregrine Fund, the Canadian Wildlife Service and many other organizations and individuals was impressive. Over 6,000 peregrines were raised and released all over North America as part of reintroduction programs. Additionally, the ban on DDT was critical to ensuring wild birds were able to reproduce successfully.

ACTIVITY

1. Begin a discussion with students about what it means for a species to be "At-Risk," "Threatened," "Endangered" and "Extinct." Discuss how it is determined that a species comes to be officially designated as each of the four categories and what it means if a species receives one of these designations.

Discussion questions prompts could include:

- Why do we have these three designations?
- When did the Congress pass the Endangered Species Act? (1973... Just after the Clean Air Act of 1970 and the Clean Water Act of 1972)
- What was happening at the time the Endangered Species Act was passed? (many notable species were declining rapidly in numbers including Bald Eagle, Peregrine Falcon, grizzly bear, American alligator, and Florida manatee)
- How many species are on the federal Threatened and Endangered Species list (1,656).
- How could a species come back from being Extinct?
- Can humans help Threatened or Endangered species?
- What does a high rate of listing indicate about how the

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ecosystem is changing?

2. (Optional) Ask students to research species that would fall in each category - "At-Risk," "Threatened," and "Endangered." After allowing students time to research, ask students to share their results with the class.

3. Discuss with students what causes species to become "At-Risk," "Threatened," and "Endangered." Most causes of wildlife population decline can be attributed to three main causes: habitat loss, habitat degradation and over hunting or over harvesting (see background information).

Questions to encourage deeper discussion could include:

- Habitat Loss:

- What habitat type covered the land before the city/town/building was constructed?;
- Why was it advantageous or necessary for people to convert the natural landscape into cities and/or agriculture production?;
- Knowing we need to produce food and have cities/towns (homes, grocery stores, roads, etc.), how can these human uses coincide with natural landscapes?;
- Have people changed their thinking on human-caused habitat loss over time? How? Why?

- Habitat Degradation:

- What are human-caused examples of habitat degradation? What are examples of natural caused habitat degradation?;
- Why would a person choose to degrade a habitat?;
- Habitat degradation includes several different causes; what do they all have in common?;
- How have humans caused habitat degradation? How have humans improved habitat conditions?;

- Over Hunting and Over Harvesting:

- Thought time, humans have always been hunters and gathers. Have we always over hunted? Do we over hunt or over gather now?;
- In the early 1900's many species were nearly driven to extinction. For example, the White

tail Deer was completely over hunted and extirpated in Nebraska. What prevented these species from becoming extinct? (the introduction of hunting rules and regulations that did not exist before).

- What is poaching? Why is poaching a problem?

4. Explain to students that Peregrine Falcons were nearly driven to extinction in the United States. Ask students if they know what caused the steep decline in peregrine falcon population numbers. Explain that at the same time peregrine falcon numbers were declining, bald eagles were declining at approximately the same rate. With this clue, some students may be able to make the connection between DDT-caused bald eagles decline and peregrine falcons. Have a short discussion about DDT, what it is, what it was used for and how it impacted species.

5. Tell students they will be playing a game to model the impacts of DDT on the population of peregrine falcons. Divide students into groups of 2-5 students. Give each group 20 dice and a copy of the "Peregrine Falcon Population Dynamics" worksheet.



6. Explain to students that each of the dice represents one peregrine falcon. When the game begins, rolling each of the dice will determine the fate of each of the 20 peregrine falcons - rolling a 1, 3, or 5 will indicate the

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peregrine falcon has died; rolling a 2, 4, or 6 will indicate the peregrine falcon successfully reproduced one young.

NOTE: Although peregrine falcon nesting pairs typically lay 2-5 eggs with 1-2 chick surviving into adulthood. For this activity, we will use a success rate of 1 chick per falcon. For example, if the dice is rolled to indicate “successful reproduction,” one new individual would be added to the population.

6. Allow groups to get set-up and complete the first 5 rounds of the game. Ask groups to not go beyond round 5 as the rules of the game change at that point.

7. Once all groups have completed rounds 1-5, explain to students that DDT has now begun to be used in the peregrine falcon’s habitat. Remind students that DDT did not kill adult peregrine falcons, but rather caused the shells of their eggs to be extremely thin. This, in turn, caused the eggs to break and thus a lower reproduction rate. For that reason, each roll number on the dice will have different outcomes: rolling a 1, 3, or 5 will still indicated the falcon died; rolling a 2 or 4 will indicate successful reproduction; and now rolling a 6 will indicate unsuccessful reproduction.

Instruct groups to play rounds 6-10. Remind groups to stop after round 10.

8. Once all groups have completed rounds 6-10, explain to students that DDT would accumulate in the bodies of adult peregrine falcons. Explain the concept of bioaccumulation. Because of this, the birth rate of peregrine falcon chicks declined even more over time. Explain to students that for this reason each number on the dice will have different outcomes: rolling a 1, 3, or 5 will still indicated the falcon died; rolling a 2 will indicate successful reproduction; and now rolling a 4 or 6 will indicate unsuccessful reproduction. Instruct groups to play rounds 6-10.

NOTE: If students ask why the death rate never changes (remains dice numbers 1, 3 and 5) explain that this is because even with DDT, the relative death rate of adult

Peregrine Falcons remained the same.

9. Ask students to graph the number of individuals in their population of Peregrine Falcons. Students can graph their population numbers on paper or using computer graphing software.

Be sure to encourage students to include:

- graph legend
- Y axis label
- X axis label
- graph title
- X axis scale
- Y axis scale
- line
- points on the line

10. Have a class discussion on what happened to the overall Peregrine Falcon population numbers? Why did this happen. Was the decline steady? Why or why not?

11. Ask students if they know what Peregrine Falcon populations numbers are at today. Explain that due to considerable conservation work, Peregrine Falcons population in the United States is approximately 70,000 individuals. Discuss with students the considerable actions of many groups, agencies and individuals to return the Peregrine Falcon population to sustainable levels.

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Peregrine Falcon POPULATION DYNAMICS

Round	Number of Peregrine Falcons	Number of DEATHS	Number of SUCCESSFUL OFFSPRING	Number of Peregrine Falcons remaining
1	20	11	9	18
2	18	9	9	18
3	18	8	10	20
4	20	9	11	21
5	21	11	10	20
6	20	10	7	17
7	17	9	6	15
8	15	8	6	14
9	14	8	4	12
10	12	5	5	10
11	10	6	2	8
12	8	4	2	6
13	6	3	1	4
14	4	2	0	2
15	2	1	0	1

	Round 1-5	Round 6-10	Round 11-15
Dice Roll & Outcome	1, 3, 5 = Death	1, 3, 5 = Death	1, 3, 5 = Death
	2, 4, 6 = Successful Reproduction	1, 4 = Successful Reproduction	2 = Successful Reproduction
		6 = Unsuccessful Reproduction	4, 6 = Unsuccessful Reproduction

NAME: _____

Peregrine Falcon POPULATION DYNAMICS

Round	Number of Peregrine Falcons	Number of DEATHS	Number of SUCCESSFUL OFFSPRING	Number of Peregrine Falcons remaining
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

	Round 1-5	Round 6-10	Round 11-15
Dice Roll & Outcome	1, 3, 5 = Death	1, 3, 5 = Death	1, 3, 5 = Death
	2, 4, 6 = Successful Reproduction	1, 4 = Successful Reproduction	2 = Successful Reproduction
		6 = Unsuccessful Reproduction	4, 6 = Unsuccessful Reproduction