

AN EDUCATOR'S GUIDE TO



Celebrating Pennsylvania

Bald Eagle and Elk Reintroductions



Additional Resources to Accompany this Guide

Correlations to Pennsylvania State Education Standards, photographs enhancing these activities, and a digital copy of this document can be found on the Pennsylvania Game Commission's website, www.pgc.state.pa.us, under the Education section.

Special Thanks To:

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Pennsylvania Bald Eagles

FAST FACTS: Bald Eagle *Haliaeetus leucocephalus*

Size: Adult male and female eagle: 30 to 40 inches in length, weigh 8 to 14 pounds, wingspan of 6 to 8 feet, stand about 2 feet tall, female is larger than the male

Color: Adults: white head and tail, dark brown body, yellow beak and feet

Juveniles: brown, mottled with white on the wings and body, yellow beak and feet, acquire mature coloration by their 5th year

Habitat: forest and woodland areas around rivers, lakes, and reservoirs

Food: wide variety of fish, small mammal, amphibians, reptiles, and small birds; will scavenge for food and eat carrion

Nest: huge nests called *eyries*, 5 to 6 feet in diameter, 2 to 3 feet tall; typically in a large tree

Eggs: one to three dull white eggs

History: Once common along waterways throughout the state, the eagle population was drastically reduced due to bounties, water pollution, habitat loss, and DDT. During the 1960s and 1970s, only two to three active bald eagle nests remained in our state.

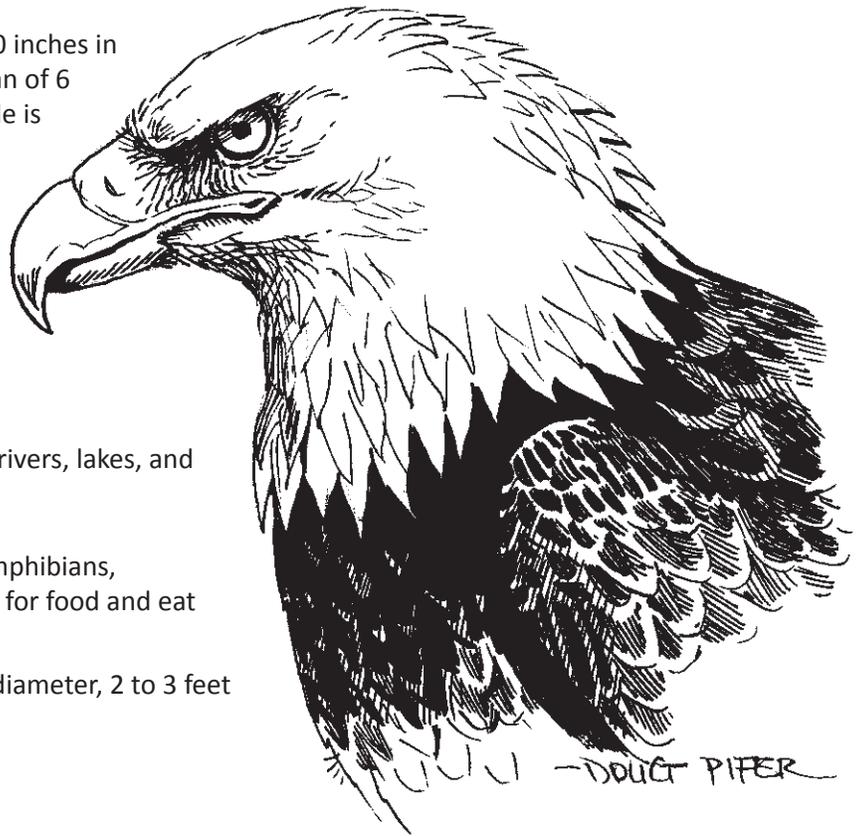
Endangered and Threatened Species Listing: Currently delisted. Federally listed in 1973; upgraded to threatened in 1995 and delisted in 2007. Delisted from the Pennsylvania Endangered and Threatened Species list in 2014.

Range in Pennsylvania:

Historical: along waterways throughout the state

Current: restored to waterways throughout the state

Reintroduced into Pennsylvania between 1983 and 1989.





Pennsylvania Bald Eagles

Celebrating 30 Years of Restoration

Guiding questions to the film:

These questions and answers are designed as an aid to teachers as they discuss key information provided in the *Pennsylvania Bald Eagles: Celebrating 30 Years of Restoration* film. The film focuses on four major topics:

- eagle biology
- population decline and recovery
- eagle monitoring and protection
- eagle rehabilitation



Eagle Biology (4 questions)

1. What makes an eagle, an eagle?

Eagles are very large birds of prey and are grouped in the same family as hawks, the Accipitridae family. Like other members of this family, eagles have hooked beaks, curved talons and are most active during the day. However, with a wingspan of 6 to 8 feet, eagles are much larger than hawks. Bald eagles are often confused with turkey vultures and osprey, especially in flight. When looking up at a large bird of prey in flight, look for the turkey vulture's two-toned underwings — dark with a pale gray color and the slight "V" shape to the outstretched wings. An Osprey has a dramatic white pattern on the underwings and an angular "M" shape to the wings. Eagles have dark wings and fly with their wings flat and horizontal, forming a straight line out from their body.

Although, eagles are found throughout the world, the bald eagle can only be found in North America. Both the golden eagle and the bald eagle can be seen in Pennsylvania. The golden eagle migrates through Pennsylvania and may stay through the winter. The bald eagle is a resident bird and now nests throughout the state.

2. How do bald eagles meet their basic needs for survival?

Bald eagles live in wooded areas by rivers, lakes, and other large bodies of water where they find trees for shelter and nesting and plenty of food. Eagles spend a lot of time alone or with their mate and have a home range (area they typically travel to find their needs) of about 13 miles. In winter, however, eagles will often congregate in areas of plentiful food. Fish make up the majority of their diet but they also eat small mammals, amphibians, reptiles, small birds, and invertebrates. Although they can catch their own prey, bald eagles will also scavenge off of dead animals or pirate prey from another bird, such as an osprey. While hunting, eagles soar

above the water or perch on tall trees where they can easily scan a lake or river for food. Eagles obtain water from their food and will also drink, scooping their beaks into the water of lakes and rivers. Their large nests, called eyries, are typically built on tall trees near water, away from highly developed areas and other eagle nests. However, bald eagles are adapting to people and nests have been found on a telephone pole, on an island in the Delaware River right outside of Philadelphia, and even in a tree overlooking a busy highway.

3. What adaptations help bald eagles survive in their habitat?

Bald eagles have long, wide wings that help them soar through the air as they search for food. Their exceptional eyesight helps them scan an area and focus on a fish, small mammal, or other prey species far below. Strong, hooked beaks, powerful feet, and curved talons help eagles catch and then eat their food.

4. What is the typical life history of a bald eagle?

After hatching, eaglets will spend 2 to 3 months in and around the nest. During this time the eaglets are growing, gaining their feathers, and learning to walk and fly. Both parents bring food to the nest and feed the eaglets until they are old enough to start feeding themselves. By fall, juvenile eagles are excellent flyers and can take prey on their own. Now is the time they separate from their parents. Like adult eagles, males are smaller than females however juveniles have brown head and tail feathers. For the next 4 years, these juvenile eagles explore their surroundings, travelling hundreds of miles from their birth site. By year 5, juveniles are fully mature and have white head and tail feathers. Most return to the area where they were born to search for a mate and begin nesting. Bald eagles are monogamous and mate for life. If their mate dies or is injured, the remaining eagle will find a new mate. Both males and females build the nest and add to the same nest each year. The female will lay two to three eggs and both male and female will take turns incubating the eggs for 35 days until they hatch. Bald eagles have a long life in comparison to many wild species. Eagles living in the wild have been known to reach at least 28 years of age, while captive eagles have lived to be 36 years old.

Population Decline & Recovery (3 questions)

1. How and why did the eagle population in Pennsylvania change from the time Europeans arrived in our state to the present, 21st century?

Historical descriptions of Pennsylvania indicate that eagles and ospreys were commonly seen along the rivers in the 17th and 18th centuries. As settlers expanded west across Pennsylvania and beyond, bald eagle populations began to decline; habitat was destroyed by logging and development; rivers were polluted; and wildlife was exploited for food, clothing and sport. Throughout the 1700s and 1800s, there was little to no protection for wildlife and the environment. By the end of the 19th century, bald eagle populations were on the decline.

In 1895, the Pennsylvania Game Commission was established to conserve wildlife. There was interest on the state and national levels to protect most wildlife. However, eagles continued to decline due to loss of habitat, pollution, and shootings for sport and predator control. In 1940, the federal Bald Eagle Protection Act was passed just in time for eagles to face a new threat, DDT (dichlorodiphenyltrichloroethane). This new pesticide caused a catastrophic decline in bald eagle populations. In the 20 years DDT was heavily used, the eagle population plummeted and the bald eagle was almost gone from the lower 48 states. Throughout the 1960s and '70s, only two to three bald eagle nests were active in our state.

During the 1970s an environmental conservation movement swept throughout our country due, in part, to Rachel Carson's book entitled *Silent Spring*. In 1972, DDT was banned from use in the United States. A year later, the eagle was one of the first species listed on the revised federal Endangered Species Act (ESA). Around the same time, the Clean Water Act was passed. This, along with state regulations, helped once-polluted rivers, lakes, and their surrounding environment, start to improve. Eagle recovery was now a possibility.

In 1983, the Pennsylvania Game Commission began a Bald Eagle Restoration Program. The reintroduction was a success. By 1999, there were 41 eagle nests in the state. This grew to 100 active nests in 2006 and more than 250 nests in 2013. Similar reintroductions throughout the country were also successes. The bald eagle was removed from the federal endangered and threatened species list in 2007 and from Pennsylvania's endangered and threatened species list in 2014.

2. How did DDT cause a dramatic decline of eagles and other large birds of prey in the mid-20th century?

From the 1940s through the early 1970s, DDT was used throughout the United States and other countries to limit insect damage to crops and to control outbreaks of malaria, typhus, and other insect-carried diseases. Although successful, some insects developed resistance to the pesticide due to its extensive use. Meanwhile, DDT proved to be disastrous to many wildlife species, especially aquatic species and large birds of prey.

When DDT is used in the environment, it becomes part of the food web. Insects are directly contaminated and killed as the DDT passes through their exoskeleton and disrupts their nervous system. The contaminated insects are eaten by many animals including fish, birds, reptiles, amphibians, and small mammals. These animals are then eaten by larger animals, such as bald eagles. As these long-lived birds continued to eat prey contaminated with DDT, the pesticide accumulated in their fat tissue, a process referred to as bioaccumulation. As more contaminated prey is eaten, more DDT is passed through the food chain, eventually resulting in a very high concentration of DDT accumulating in eagles. This is referred to as biomagnification. DDT did not directly kill the bald eagle or other birds of prey. However, over time, DDT breaks down into other chemicals such as DDE (dichlorodiphenyldichloroethylene). DDE affects an eagle's endocrine system disrupting the reproductive cycle. Eggs were misshaped or had thin shells. Embryos within eggs did not develop properly or died. Courtship and mating may even have been affected. Ultimately, not enough young were produced to sustain the population.

3. How did the eagle population recover in our state?

In 1983, the Pennsylvania Game Commission, joined other states, in reintroducing eagles through a process known as hacking. Hacking — a falconer's term for raising birds in a semi-wild state — is often used in the reintroduction of large birds of prey because they tend to return to the general area from which they fledged (flew from the nest). In the process of hacking, young birds are placed in a specially designed hack box several weeks before they are able to fly. Food and water are provided and contact with people is kept at a minimum so the birds remain wild. Once birds are ready to fledge, the hack box is opened and the birds are able to exercise their wings and soon after, fledge. Food and water continue to be provided until the birds are ready to fend for themselves.

Between 1983 and 1989, 88 eaglets were removed from nests in Saskatchewan, Canada and transported by plane to Pennsylvania. To ensure the population in Canada, as well as the adult eagles, were not overly affected, only one bird was removed from a nest, leaving one to two other eaglets for the adults to continue to raise.

Once the birds arrived in Pennsylvania, they were transported to two specially built towers and hack boxes, one on Haldeman Island on the Susquehanna River in Dauphin County and one at Shohola Falls in Pike County. All of the eaglets were banded for identification and tracking purposes. After the eaglets were placed in the hack boxes, they had no contact with people. However, student interns kept watch over the eaglets through one-way glass and provided the young birds with food and water through a special hatch. When the birds were between 12 and 14 weeks of age and ready to fly, the hack boxes were opened and the young birds exercised their wings and eventually took flight. Food continued to be provided until the birds could hunt for themselves. The juveniles stayed around the nest sites for awhile, then, as all juvenile eagles do, they dispersed on their own to explore the countryside.

By 1990, there were seven active nests in Pennsylvania, several occupied by adult eagles that had been hacked in the state. In fact, one of the nests was within a few hundred yards of a hack site. Almost each year, eagle nests have increased in our state. By 1999, there were 41 eagle nests, then more than 100 in 2006. As of 2011 there were 200 nests and in 2013 there were 250 nest sites. The reintroduction of the bald eagle into Pennsylvania is a wild success story.

Eagle Protection (3 questions)

1. How and why do biologists monitor bald eagle populations?

Bald eagle nests are discovered by many different people, from biologists and avid birders to hikers and casual observers. Periodically, a Breeding Bird Atlas takes place where people actively look for breeding birds. The Game Commission also receives many reports from people who are excited to share sightings of eagles and their nests.

Once a nest is discovered, plans are made to monitor the eagles as they nest and reproduce. Nest monitors are often volunteers, but might be biologists, land managers, and wildlife conservation officers. Using scopes to observe from a distance, nest monitors record and report information such as: nest activity; number of eggs or young; number of young fledged; predator activity in or around the nest; and any other concerns with the nest, adults, or young. Winter feedings areas are also monitored to see where eagles are congregating and how many eagles are using these areas.

Biologists monitor the bald eagle population to make sure the population continues its recovery. By knowing where eagles nest in spring and feed in the winter, habitat can be conserved and managed. If a downward trend in the population would occur, biologists could immediately research any problems or issues and, hopefully, prevent another major decline.

2. What laws protect the bald eagle?

The bald eagle is protected by the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, and the Lacey Act. Prior to delisting, the bald eagle was also protected by the Endangered Species Act.

Lacey Act: First passed in 1900 and amended several times since then, the Lacey Act prohibits the import, export, transport, sale, or purchase of wildlife and rare plants taken or sold in violation of any law including state, tribal, federal, or foreign laws. The act also makes it illegal to mislabel wildlife shipments, bring harmful species into the United States, or import animals under inhumane conditions

Migratory Bird Treaty Act: Passed in 1919 and amended several times since then, the Migratory Bird Treaty Act makes it illegal to hunt, kill, capture, possess, sell, or purchase any migratory bird, part, nest, egg, or product without a special license or permit.

Bald and Golden Eagle Protection Act: First passed in 1940 for bald eagles only, this act was amended to protect both the bald eagle and the golden eagle, making it illegal to take, possess, and sell these birds, except under certain specified conditions.

Endangered Species Act (ESA): Based on the Endangered Species Protection Act, the ESA was passed in 1973 and authorized the government to identify and protect endangered and threatened plants and animals and their habitats. It also required plans for the recovery of the listed species.



3. Why should we celebrate when a species is delisted?

The purpose of the Endangered Species Act is to prevent a species from becoming extinct. The law requires special protections for a species and its habitat. It also requires that a recovery plan be developed. Delisting a species means that the recovery plan was developed, implemented, and successful. A species is recovered when the wild population is found throughout most of its native range and is large enough to sustain future generations.

Rehabilitation (4 questions)

1. What is a wildlife rehabilitator?

A wildlife rehabilitator is a person who specializes in the care of sick, injured, and orphaned wildlife. In Pennsylvania, rehabilitators must have specialized training for the species they will treat; pass written and oral exams and facility inspections; work with a licensed veterinarian; attend continuing education classes; and be licensed. Many wildlife rehabilitators are dedicated volunteers interested in helping wildlife return to the wild.

2. Why might a bald eagle end up with a rehabilitator?

Although incredibly large and strong, bald eagles can become sick or injured. At times eagles are attacked and injured by other wildlife, such as great-horned owls. However, many injuries or ailments are due to some type of interaction with people, such as being hit by a car, tangled in fishing line left on lakes and rivers, or being illegally shot. Eagles can get unintentionally poisoned by lead and other toxins.

3. What is the goal of rehabilitation?

The goal of wildlife rehabilitation is to provide the medical treatment and care needed for an injured, sick, or orphaned wild animal to return to the wild in its natural habitat. Although rehabilitation has had many successes, there are times when a wild animal just cannot recover enough to survive on its own in the wild. When possible these animals are placed in a zoo or wildlife educational facility.

4. How can adults and children (or you) contribute to the recovery of the bald eagle in our state?

There are many ways adults and children can help bald eagles and other wildlife. First, keep our land and water clean by practicing integrated pest management; taking care of what you place on and in the ground, down drains and sewers; recycling and reusing; and disposing of trash and other waste materials properly. Create or improve habitat for all wildlife by planting trees, shrubs, and flowers in appropriate areas. Respect eagles and other wildlife by observing them from a distance. Lastly, If you see an injured eagle or a nest that you think is new, contact the Pennsylvania Game Commission.

Your name: _____ Date: _____

Directions:

1. Read the information about bald eagles.
2. Color the eagle and eaglets.
3. Write a sentence about the bald eagle in the space provided.

Bald Eagle *Haliaeetus leucocephalus*

1. Adult male and female eagles have a white head and tail. Immatures have a brown head and tail until they are around five years old.



5. Eagles have wide wings for soaring.

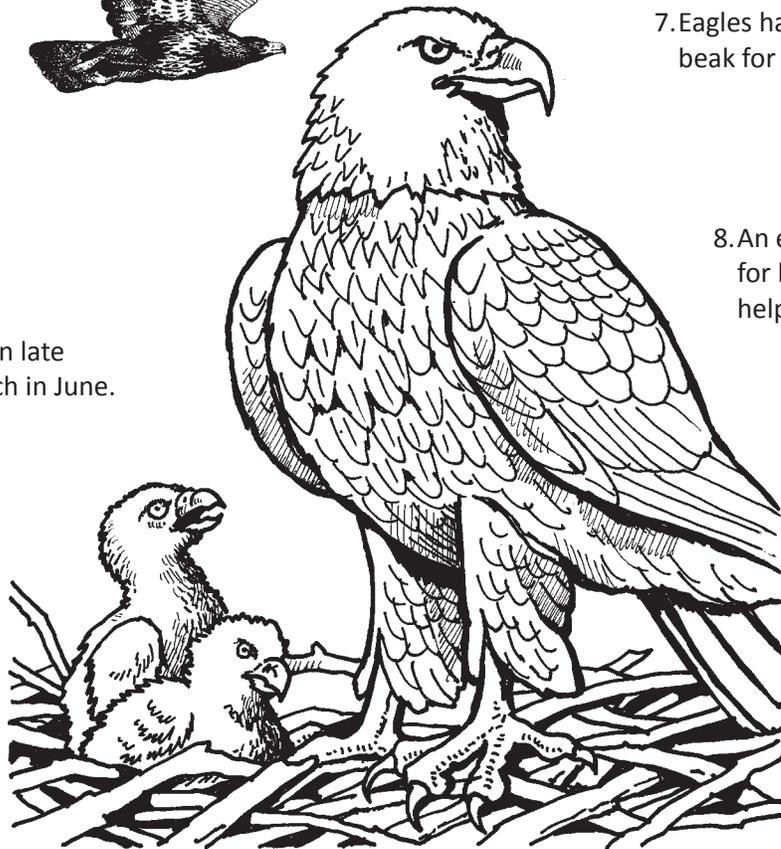
6. Eagles have wingspans of 6 to 8 feet.

7. Eagles have a strong, hooked beak for tearing meat.

2. Female eagles are larger than male eagles.

3. Eagles lay one or two eggs in late March or April; **eaglets** hatch in June.

4. Eagles make a large nest, called an **eyrie**, built in sturdy trees near lakes, rivers, and oceans.



8. An eagle's eyes face front for binocular vision to help focus on prey.

9. Eagles have strong toes with sharp, curved claws, called **talons**, for grasping their prey.

Write your sentence about bald eagles here:



Your name: _____

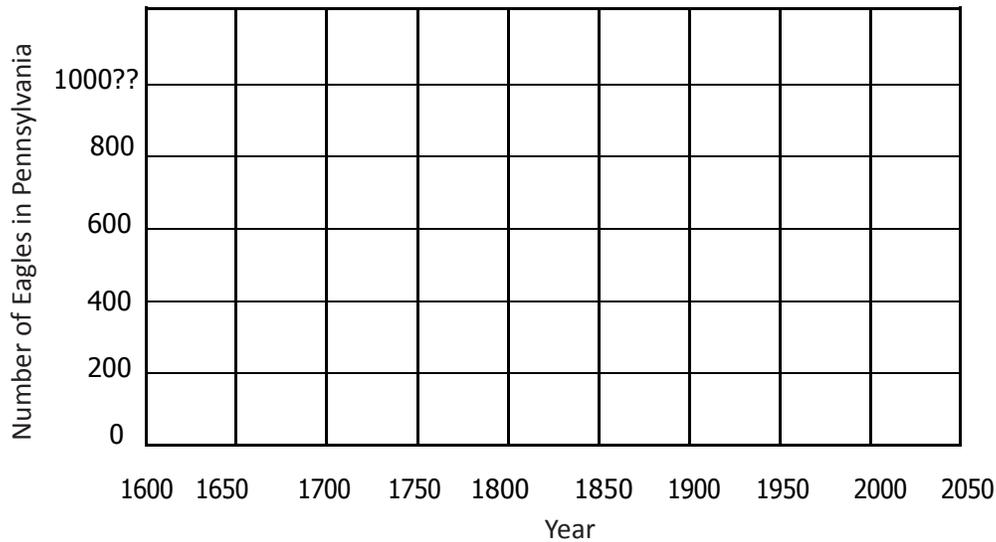


This young eagle is leaving the nest to explore the state and find a new home. Help this eagle find a place to live. Draw a picture of good habitat for this eagle in the space below.

Your name: _____ Date: _____

Directions: Biologists do not know how many bald eagles there were in Pennsylvania in the 1600s. However, they do know these eagle were fairly common along most waterways. Based on the incredible recovery of eagles seen today, it is possible that there were 1,000 eagles in our state during the 1600s. Using information from the *Pennsylvania Bald Eagles: Celebrating 30 Years of Restoration* film, draw a line graph depicting the bald eagle population changes from 1600 to 2014. Then answer the questions that follow Table 1.

Table 1: Bald Eagle Population Trends 1600 to present

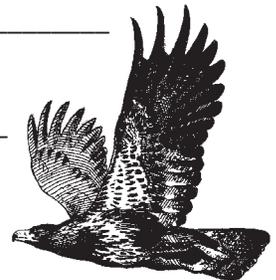


1. If all goes well, what do you think will happen to the eagle population after 2014?

2. In a balanced ecosystem, animal populations will eventually become stable. Population growth is limited by the nature of the animal itself and/or by one or more habitat components limiting population increases. Currently, what do you think is the limiting factor for eagles in Pennsylvania?

3. Why?

4. This young eagle is leaving the nest to explore and find a new home. Help this eagle find a place to live. Draw a picture of good habitat for this eagle in the space below.





Toxic Connections

Objectives: Students will be able to:

- give examples of how pesticides enter food chains
- describe possible consequences of pesticides entering food chains

Subjects: Environment and Ecology, Science, Physical Education

Suggested Grades: 3-9

Vocabulary: food chain, food web, bioaccumulation, biomagnification, herbicide, pesticide, insecticide

Materials: Large open space; small paper bags (one per mosquito larva); flagging, vests or pinnies to indicate roles of eagle and fish; whistle or other signal for students; colored pipe cleaners or popsicle sticks (30 per student; if playing outside, can use cereal; 2/3 yellow or white to represent food, 1/3 any other color or mix of colors to represent contaminated food).

Background:

The bald eagle is a large bird of prey that eats fish, small mammals, birds, reptiles, and other small animals. Eagles typically live near large bodies of water with forests or woodlands nearby. Between the 1950s and 1970s bald eagles, along with peregrine falcons, ospreys, other birds of prey, and pelicans, suffered a major decline in population ultimately traced to the use of the pesticide DDT (dichlorodiphenyltrichloroethane).

Pesticides are chemical compounds developed to control organisms that have been identified as pests under some conditions. Herbicides are pesticides that control unwanted plants; insecticides are pesticides that control nuisance insects. Although pesticides can be useful to humans when used properly, they frequently end up in places where they are not wanted. Some pesticides can persist in the environment and



become concentrated in the water and food supplies of wildlife and people.

From the 1940s through the early 1970s, DDT was used throughout the United States and other countries to limit insect damage to crops and to control outbreaks of malaria, typhus, and other insect-carried diseases. While mostly successful in these endeavors, DDT proved to be disastrous to many wildlife species, especially aquatic species and large birds of prey.

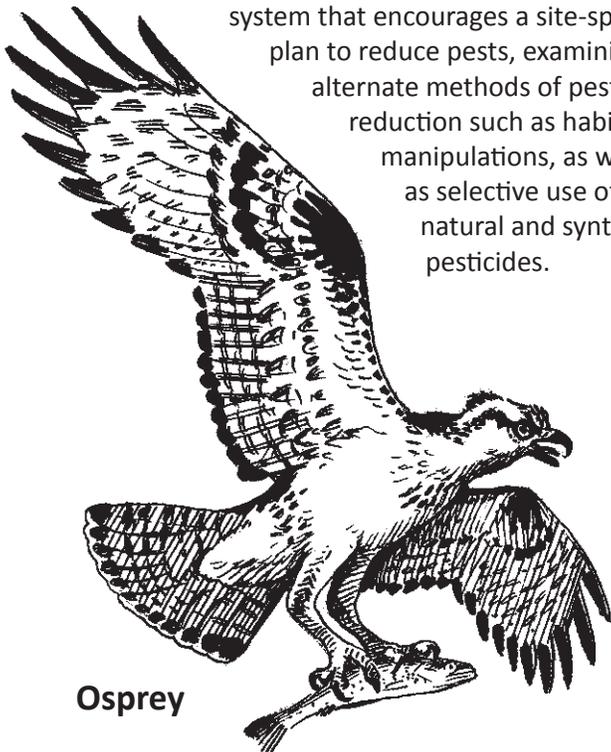
When DDT is used in the environment, it becomes part of the food web. Insects are directly contaminated and killed as the DDT passes through their exoskeleton and disrupts their nervous system. The contaminated insects are eaten by many animals including fish, birds, reptiles, amphibians, and small mammals. These animals are then eaten by larger animals, such as bald eagles. As these long-lived birds continue to eat prey contaminated with DDT, the pesticide accumulates in their fat tissue, a process referred to as bioaccumulation. As more contaminated prey is

eaten, more DDT is passed up the food chain, eventually resulting in a very high concentration of DDT accumulating in eagles. This biomagnification results in eagles accumulating much higher concentrations of DDT in their bodies than originally sprayed.

DDT did not directly kill the bald eagle or other birds of prey. However, over time, DDT breaks down into other chemicals such as DDE (dichlorodiphenyldichloroethylene). DDE affected eagles' endocrine systems disrupting the reproductive cycle. Eggs were misshaped or had thin shells. Embryos within eggs did not develop properly or died. Courtship and mating even may have been affected. Ultimately, not enough young were produced to sustain the population.

Concern about pesticides led to the establishment of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) in 1972, which controls the use and distribution of pesticides, and the Toxic Substance Control Act (TSCA) in 1976, which calls for the regulation, testing, and screening of all chemicals imported or produced in the United States. However, not all are tested for the effects of bioaccumulation and biomagnification in wildlife. DDT was banned from use in the United States in 1972, although it can still be manufactured here and used in other countries.

Since the late 1980s, there has been a movement towards pest reduction through Integrated Pest Management (IPM). This is a management system that encourages a site-specific plan to reduce pests, examining alternate methods of pest reduction such as habitat manipulations, as well as selective use of natural and synthetic pesticides.



Osprey

With the banning of DDT and the recovery of habitat, a bald eagle reintroduction was successful in Pennsylvania and throughout the United States. Once again eagles are soaring through Pennsylvania's sky.

In this activity, students will model how some pesticides, like DDT, can be accumulated and magnified in animals and examine possible consequences.

Procedure:

1. Explain to students that this is an activity about food chains and food webs. Ask them to give an example of a food chain. For example: Fox eats mouse; mouse eats seeds; seeds are from green plants that make energy from the sun. Tell students that they are going to participate in a simulation where they play the roles of different animals in a food chain/food web.
2. Divide the student into three groups: mosquito larva, fish, and bald eagles. There should be three times as many larvae as fish, and three times as many fish as eagles. For example, in a class of 26 students there should be 18 mosquito larvae, 6 fish and 2 bald eagles.
3. Establish a starting zone and an out (or eaten) zone on your playing area. On one side or in the middle of the playing area, randomly scatter all of the algae and aquatic plants (pipe cleaners/popsicle sticks), making sure the "contaminated" pieces are thoroughly interspersed.
4. Explain the rules of the simulation. Each animal will get a chance to gather its appropriate food. What do mosquito larvae eat? Algae, bacteria, and other aquatic plants. What do the fish eat? In this case, mosquito larvae. What do the eagles eat? Fish.
5. In this activity, mosquito larva will gather their food first, placing pipe cleaners or popsicle sticks into their bags. On the teacher's whistle, the fish will swim out and tag a mosquito larva. The fish will escort the larva to the out/eaten zone and take the larva's bag of food. The fish then returns to the activity to capture more larva. The teacher will whistle again and eagles will fly out and tag fish. The eagle escorts the fish to the out/eaten zone and takes all of the bags of food collected by the fish. The eagle returns to the activity to catch more fish.

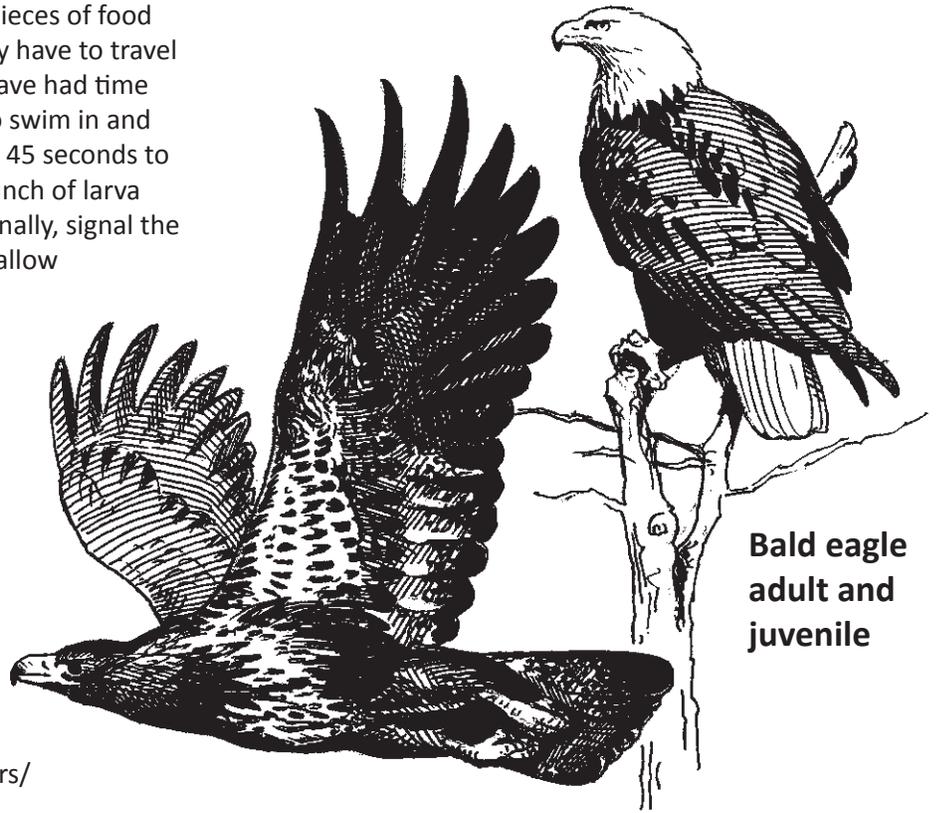
Assemble all of the students in the start zone. Give each mosquito larva a small paper bag representing its stomach. Provide flagging or pinnies of different colors to the fish and eagles.

6. Signal the larvae to go out and collect pieces of food (approximately 30 seconds, more if they have to travel far to the food area). Once the larvae have had time to collect a lot of food, signal the fish to swim in and start eating the larvae. Allow fish about 45 seconds to hunt, enough time for fish to catch a bunch of larva without all of the larvae being eaten. Finally, signal the eagles to fly out to capture fish. Again, allow time for eagles to catch fish without all of the fish being captured, if possible. All throughout the activity the larva and fish not originally captured should continue hunting for food.

Once the activity is over, gather all of the students into one group. Explain to the students that DDT, a pesticide, was sprayed over the water to control the mosquitoes. It got on the mosquitoes, into the water and on the plants the mosquito larvae eat. The contaminated plants are represented by the colored pipe cleaners/ popsicle sticks. Ask the following:

- Did any mosquito larva survive being eaten by the fish? If so, check your bags. Count the contaminated and not contaminated foods and record on your bag. If you have any contaminated food, you died from DDT.
- Did any fish live? If so, ask fish to dump out their bags collected from the larvae and separate the contaminated from the uncontaminated food. Record the number of each on your bag. Any fish with more than one-half contaminated food also died from DDT.
- Now, ask the eagles to dump out their bags and separate the contaminated from the non-contaminated foods. Count each and record on one of the bags.

Explain that the eagle with the most contaminated food is not dead, but will have trouble reproducing and successfully raising young. It may lay eggs but they might be very thin or misshaped. The eggs might even break when the eagle tries to sit and incubate them. Even if the eggs look good, the embryo inside will most likely not grow properly and die. This is what happened to the eagles during the 1950s thru 1970s and why the eagle population dropped so dramatically.



**Bald eagle
adult and
juvenile**

7. Return to the classroom. Draw a chart on the board or a large piece of paper. List and summarize the results of the activity, recording the number of contaminated pieces of food for each surviving larva, fish, and eagle. Ask students if they see any pattern in the number of contaminated pieces of food found within each animal.
8. Explain to students that as an animal eats DDT-contaminated foods, the DDT does not just pass through their bodies, it stays there. If the animal lives long enough, like many fish and bald eagles, the DDT accumulates in its body, typically in the fat tissue. This is called bioaccumulation. As the fish or eagle continues to eat more contaminated foods, DDT continues to accumulate. Over time, the result is a very high concentration of DDT in the animal's body, much higher than the original concentration of DDT when it was sprayed. This is called biomagnification. Eventually this would interfere with an animal's life process and could result in death. Point to the chart to show that the concentration (dose) of DDT for each individual grew larger as it went up the food chain.

9. Ask students what happened to bald eagles because of the accumulation of DDT. Hopefully they will know that DDT was used throughout the United States for more than 20 years before it was banned in our country. As eagles and other large birds, like ospreys and peregrine falcons, accumulated DDT, the DDT eventually affected the birds' reproductive cycle. Eggshells were thin, embryos inside the eggs did not develop properly or no eggs developed at all. Bald eagles were not able to produce young and the population was decimated. Bald eagles were placed on the federal and state endangered species list.

Wrap-up:

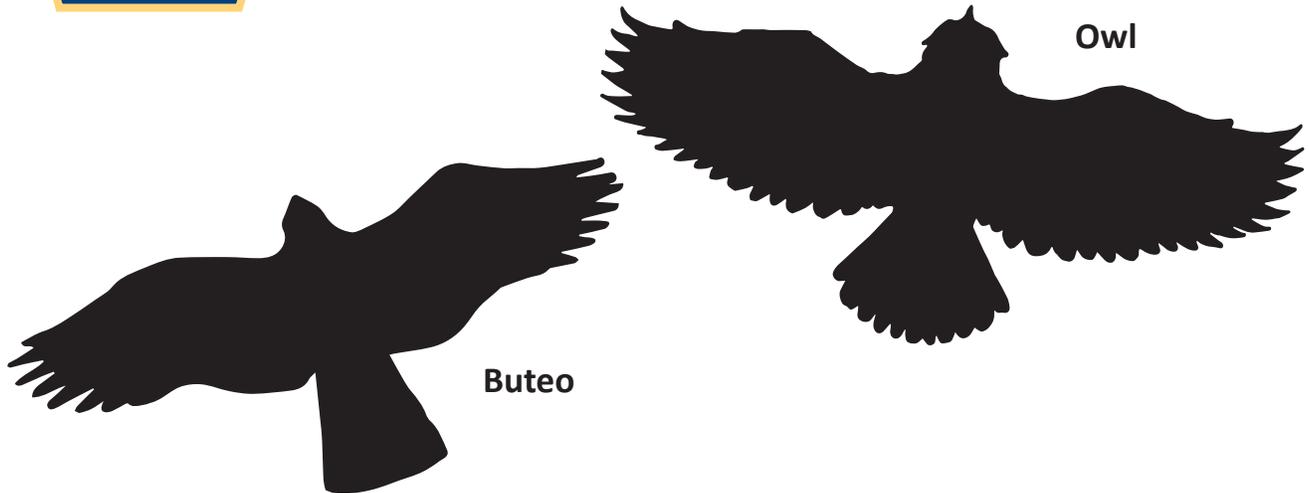
Explain to students that pesticides are still being used to control insects and unwanted plants. What do they think of this use of pesticides? Can they think of any reasons to be concerned? Are there any safeguards that should be put in place? Tell students about the Toxic Substance Control Act (TSCA) and Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) federal laws and ask for other ideas. Discuss alternatives to the use of pesticides? Organic farming, crop rotation, companion planting, use of biological controls (for example predatory insects), and genetically resistant crops are some examples of alternatives. Ask students if pesticides are used around their homes? If so, what safeguards are used? Explain Integrated Pest Management (IPM) and ask how they could reduce the use of pesticides at home, in businesses, and in agriculture.

Extension:

1. Ask students to research the history of bald eagles in Pennsylvania and create a time-line for their decline and recovery.
2. Look up a pesticide that is readily available for home use. Find out its ingredients, its use, and any safeguards that should be taken when used.
3. Research other species that were affected by DDT, such as the peregrine falcon and osprey, and write a short history of one of these species.



Raptor Artistry



Objectives: Students will be able to:

- identify several physical characteristics shared by raptors
- identify several groups of raptors and give examples of each
- describe several adaptations that help raptors survive in their environment

Methods: Students identify characteristics of raptors through group discussions, completing student sheet and creating a raptor.

Background:

Raptors are a group of birds also known as birds of prey. There are many different types of raptors, such as ospreys, owls, hawks, falcons, eagles, and vultures; all share key characteristics that help define them as raptors. In addition to being carnivores, they have keen eyesight for finding prey or carrion; strong, hooked beaks for tearing; and strong feet with long, curved talons for grasping.

Although raptors share several similar characteristics, each group and species of raptor also have specific adaptations that help them live in their habitats and obtain the particular food, water, shelter, and space they need to survive. This activity focuses on owls, eagles, vultures, falcons, hawk-accipiters, and hawks-buteos.

The term hawks can be used in several ways. Hawk is an actual taxonomic family of birds that includes kites, eagles, and birds that people commonly call hawks, such as the red-tailed hawk and sharp-shinned hawk. Those birds commonly referred to as hawks are further categorized into the genus accipiter and genus buteo.

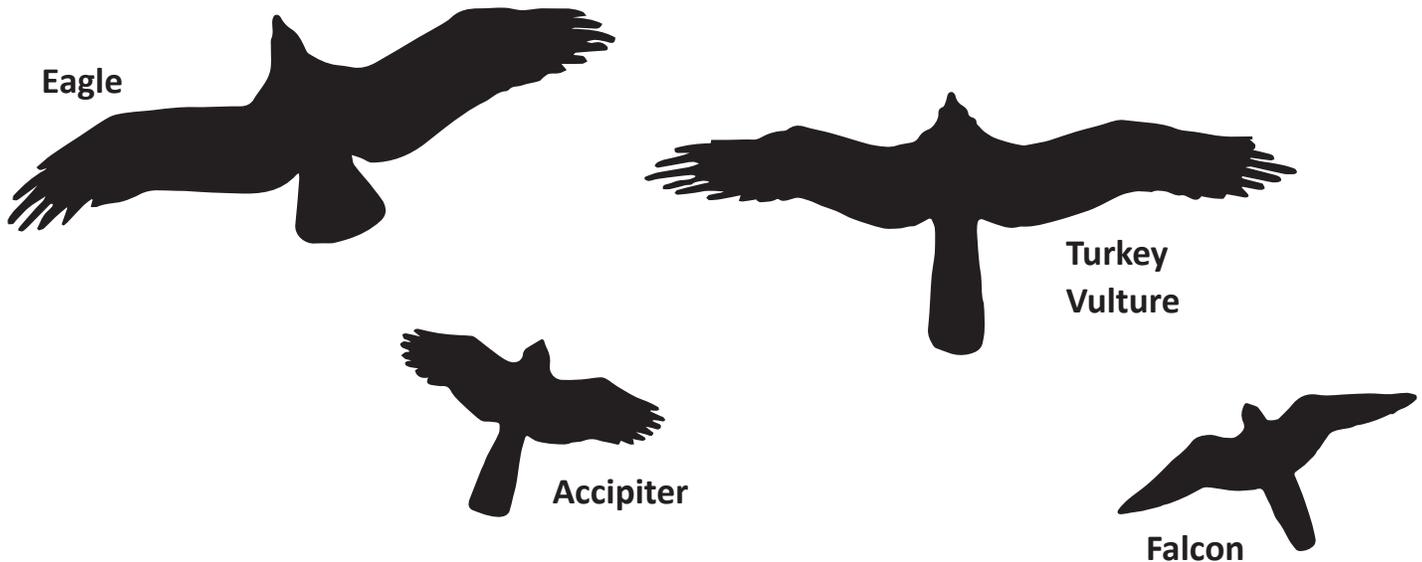
Subjects: Environment and Ecology, Science, Art

Suggested Grades: 4-8

Duration: two 45-minute class periods

Vocabulary: raptor, adaptation, diurnal, nocturnal, accipiter, buteo

Materials: student sheet; raptor cards; large paper; markers; assortment of craft materials, clay and recyclables or large paper and crayons



Accipiters are woodland hawks and have short, rounded wings and long tails that help them maneuver among the trees. These hawks, such as the sharp-shinned hawk, primarily prey on birds. **Buteos**, such as the red-tailed hawk are larger hawks with stocky bodies. They have long, broad wings and fan-like tails that are great for soaring and primarily eat small mammals.

Eagles are in the hawk family, which includes the accipiters and buteos. In fact, eagles are buteo-like hawks but are so much larger that they are placed in their own group. There are 50 different species of eagles in the world, all having a wingspan of 6 to 8 feet. Two species can be found in Pennsylvania. The golden eagle migrates through Pennsylvania while the bald eagle lives and nests within the state.

Falcons are built for speed and maneuverability. They have long, pointed, angled wings that help them fly quickly and change direction abruptly as they catch their prey in flight. Peregrine falcons and kestrels are two falcons that live in Pennsylvania.

Vultures are large birds of prey with long, broad wings that are great for soaring. Their heads have no feathers, which helps keep them clean as they eat carrion. The turkey vulture is the most common vulture in Pennsylvania; the black vulture can be found in some southcentral and southeastern counties. Unlike other birds of prey, vultures have a keen sense of smell, which helps them locate their food.

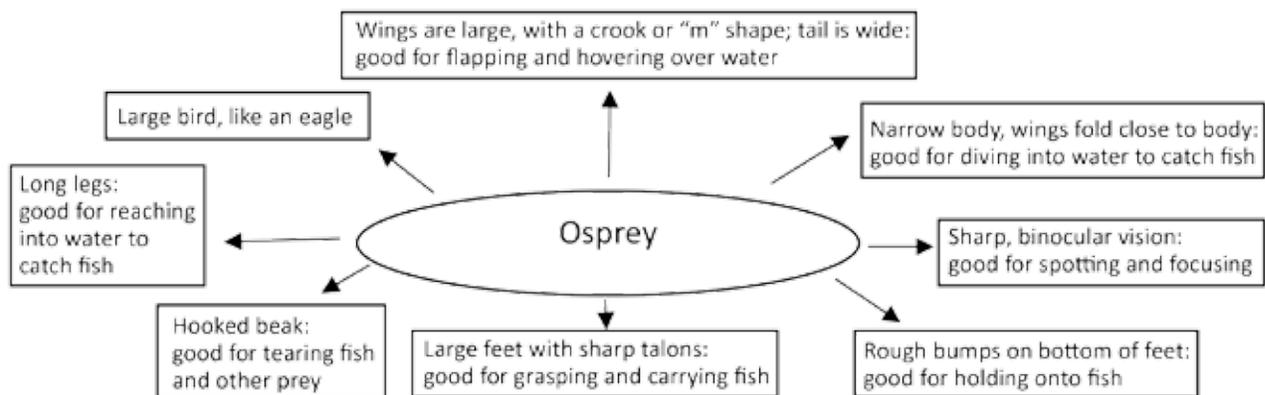
Owls are stocky birds with oval-shaped bodies and large heads. They have broad wings and are covered with exceptionally soft feathers. They have keen night vision and excellent hearing, which helps them find their prey at night. Great-horned owls and screech owls are common owls found in Pennsylvania.

Procedures: Part 1

1. Ask students what they think when they hear the words *birds of prey* and *raptor*. Are they the same thing? Can they give any examples? Explain to students that raptors are birds of prey and that there are many different species of raptors including red-tailed hawks, peregrine falcons, bald eagles, and great-horned owls.
2. Show pictures of many different raptors and ask students if they notice any similarities and differences. Images of several raptors can be found at www.pgc.state.pa.us in the Education section. Continue to explain that there are many groups of raptors but all raptors share some characteristics. Additionally, each group of raptors have their own characteristics that help them survive in their habitats. Explain to students that they will be participating in an activity to explore raptor adaptations.
3. Divide students into groups and provide each group with a raptor card and a large piece of paper.
4. Ask students to read their raptor card and label their paper with the name of their raptor group. For example, the group with the owl card should label their paper *Owls*. Then ask students to make a concept map or chart of the adaptations and their uses (form and function) for their raptor group. At a minimum they should include beak, wings, tail, eyesight, feet/toes, and how they help their raptor survive. They should include any additional adaptations or characteristic of their raptor group as well. Finally, they should write examples of their raptor group that can be found in Pennsylvania on the bottom of their paper. Help them by drawing a sample concept map or chart on the board for them. (See example provided.)
5. Allow students time to complete the concept map or chart and then hang them around the room. Ask students if they note similarities and differences. Make a list of characteristics shared by all groups. The list of similarities should include: carnivores, keen eyesight, hooked beaks, and talons on their feet. Then ask students to note any additional characteristics that are adaptations for specific groups of birds, such as wing-shape. How does wing-shape influence how a bird flies? Which types of wings are great for soaring, for speed, for maneuvering through trees? What adaptation helps owls fly silently at night?
6. Divide students into pairs and provide each student with a Raptor Adaptation student sheet. Ask students to work together to complete the blanks.

Wrap-up: Discuss worksheet responses with students and ensure that student answers are correct.

Example of Concept Map:



Examples of Raptor Adaptations:

Characteristic	Advantage
Strong, hooked beak	Tearing meat/flesh
Powerful talons	Grasping prey
Small, unfeathered head	Keeping clean while eating carrion
Broad, long wings	Soaring, searching for food
Long, narrow, pointed wings	Skillful maneuvering and speed
Short, rounded wings	Maneuvering while flying through trees
Strong flight muscles	Long distance flying
Large eyes	Good vision at night
Facial disks	Increased hearing
Exceptionally soft feathers with serrated edges	Fly quietly
Mottled brown/white coloration	Camouflage
Eyes that face front	Binocular vision to focus on prey
Keen sense of smell (most raptors do not have)	Find carrion

Procedures: Part 2

1. Explain to students that they are going to work in small groups and create their own raptor. Before they design their raptor, they must decide: where the raptor lives, what it eats, how it catches its prey, how it is uniquely adapted to fly and hunt in its habitat.
2. Reiterate that this should be an imaginary raptor and their model must have the adaptations needed to hunt and catch its prey and survive in its habitat.
3. Ask students to use their student sheets as a reference tool or copy the Raptor Adaptation chart on the board or as a hand-out.
4. Review raptor adaptations with students.
5. Provide students with the materials they can use to make their models and the time to put their raptors together. Or provide students with markers and large paper and ask them to draw their imaginary raptor.
6. After students have completed their models, ask students to briefly describe the raptor and how it is adapted to its habitat. Place the models around the room so students can take a closer look when time allows.

Wrap-up: Compare and contrast adaptations from the imaginary raptors and discuss how form helps dictate the function of the adaptation in helping animals survive in their habitat.

Assessment: Students demonstrate their ability to identify general and specific raptor adaptations and their functions and provide examples of raptor species through group work, student worksheets, and raptor models.

Extensions:

Assign students two different raptor species or raptor groups and ask them to compare and contrast adaptations between the species using a Venn Diagram.

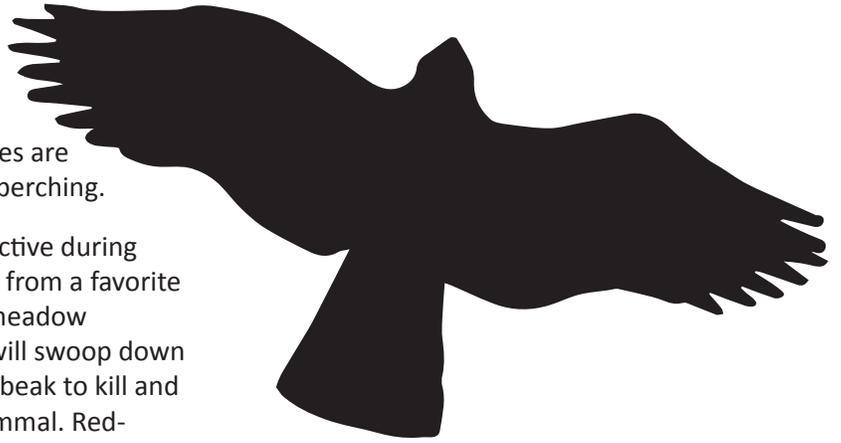
Students research a specific raptor species that lives in Pennsylvania and write a short report on its natural history (habitat, food, adaptations etc.), range, and status in the state.

Students write a natural history note for their imaginary raptor.

Raptor Card: Buteo

Buteos are rather large, stocky hawks with long, broad wings and wide, fan-like tails. These birds are adapted for soaring high in the sky over fields and other open areas. Trees are important to buteos as sites for nesting and perching.

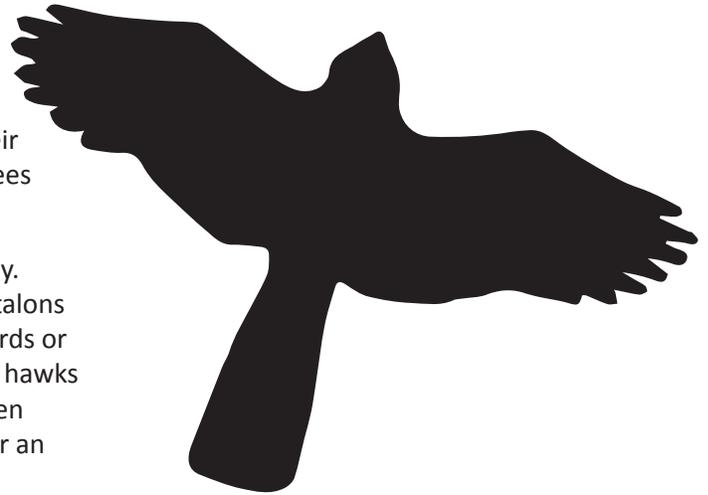
Buteos are diurnal, meaning they are most active during the day. Keen eyesight enables them to hunt from a favorite perch above a field or soar in circles over a meadow searching for prey. Once spotted, the hawk will swoop down and use its sharp, curved talons and hooked beak to kill and eat a vole, mouse, rabbit, or other small mammal. Red-tailed hawks and broad-winged hawks are two examples of buteos found in Pennsylvania.



Raptor Card: Accipiter

Accipiters are hawks with short, rounded wings and long, squared-off tails. They live in woodlots and forests, as well as parks and neighborhoods with many trees. The shape of their wings and tails, along with their more slender bodies, helps them maneuver through trees as they hunt for small birds.

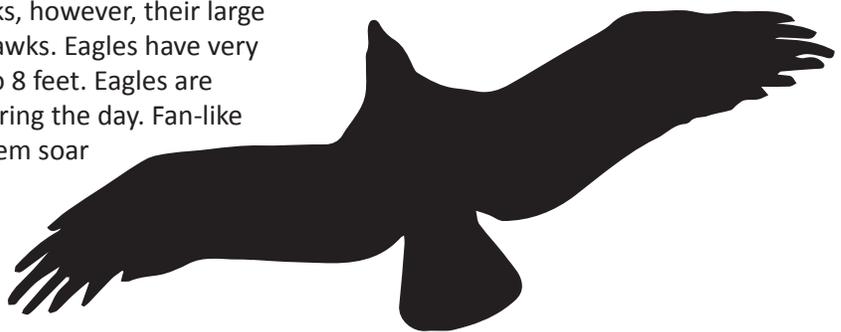
Accipiters are diurnal, meaning they hunt during the day. Their keen eyesight helps them spot their prey. Strong talons and a hooked beak help accipiters catch and eat songbirds or other smaller birds. Cooper's hawks and sharp-shinned hawks are accipiters that live in Pennsylvania and are often seen in neighborhoods near winter bird feeders, watching for an opportunity to take an unsuspecting bird.



Raptor Card: Eagles

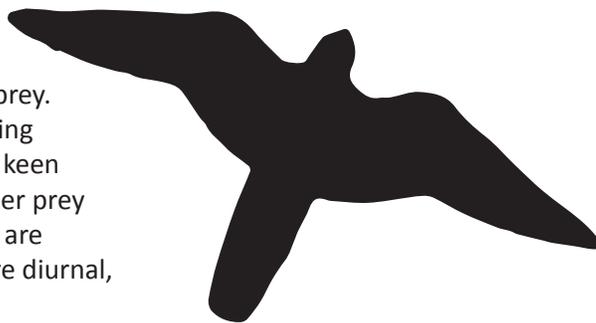
Eagles belong to the same family as hawks, however, their large size distinguishes them from the other hawks. Eagles have very long, broad wings, with wingspans of 6 to 8 feet. Eagles are diurnal, meaning they are most active during the day. Fan-like tails, along with their large wings help them soar through the sky as they search for small rodents, birds, fish, rabbits, and other small mammals to eat.

Eagles have very keen eyesight, which enables them to spot small animals from a high perch or while flying. Strong talons and a hooked beak help them kill and eat their prey. Bald eagles and golden eagles can be found in the commonwealth, however only the bald eagle nests in Pennsylvania.



Raptor Card: Falcon

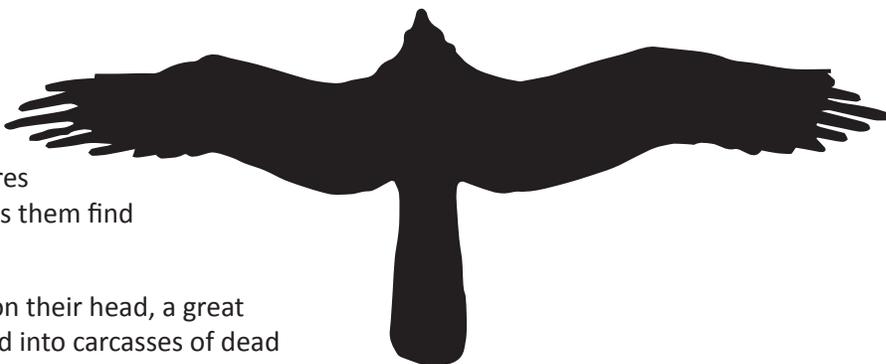
Falcons are known for their speed. They have narrow, pointed wings and long, narrow tails which help them fly quickly and maneuver through the air to dive and catch their prey. The falcons found in Pennsylvania are a diverse group, preferring different habitats and foods. However, all are carnivores, with keen eyesight to help locate birds, small mammals, insects, and other prey species. Strong talons and a hooked beak with a special notch are adaptations that help falcons kill and eat their prey. Falcons are diurnal, meaning they are most active during the day.



Peregrine falcons are the fastest bird in the world and can dive up to 200 miles an hour to catch a small bird in flight. The American kestrel, a much smaller falcon, may eat some birds, but preys mostly on insects in summer and mice in the winter. Both falcons are found in Pennsylvania.

Raptor Card: Vulture

Vultures are large birds with very long, wide wings and long tails. These scavengers are often seen soaring in the sky during the day searching for carrion. Unlike other raptors, vultures have a keen sense of smell, which helps them find their food.



Vultures also have few or no feathers on their head, a great adaptation for a bird that sticks its head into carcasses of dead animals. They have a strong, hooked beak for tearing and talons for grasping, however, their talons and feet are not as strong as the other birds of prey that have to hunt and catch their prey. The turkey vulture and black vulture are examples of vultures that live in Pennsylvania.

Raptor Card: Owl

Owls have stocky, almost oval bodies and large heads. Most owls are nocturnal — active during the night. Their large eyes gather any available night-time light for night vision. Wide, rounded wings and tails, along with exceptionally soft ragged-edged feathers, allow them to fly almost silently as they search for rabbits, mice, voles, birds, insects, and other small animals to eat.



Round, cup-like facial discs around their eyes help focus sound, giving owls finely tuned hearing. This, along with their keen eyesight, helps them find their prey at night. Owls also have strong talons and a hooked beak for catching, killing, and eating prey. Pennsylvania is home to many different owls, such as great-horned owls, screech owls and barn owls. Each owl species has preferences for food, habitat, and hunting. Although most species hunt at night, short-eared owls tend to actively hunt during the day.

Raptor Artistry

Your name: _____ Date: _____

1. Complete the chart. Fill in the blanks for each type of raptor.

Raptor (Bird of Prey)	Beak	Feet/Toes	Eyesight	Wings	Flight	Common Prey	Adaptation	Example
Vulture		talons		wide, long	soar in sky			turkey vulture
Eagle			keen, good	large, wide		small mammals, fish, birds	fan-like tails	
Buteo		talons			soar in sky		fan-like tails	red-tailed hawk
	hooked		keen, good		fast, maneuver through trees	birds	long tails	
Owl		talons			silent	small mammals, birds	night vision	
Falcon	hooked		keen, good	narrow, pointed			notch in beak	





Eagles & Osprey

Large, striking and charismatic birds of prey, the bald eagle, golden eagle and osprey seem to embody power and majesty. All regularly occur in Pennsylvania, but only the bald eagle and osprey nest here. The golden eagle migrates through the state on a pathway connecting its breeding and wintering territories.

In the not so distant past, direct persecution and environmental contaminants drove eagle and osprey populations to catastrophically low levels. Protection at both state and federal levels, tremendous conservation efforts and improved waterway quality enabled them to rebound in Pennsylvania and elsewhere.

While persecution and environmental contaminants continue to impact these large raptors, today's primary threats include loss of habitat due to land-use changes and declining habitat quality.

Taxonomists place bald and golden eagles in the same family as hawks, kites, harriers and Old World vultures – the family Accipitridae. The osprey is the only species of the family Pandionidae.

Bald Eagle

The bald eagle's scientific name, *Haliaeetus leucocephalus*, means "white-headed sea eagle." The word "bald" is a misnomer. The mature eagle's head is covered with gleaming white feathers. Its body is dark brown, its tail white. Immatures are brown, mottled with white on their wings and body. Full adult plumage is attained in the fifth year. Both adults and immature bald eagles have yellow bills and feet, and their legs are feathered halfway down.

Bald eagles were listed as a federally endangered species until 1995, when their status was upgraded to "threatened." In 2007, following a remarkable population recovery, the bald eagle was removed from the federal List of Endangered and Threatened Wildlife in the lower 48 states. Although no longer listed at the federal level, the bald eagle remains protected under the federal Bald and Golden Eagle Protection Act, the Lacey Act and the Migratory Bird Protection Treaty Act. In Pennsylvania, the bald eagle is



given additional protections under the state Game and Wildlife Code.

Adult bald eagles are 30 to 40 inches in length and weigh 8 to 14 pounds. Their wingspans are 6 to 8 feet, and they stand about 2 feet tall. As with other birds of prey, the female is larger than the male.

Bald eagles fly with strong, deep strokes, or soar on flattened wings. Their eyesight is among the keenest in the animal world, five or six times sharper than a human's. A bald eagle's call is a rapid, harsh cackle, kweek-kik-ik-ik-ik, or a lower kak-kokkak.

Fish, either caught live or scavenged as carrion, make up 60 to 90 percent of a bald eagle's diet. Bald eagles also eat birds, small mammals, reptiles, amphibians and invertebrates. Eagles soar above the water or sit on a perch, and when they spot a fish near the water's surface, they swoop down and snatch it in their talons. They use their talons for killing, and their heavy bills for tearing prey apart for eating. Sometimes an eagle will go after an osprey or another fish-eating bird, forcing it to drop a captured fish, which the eagle grabs in midair. This behavior is known as "pirating" prey.

Generally, bald eagles mate for life, although when one partner dies, the other quickly finds a new mate if one is available. Nesting is preceded by a spectacular aerial courtship, with the birds locking talons, diving and somersaulting in the sky.

An eagle's nest is called an eyrie. The big raptors choose large, sturdy trees with good views of their surroundings. Nest sites are near lakes, rivers, reservoirs, and seashores.

A new nest is about 5 feet wide and 2 feet high, with an inside depression 4 to 5 inches deep and 20 inches in diameter. Often a pair returns to the same nest year after year, repairing damage and adding a new layer of sticks, branches and cornstalks, plus a lining of grass, moss, twigs and weeds. Enlarged annually, some nests grow so big and heavy that they break the branches or tree supporting them. Unlike ospreys, bald eagles are not likely to build on artificial structures, although a few have done so in Pennsylvania.

The female lays two eggs (sometimes only one and occasionally three) during the span from February through April. Eggs are about 2¾ by 2½ inches, dull white and unmarked. Both parents incubate, with the pair taking turns at the nest.

If all goes well, the eggs begin hatching after about 35 days. Young birds (eaglets) are fed by their parents. Because eggs hatch over several days, age and size differences among hatchlings often gives the first hatchling a head start and a competitive advantage at feeding time. A large, healthy eaglet might kill a smaller, weaker one or out-compete it for food.

Eaglets develop most of their feathers by 3 to 4 weeks, walk in the nest at 6 to 7 weeks, and begin to fly at about 3 months. Young separate from their parents in autumn.

Factors affecting nest success are many. Bald eagle nests and young eagles are easily disturbed and nest failure can occur when people get too close to an active nesting area. Adults might abandon a nest site altogether or leave eggs or hatchlings exposed to sun, cold temperatures, severe weather and predators. Also, when growing eaglets are disturbed before their first flight, they may fledge prematurely which makes them vulnerable to terrestrial predators and inclement weather. To protect eagles, people should keep their distance from active nests, roost sites or feeding areas, and avoid approaching a nest directly. Federal regulations prohibit any intrusion within 660 feet of the nest.

Eagles do not breed until 4 or 5 years of age. Their natural reproduction rate is slow. High water quality, riparian forest and wetland habitat are vital for Pennsylvania's breeding eagles. Breeding habitat – tall, sturdy trees near bodies of water in protected areas—continues to dwindle. Toxic chemi-

cals introduced into the environment cause repeated nest failures.

Bald eagles are now fairly widespread in Pennsylvania, and may show up here in all seasons, and particularly along major river systems. Nesting pairs might remain in their territories year-round. Many eagles migrate through the state, some from the north and others from southern parts of the United States. In fall, bald eagles are among the earliest raptors to pass through, soaring on thermals over mountain ridges and along large streams. Many of the early migrants are southern bald eagles that have wandered north into Pennsylvania and other northeastern states following nesting and are returning south again. During winter, bald eagles are seen around water bodies across the state. During colder winters, when open water is rare, eagles congregate in areas where

water remains unfrozen and they can forage.

Bald eagles congregate at several locations in winter, including sites along the lower Susquehanna River, upper Delaware River, Raystown Lake, and the reservoirs and wetlands of northwestern Pennsylvania. In order to record wintering eagle populations and to get a preview of nesting behavior, the Game

Commission each year coordinates a mid-winter bald eagle survey in cooperation with volunteer eagle-watchers and the U. S. Army Corps of Engineers.

While bald eagles today appear in Pennsylvania in good numbers, not so very long ago, the future for the state's eagles looked bleak. In 1983, when the Game Commission launched what would be a seven-year restoration program, only three pairs of nesting eagles remained in the state—all of them located in Crawford County, in northwestern Pennsylvania along the Ohio border.

As part of a federal restoration initiative, the Game Commission sent employees to the Canadian province of Saskatchewan to obtain eaglets from wild nests. From 1983 to 1989,

88 eaglets were brought to Pennsylvania, where they were raised in specially constructed towers and released into the wild through a process known as "hacking." Hacking is a falconer's term for maintaining a young bird in a semi-wild condition, providing food until it can fend for itself. Pennsylvania's reintroduction effort jump-started a remarkable recovery.

By 1998, Pennsylvania was home to 25 pairs of nesting bald eagles. Within the next three years, the number of nesting pairs doubled. By 2006, more than 100 nests were confirmed statewide. And the number of nests topped 250 in 2013, with bald eagles nesting in all but a handful of the state's counties.



A bald eagle's head feathers change as it matures.

The nesting population continues to grow in size and expand in geographical range, and a lot of good habitat remains.

Bald eagles can live 32 years or longer in the wild. They have few natural enemies and mortality is often directly or indirectly related to humans. They are sometimes killed by motor vehicles, occasionally shot and some get lead poisoning from ingesting contaminated prey. Eagles are sometimes electrocuted when they land on powerlines, and are at risk of colliding with wind turbines on ridgetops during migration.

The bald eagle was chosen the United States' national symbol in 1782. At that time, an estimated 100,000 lived in what is now the lower 48 states. In 2007, the U.S. Fish and Wildlife Service estimated that at least 9,789 nesting pairs populated the contiguous United States.

Golden Eagle

The golden eagle, *Aquila chrysaetos* is a magnificent predator of remote, mountainous areas. The species occurs in Europe, Asia, northern Africa and North America, where it's most common in the western United States, Canada and Alaska.

The golden eagle is rare in the Northeast. A small population exists in eastern North America. This geographically isolated population breeds in northeastern Canada in the northern forests of Quebec, Labrador and northern Ontario.

The eastern golden eagle is closely linked to the Appalachian Mountains where it travels the mountain ridgelines during southbound and northbound migrations and spends the winter on the steep forested ridges of the central and southern Appalachians, primarily in Virginia and West Virginia. Pennsylvania hosts its share of migrating and wintering golden eagles, mainly in the Ridge and Valley Province between the Allegheny Front and the Kittatinny Ridge.

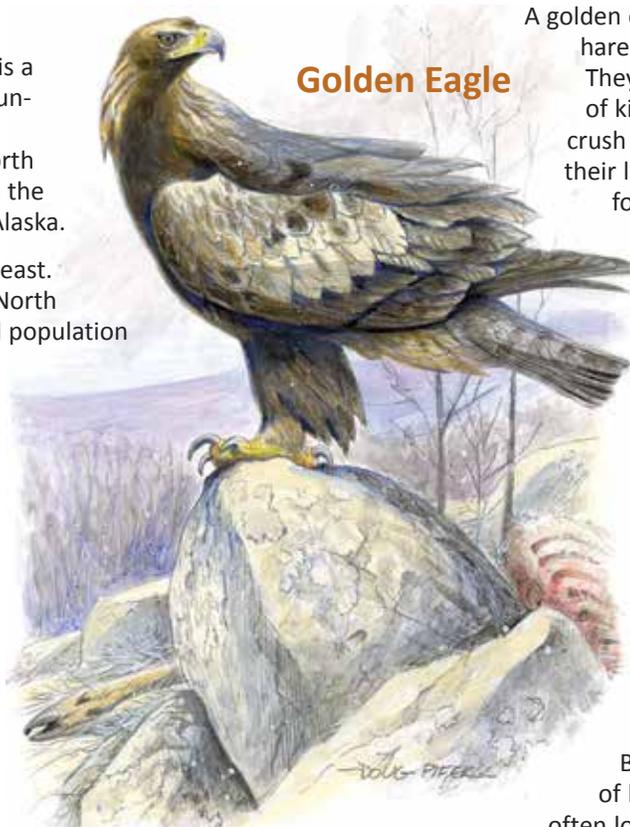
Pennsylvania's Wildlife Action Plan designates the golden eagle as a vulnerable species, and as a top predator, it is an indicator of habitat quality.

Like the bald eagle, the golden eagle is federally protected under the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act and the Lacey Act. The golden eagle generally prefers open country on its breeding range, but on migration and during winter it favors the Appalachian's forest ridges and small openings along those ridges.

Adults and immatures have rich, dark-brown body plumage, with gold-tipped feathers on the back of the head and neck. The golden eagle is in a subfamily of "booted" eagles and its

legs are feathered to the toes. Adults resemble immature bald eagles, but goldens are darker with fewer splotches of white. Immatures have white wing patches and, for their first several years, a broad, white band at the base of the tail. In flight the eagle's tail protrudes noticeably more than its small-looking head protrudes. It also holds its wings in a slight "V" as compared to the bald eagle's flat plane, the so-called "flying plank" of hawk watches.

Golden eagles are shaped like buteo hawks, with long, rounded wings. They flap less and soar more than bald eagles. Body length is 28 to 40 inches; wingspan is 6 to more than 7 feet, and standing height is about 2 feet. Their calls are a series of rapid, sharp chirps or yelps, although they are most often silent. Neither eagle calls as much as the more common red-tailed hawk.



Golden Eagle

A golden eagle's prey includes small rodents, hares, rabbits, birds, reptiles and fish. They also eat carrion and are capable of killing large animals. Golden eagles crush prey in their sharp talons, and use their large, hooked beaks to rip it apart for eating. In Pennsylvania, golden eagles are regular migrants in mid-October through early December. Northbound migrations occur in late winter and spring with most sightings at hawk-watch sites in March and April.

Golden eagles do not breed in Pennsylvania. Some occasionally winter here in rugged, remote forest terrain, remaining out of site most of the time. Most golden eagles breed across central Canada, in the western United States, Alaska and mountainous parts of Mexico.

Breeding habits are similar to those of bald eagles, except golden eagles often locate their nests on cliffs. After fledging, young remain in the nest area during summer, then wander away from the site with their parents. They do not breed until 5 years of age.

A recent four-year survey (2006 to 2009) conducted by the U.S. Fish and Wildlife Service suggests there may be 30,000 golden eagles across the United States. The eastern golden eagle population is believed to be fewer than 2,000. The golden eagle is not on the federal threatened or endangered list, but has disappeared from most of the northeastern states.

Osprey

The osprey, *Pandion haliaetus*, is a large, eagle-like hawk found throughout North America and in the Eastern Hemisphere. It inhabits seacoasts and the areas near large rivers and lakes. In Pennsylvania, it shows up along the major rivers

and their tributaries and around lakes, ponds, reservoirs and wetlands. The osprey prefers shallow water and requires an abundant supply of fish within a reasonable distance from its nest. Nests are usually nearby food sources, but occasionally up to about 12 miles away. Ospreys are not as likely as bald eagles to nest near flowing fresh water. Ospreys also are more likely to nest in clusters at a lake or reservoir, and usually on an artificial structure.

Osprey plumage is dark brown above and white below. Adults and juveniles are colored similarly except juveniles show buffy-white spots on their backs, a buffy shading on their necks and chests and reddish-orange eyes. Adults have yellow eyes. The osprey's head is largely white, with a black patch across each cheek. A conspicuous crook to the wings, creating a characteristic "M" shape, and black "wrist" marks are good field identifiers.

Except when migrating, ospreys flap more than they sail. Wing beats are slow and deep. Ospreys hover 50 to 150 feet in the air and then plunge to the water for their fish prey, sometimes going all the way under.

Ospreys are 21 to 24 inches from bill to tail. Their wings span 4 ½ to 6 feet. They stand about 1 ½ feet tall. Ospreys are quite vocal and use several different calls to communicate with one another. Their call is a series of loud whistles, cheep, cheep, etc.

Ospreys typically migrate south in winter and return to Pennsylvania in late March and early April to nest. They can be seen migrating south along the mountain ridges in August, September and October, with peak migration occurring around the middle of September. During fall, many migrating ospreys are also observed along Pennsylvania's rivers. Ospreys migrate to southern wintering grounds along the Gulf Coast and in southern Florida south through Central America and South America.

Like eagles, ospreys build bulky nests of sticks and twigs, lined with inner bark, sod or grasses. Sometimes they add debris (rope, fishnet fragments, cans, seashells, etc.). Nests are in living or dead trees, on the ground, or on man-made structures – cell towers, utility poles, fishing shacks, billboards, channel buoys, light standards, chimneys and platform-topped poles or towers erected specifically for osprey nesting. In Pennsylvania, most known osprey nests are on man-made structures. Since ospreys add to nests year after year, the nests can become huge and conspicuous.

The nests usually include three eggs, sometimes two and rarely four. Eggs are 2¾ by 1¼ inches, and white or pinkish-white with brown spots and blotches. The female incubates 36

to 42 days, and young leave the nest when they are 51 to 59 days old.

Dr. Larry Rymon of East Stroudsburg University in 1980 began reintroducing ospreys to the state's northeastern counties. The first Pennsylvania-hatched osprey returned in 1983, and two years later the state documented its first nesting pair since 1910. An osprey has strong ties to the area where it was hatched, and usually returns in the same area to breed. Between 1980 and 1996, 265 young ospreys were released into Pennsylvania at three different locations: the Poconos in northeastern Pennsylvania, the Tioga County reservoirs in northcentral Pennsylvania and Moraine State Park in western Pennsylvania. These nestling birds were obtained from the Chesapeake Bay, which has the largest nesting population of ospreys in the world. A total of five reintroduction projects

between 1980 and 2007 helped fuel the osprey's recovery in Pennsylvania. The recent Second Breeding Bird Atlas (2004-08) documents the osprey's recovery with confirmed nests reported in at least 90 atlas blocks, a tenfold increase compared to the nine blocks confirming nests during the first atlas period (1984-89). Most recently, osprey nest surveys in 2010 reported 115 osprey nests in 21 counties with more found since that year. The osprey is a state threatened species and protected under the Game and Wildlife Code. Although not listed at the federal level, all migratory birds are protected under the Migratory Bird Treaty Act.

Raptor Reproduction

Reproductive failure is a problem for bald eagles and ospreys. Much of the problem stems from man's use of now-banned toxic chemicals. DDT, dieldrin, and other chlorinated hydrocarbons sprayed to kill insects, which contaminates water and prey species in the food chain.

Bald eagles eat a lot of fish, and accumulate the chemicals in their bodies. Other pollutants such as PCBs and heavy metals may also affect their reproduction.

The chemicals cause birds to lay infertile or thin-shelled eggs, which break under the weight of an incubating bird. Although environmental regulations have banned the use of "hard" pesticides, some chemicals remain in our natural food chains because they do not break down rapidly and some harmful chemicals banned in the United States continue to be used in other parts of the world. Many birds are still exposed to these toxins during migration and on wintering territories. Monitoring bald eagle nests helps the agency follow the recovery process and determine their population status. It also allows biologists to detect environmental problems that may be occurring both locally and statewide.





Pennsylvania Elk

FAST FACTS: Elk *Cervus elaphus*

Size: **Newborn (Calf):** Weight: 37 to 42 pounds; Length: 36 to 40 inches from nose to tail

Female (Cow): Weight: 500 to 600 pounds; Height: approximately 4.5 feet at shoulder; Length: 6.5 feet from nose to tail

Male (Bull): Weight: 700 to 1,000 pounds; Height: approximately 5 feet at shoulder; Length: 8 feet from nose to tail

Color: Body color varies from a brown-gray color in winter to reddish-brown in summer; rump is light beige; legs and neck usually darker than body

Antlers: Grown by males and can weigh up to 40 pounds

Habitat: Mixed deciduous forest interspersed with clearings of grasses, grassy meadows, and reclaimed strip mines

Food: Varies with season

Spring: young grasses, leaves, new sprouts

Summer: grasses, clovers, other field plants

Fall: dried grasses, twigs, acorns, mushrooms

Winter: twigs, bark, evergreen leaves, dried grasses uncovered from beneath the snow

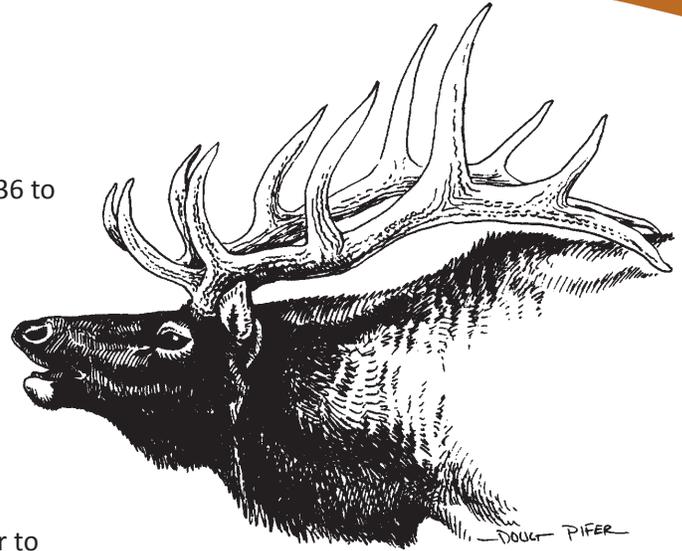
History: Once common throughout the state, elk became extirpated from Pennsylvania in 1867 due to market hunting, habitat loss, and lack of wildlife protection laws.

Range in Pennsylvania:

Original: throughout the state

Current: northcentral Pennsylvania in Elk, Cameron, Clinton, Clearfield and Potter counties

Reintroduced into Pennsylvania between 1913 and 1926 by the Pennsylvania Game Commission.





Pennsylvania Elk

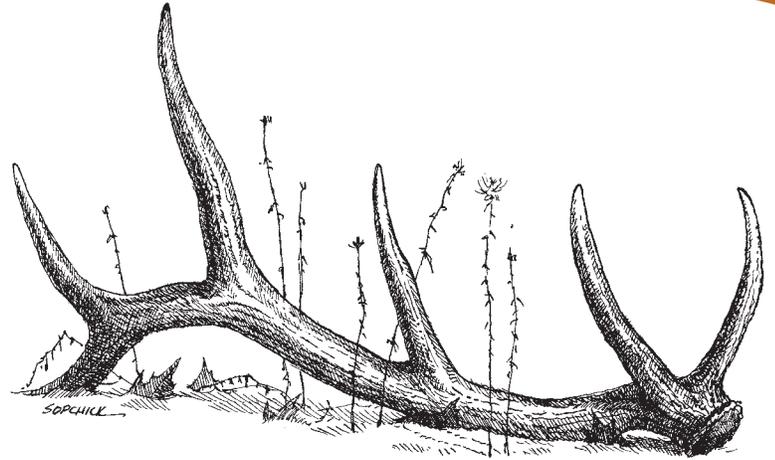
Celebrating 100 Years

Guiding questions to the film:

These questions/answers are designed as an aid to teachers as they discuss key information provided in the *Pennsylvania Elk: Celebrating 100 Years* film.

The film focuses on three major topics:

- wildlife and the colonization of Pennsylvania
- reintroduction of elk into Pennsylvania
- elk conservation and management



Wildlife and the Colonization of Pennsylvania (3 questions)

Pennsylvania went from a land of forests scattered with clearings and wetlands with numerous pristine streams and rivers to a developed state. Along with development came habitat destruction, logged-over forests, and polluted waters, which ultimately lead to the loss of many wildlife species, including elk, by the 1900s.

1. How did Pennsylvania change from the 1600s to the 1900s?

In the early 1600s, when Europeans first came to the area now known as Pennsylvania, the land was covered in great expanses of deciduous and evergreen forests. Small clearings made by Native Americans or by windfalls were scattered throughout the forests. Rivers and streams flowed through the countryside. Acres of wetlands dotted the landscape. Pennsylvania's diverse ecosystems were home to bison, mountain lions, timber wolves, deer, foxes, bears, beavers, otters, eagles, herons, hawks, shad, and a multitude of other species, including the now extinct passenger pigeon. The Eastern elk was found in great numbers throughout the land.

As Pennsylvania was settled, the landscape was changed. Forests were cleared for farms and towns. By the end of the 1700s paper mills and saw mills were founded and coal was discovered. Small industries were starting to take a toll on the forests, wildlife, water, and land in several parts of the state, especially the southeast, but industry was just beginning. Canals, rivers, boats, stage coach, and ultimately railroads, enabled goods to be transported quickly from one part of the state and country to another. Oil was discovered in Titusville in 1854, fueling more and larger industries, mills, and manufacturing plants.

In the mid-1800s, logging became a huge industry, supplying wood and wood products to the growing population of Pennsylvania and the surrounding states. By the early 1900s, most of Pennsylvania had been logged and fires burned on the mountains. The great expanses of forests were decimated and most of the waterways were polluted. Almost all species of wildlife were on the decline, some even disappearing from the state.

2. How did the colonization of Pennsylvania affect wildlife?

As settlers arrived in Pennsylvania, land was cleared for farming and animals were hunted and trapped for food and clothing. Those wild species considered a threat to people or farm animals such as wolves, mountain lions, hawks, eagles, and owls, were shot. Beavers were trapped for their fur. By the 1800s many species, such as timber wolves, bear, deer, beaver, and otter were rare or gone from southeastern Pennsylvania. Bison were essentially gone from the state.

With the discovery of coal and oil, increased industry, and the arrival of the railroads, cities and towns began to grow and settlers expanded north and west. Market hunters provided food for the increasing population, many providing deer and elk for the buffets at better restaurants. Other wild species, such as beaver, foxes, squirrels, hawks, and herons continued to be trapped and hunted either for sport, bounties, or to supply fur and feathers to the fashion industry. There were few, if any, laws protecting most of the wildlife species in Pennsylvania.

By the end of the 1800s timber wolves, mountain lions, elk, and beavers were gone from the state. In 1867, the last Pennsylvania elk was killed. The passenger pigeon was very close to extinction and deer and turkey were found only in the wildest of areas of the state. Ducks, bears, hawk, herons, foxes, eagles, songbirds, rabbits, and other small mammals — almost all species — were on the decline, from a combination of habitat loss, market hunting, trapping, and/or bounties.

3. What factors led to the extirpation of elk from Pennsylvania?

Elk once roamed the mountains and valleys throughout the state. However, the settlement of Pennsylvania led to increased pressures on elk and other wildlife. The combination of several factors led to the loss of elk in Pennsylvania including market hunting, habitat loss, and lack of wildlife protection laws. In 1867, the last free-roaming Pennsylvania elk was killed, although there were a few remaining on a private reserve in Monroe County.

Reintroduction of Elk into Pennsylvania (3 questions)

Elk were reintroduced from 1913 to 1926 and had a history of highs and lows until the 1980s. Since then, a renewed interest, along with a better understanding of elk management, has enabled the elk herd in Pennsylvania to grow and the range to expand.

1. When and how were elk reintroduced into Pennsylvania?

By the end of the 19th century, interested groups and individuals were pushing the Pennsylvania legislature to establish laws and an agency to conserve wildlife. In 1895, the Pennsylvania Game Commission was established to protect and conserve the wild birds and mammals of the state. At first there was little support for this Commission but slowly attitudes changed. By 1905, the Commission established the first wildlife refuge in Pennsylvania, more followed. These refuges, in combination with wildlife protection laws, the development of seasons and bag limits, and in some cases, reintroductions, helped hasten the recovery of many of the state's wildlife species, such as deer, beavers, bears, and wild turkeys. Unfortunately, many people still considered predators to be harmful to other wildlife populations, a threat to their farm animals, or a danger to their children, so bounties on bobcats, hawks, owls, weasels, and other predators continued to exist at different times during the early- to mid-1900s.

Before long, the Commission began to discuss the possibility of reintroducing elk. However, there were no herds of Eastern elk remaining in Pennsylvania or in any eastern state, so, where could Pennsylvania obtain elk? It turns out that, at this same time, Wyoming had an overpopulation of Rocky Mountain elk, a different subspecies of elk. These elk were dying of starvation due to continued severe winters. In addition to feeding these elk, the federal government decided that elk should be trapped and transferred from Yellowstone National Park to other areas of the country.

Unfortunately, improving the land for elk habitat was not easy. Much of the lands purchased in the elk range were abandoned strip mines, left with deep pits and piles of soil, rock, and mine debris. Top soil was gone and the pH of the remaining soil was very low. After the land was re-contoured, the soil had to be fertilized, the pH raised and then the area reseeded for grasses. This increased the cost of reclamation and limited the number of acres that could be re-vegetated. The pH problem was solved through a partnership with a paper company. The company had a byproduct from the mill that was a mulch-like slurry with a high pH. This slurry cost much less than lime and fertilizer yet acted as a fertilizer and raised the pH so that grasses, clovers, and other plants flourished. Due to the lower costs, additional lands could be reclaimed.

After much planning and letter exchanges, the first shipment of 50 elk arrived in Pennsylvania in 1913 and were reintroduced into Clearfield and Clinton counties, where habitat seemed suitable for elk. An additional 22 elk from a private reserve in Monroe County were released in Monroe and Centre counties. Between 1913 and 1926, 177 elk were trapped and transferred from Yellowstone National Park and South Dakota to Pennsylvania. Others were relocated from the private reserve in Monroe County. Transporting elk into Pennsylvania was a huge undertaking.

In Yellowstone, elk were rounded-up and kept in corrals until they were driven (similarly to cattle drives) to a train station that was just across the border in Montana. The elk rode by train in box cars to Pennsylvania where they were off-loaded and placed in large individual crates. These crates were then loaded onto wagons and pulled by horses over mountains to the reintroduction sites. Elk were placed into corrals to get used to the new habitat and then released into their new homes.

2. What was the result of the reintroduction?

At first, elk prospered in all the areas where they were released. As the elk population increased, these large animals started to wander into yards and farm fields. Complaints of crop damage in corn, wheat, and alfalfa fields started to grow. The elk that were damaging crops were either relocated or killed. An elk hunting season was established in 1923 and around the same time, it appears that some elk were stricken with brain worm, a parasite that ultimately kills the animal. These pressures combined with habitat loss lead to a decline in the population until only a limited number remained in Cameron and Elk counties. The hunting season was abolished in 1931.

From the 1930s to the 1960s, little is known about the elk. Strip mining became a major industry in the elk range after World War II, once again causing elk habitat to be destroyed. By 1965, the population was estimated to be 35. At this time, new laws came into place requiring strip mines to be reclaimed and grasses and trees planted. This was good for the land, the elk, and many other wildlife species. By the 1970s, elk gained the interest of people, foresters, land managers, universities, and biologists and an official count of elk was taken. The population numbered 65, but again, brain worm and shooting for crop damage took a toll. The population decreased to 38.

Working with the Bureau of Forestry and interested organizations, such as the Rocky Mountain Elk Foundation, the Pennsylvania Game Commission began new efforts to establish a sustainable elk population in our state. From the 1980s to the 1990s efforts focused on research to gain a better understanding of the needs of elk, creating suitable habitat on public lands, and fencing to prevent crop damage.

The elk population began to grow and this time the growth continued. In 2001, a limited elk hunt was initiated. The elk herd was large and healthy enough to sustain the hunt so that currently the hunt takes place each year. It is now safe to say that the elk reintroduction was a resounding success and the 2014 elk herd is healthy and expanding with more than 900 found in northcentral Pennsylvania.

3. How has the Pennsylvania elk population been monitored since the reintroduction?

For many years after the reintroduction, there are no records of official population counts, however, elk continued to be seen in Elk and Cameron counties. In 1971, as part of a study initiated by the Pennsylvania State University with support from the Pennsylvania Game Commission, a formal elk census was taken, resulting in a count of 65 elk. A year later the population declined to 38 individuals. Although biologists are not certain of the cause of this decline, brain worm was found in some of the elk that had died. In addition, elk continued to be shot for crop damage.

Elk population counts were not taken again until the 1980s when a new focus on elk management began and still continues. Wildlife biologists placed radio-collars on elk to track home range size as well as food and habitat preferences. Population counts were completed on a regular basis, with the elk herd remaining stable at approximately 100 throughout the 1980s. Elk management changed and improved in response to research findings, resulting in the development of more food plots planted in critical areas, as well as highlighting the need for more elk habitat and additional public lands

In the 1990s biologists focused on elk population and health, using telemetry and blood analyses to examine herd reproduction, herd health and calf mortality. Aerial population counts were also initiated, which reduced the number of people necessary to complete an elk census and provided more reliable estimates. However, this census relied heavily on snow covering the land so that elk could be seen from the air.

During this time, elk mortality due to poachers, crop damage, and vehicle collisions continued to prevent the population from growing. So, the Game Commission, with the help of the Rocky Mountain Elk Foundation, took measures to minimize these losses by purchasing public lands for elk habitat management and initiating a program to place electric fences around farm fields. Elk were also trapped and transferred from the more populated areas of Elk County to public lands in Clinton County. This expanded the elk range and also reduced the number of elk close to farm fields. The combination of management strategies appeared to work, because by 1999, the elk population grew to 500.

In the 2000s the elk herd continued to grow and expand its range. The herd, up to more than 900 elk in 2014, continues to be large enough to support a limited elk hunt each year. Biologists estimate the elk population annually but due to costs and safety concerns, the aerial population count was discontinued. Currently the Game Commission uses a minimum-number-alive method which does not rely so heavily on snow cover and uses radio-telemetry to locate elk for a ground-based count. New research studies were initiated that focused on calves, resulting in new information to add to our understanding of the Pennsylvania elk herd, such as the number of calves born each year, their weight and their rate of survival.

Each year, decade and century, new questions will be asked and more challenges will be faced by elk and elk biologists. How will gas drilling near the elk range affect elk habitat? Will chronic wasting disease spread from the deer herd to the elk? Ongoing research, monitoring, and commitment will be needed to sustain our elk population through the 21st century.



Elk Conservation and Management (3 questions)

Elk management methods, strategies, and goals have varied over the years with changes in attitudes and an increase in knowledge about elk and habitat needs. However, conservation of any wildlife species, including elk, involves partnerships with other agencies and conservation groups working together to sustain a healthy population in balance with its habitat and with acceptable human-wildlife interactions.

1. What are major components of elk conservation and management?

Many factors must be considered in elk management including 1) sustaining a healthy, stable elk population, 2) providing suitable habitat, 3) offering recreational opportunities and 4) minimizing elk-human conflicts. In order to address all of these components, the Pennsylvania Game Commission has biologists, habitat managers, Wildlife Conservation Officers, and wildlife educators working in the elk program. In addition, the Game Commission partners with other state agencies, such as the DCNR Bureau of Forestry, and conservation organizations such as the Rocky Mountain Elk Foundation and the Keystone Elk Country Alliance.

Active elk management has been ongoing, since the 1980s. Research projects have helped determine habitat and food preferences, seasonal habits, causes of mortality, and home range size. This information has helped biologists and land managers improve habitat for elk and establish elk food plots away from populated areas. Biologists have also used this information to design more accurate population counts and to allow sustainable elk hunting. This increased knowledge about elk has also helped biologists and land managers to minimize elk-human conflicts on roads, farms, and backyards, and, at the same time, to develop areas where people can view elk on public lands without interfering with elk or local homeowners.

Managing elk in Pennsylvania continues to be an on-going program which requires the support and partnership of government agencies, conservation organizations, and interested individuals.

2. What is the preferred habitat for elk?

Elk inhabit grassy meadows, reclaimed strip mines, and forest clear cuts. Although clearings are essential, elk also rely heavily on forests for shelter and even some food. Elk are primarily grazers and eat a variety of grasses and plants such as orchard grass, Kentucky blue grass, timothy, and foxtail, as well as shrubs and flowering plants such as blueberry, teaberry, and clovers. Elk also will eat the nuts, leaves and bark of trees, especially in fall and winter. Elk typically shy away from populated areas, but will visit farms and backyards to obtain some favored food, especially corn, alfalfa, and wheat. In Pennsylvania, elk can be found in Elk, Cameron, Clearfield, Clinton, and Potter counties.

3. How has land been managed for elk since the reintroduction?

When elk were reintroduced, most of the forests in northcentral Pennsylvania had been logged and were re-growing with young trees, shrubs, grasses, and flowering plants. This provided excellent habitat for elk. However, after WWII,

Restoring elk habitat has also helped many other species. Grassland birds are declining throughout Pennsylvania, but in the elk range, birds such as the meadowlark, whip-poor-will, and dickcissel are starting to thrive. Turkey, deer, bear, ruffed grouse, and rabbits are just a few of the species benefiting from the improved elk habitat.

strip mining became a booming business in and around the elk area. Land was stripped of the young forests and vegetation, coal was obtained, and then the land was abandoned. Deep pits, as well as piles of soils, rocks, and other mining debris were left behind; local creeks and streams were polluted. In many areas, nothing could grow on the land. Although the elk survived, the population declined. In the 1960s, new laws were established which required strip mined lands to be restored and planted in grasses and trees. Although not all the land recovered, the reclaimed grasslands and trees provided habitat for

elk and the population was able to sustain itself with little to no active management. Although some food plots were planted and an elk survey was done in the 1970s, active focused elk management did not really start until the 1980s.

Since the 1980s, habitat management has been, and continues to be, an integral part of elk management. As habitat improved, the elk population grew. As the population grew, interest in elk viewing grew. The

following are some examples of management projects to improve elk habitat and to allow for safe elk viewing:

- By the 1980s elk were roaming the area, going onto roads, farm fields, and backyards and interfering with people. To encourage elk to stay off private lands, the Pennsylvania Game Commission and DCNR Bureau of Forestry focused on increasing habitat quality and food sources on public lands.
- In the 1990s with the help of organizations such as the Rocky Mountain Elk Foundation, the Game Commission focused on purchasing more land to expand the elk range and to encourage elk to stay on public lands. A variety of grasses and clovers were planted as food plots, and trees were planted for shelter as well as food. A trap and transfer program was implemented to move a small portion of elk from populated areas to expand the range further onto public lands.
- A fencing program was initiated in the 1990s to prevent elk from roaming onto farmlands and damaging farm crops.
- Research to better define elk habitat and preferences took place from the 1990s through the 2000s and guided the tree, grass, and other plant species chosen for food plots and new habitat areas.
- Elk viewing areas were developed to help people view elk from a safe distance and provide areas to park. In 2010 the Keystone Elk Country Alliance opened an elk visitor center with support from a variety of organizations and agencies including the Department of Conservation and Natural Resources and the Pennsylvania Game Commission.

Acid mine drainage has been an issue on the elk range. There are active systems to add lime to the streams to increase the pH and then ponds to take out the iron and other metals. Slowly, the streams are recovering and fish and macro-invertebrates are returning.



Directions:

1. Read the information about elk.
2. Color the picture of the bull.
3. Write a sentence about elk in the space provided.

Eastern Elk *Cervus elaphus*

1. Elk live in northcentral Pennsylvania where they take shelter in the forests and graze in clearings of grasses, clovers, and other green plants.

2. The male elk is called a bull. Bulls grow a new pair of antlers every year.

3. Native Americans and early settlers hunted elk, eating the meat and using the warm hides for moccasins, robes, and other clothing.

4. Females, called cows, are smaller than bulls and do not grow antlers.



5. The Shawnee tribe called elk wapiti, which means "white rump".



6. Calves are brown with white spots. This coloration camouflages them as they lay among grasses and shrubs. Predators beware, the cow is always nearby.

Write your sentence about elk here:



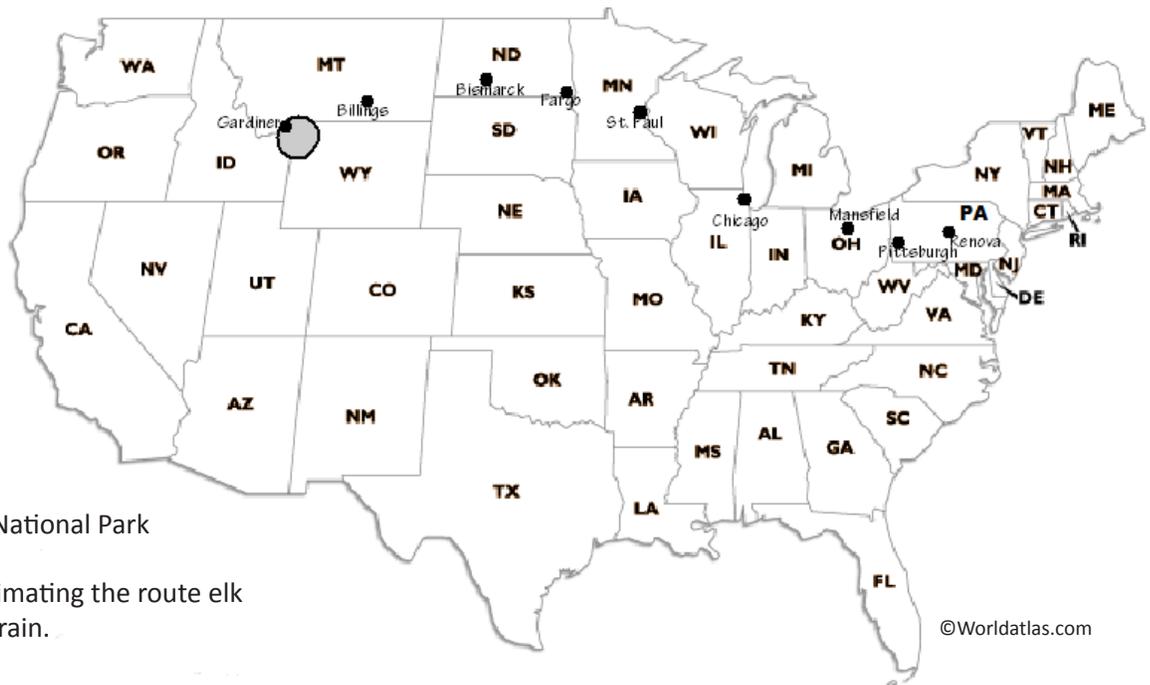
Your name: _____

Directions:

1. Read **Elk Travels** below.
2. Draw a line tracing the route the elk travelled across the United States to reach Pennsylvania.
3. Answer the questions.

Elk Travels

On January 17, 1913, 50 elk were loaded onto trains in Gardiner, Montana at the entrance to Yellowstone National Park. These Rocky Mountain elk were bound for Pennsylvania. From Gardiner they travelled to Billings, then northeast to Bismarck, North Dakota. They continued, crossing the Great Plains to Fargo, then south to St. Paul, Minnesota. They went southeast across Wisconsin and down to Chicago, Illinois. From Chicago they travelled through Indiana to Mansfield, Ohio, then south to Pittsburgh, Pennsylvania. From Pittsburgh they continued to Renova arriving on January 28, 1913. There the elk were transferred from the train to wagons and driven to their new homes in the forests of northcentral Pennsylvania.



- Yellowstone National Park
- Cities approximating the route elk travelled by train.

1. List four states the elk crossed on their way to Pennsylvania. 1) _____
2) _____ 3) _____ 4) _____
2. How many days were the elk travelling on the train? _____
3. Yellowstone National Park is located in which three states?
1) _____ 2) _____ 3) _____

Help this calf. This newborn calf has to stay quiet and hide among grasses and shrubs. Color the calf and draw the grasses and shrubs to help her hide.





A Time for Elk

Objectives: Students will be able to:

- trace the history of elk in Pennsylvania
- explain the reasons for the rise and decline in elk populations in our state
- describe current management practices used in Pennsylvania to conserve elk

Subjects: Environment and Ecology, Science, Social Studies

Suggested Grades: 5-12

Vocabulary: reintroduction, extirpate

Materials: History of Pennsylvania Elk Cards; highlighters; colored markers; large, long roll of paper (approximately 20 feet long); approximately 200 4-by-6 index cards and 50 3-by-5 index cards; tape

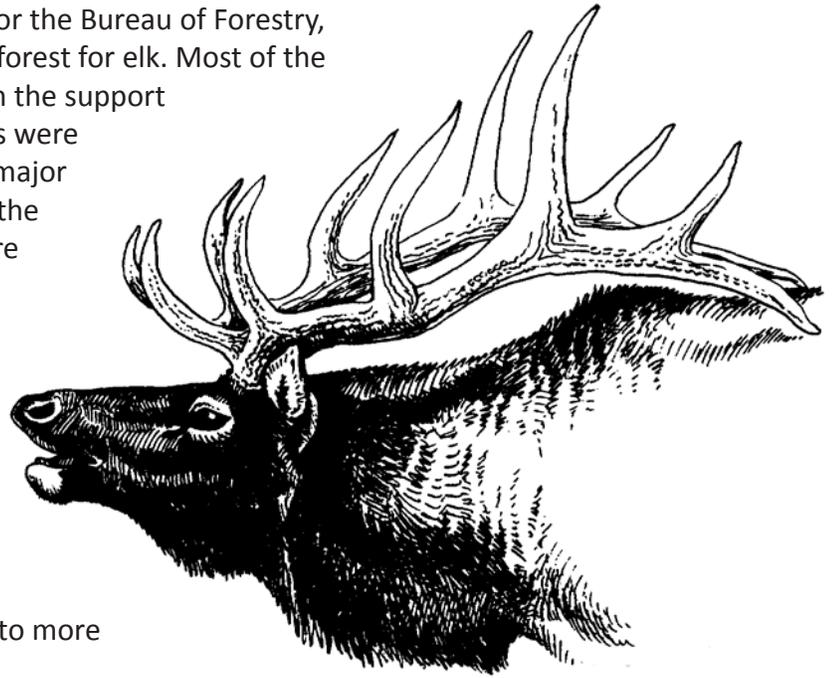


Background: Eastern elk (*Cervus elaphus canadensis*) once ranged throughout Pennsylvania, but rapid settlement and use by early immigrants decimated the state's herds and caused the remaining elk to retreat. By 1867, elk had been completely eliminated from Pennsylvania. Unregulated subsistence hunting, market hunting, and habitat loss were the biggest factors leading to the elk's demise.

In an effort to re-establish an elk population, the Pennsylvania Game Commission participated in a Rocky Mountain elk (*Cervus elaphus nelsoni*) trap and transfer program between 1913 and 1926. During this 14-year period, 177 elk from Yellowstone National Park, South Dakota, and a private reserve in Monroe County, Pennsylvania were introduced to central and northeastern Pennsylvania. Only the northcentral releases were successful. An elk hunting season was held in 1923. Hunting seasons were curtailed in 1932 due to dwindling elk numbers. From the 1940s to 1960s the elk population began to slowly increase.

The years 1972 thru 1975 were bad for elk. Many elk became infected with brainworm and died. Brainworm is a parasite that causes damage to the nervous system. The larvae of the brainworm infest slugs and snails that can then be taken up by elk when they feed. In 1972, an extended period of wet weather may have increased the presence of brainworm. In addition, elk continued to be shot for crop damage. Elk can do major damage to fields and crops, so it is understandable that farmers wanted the elk out of their fields. By the mid-1970s, the survival of the elk herd looked bleak.

Then, Ralph Harrison, a local citizen who worked for the Bureau of Forestry, convinced the bureau to start managing the state forest for elk. Most of the elk were located on state forest property and, with the support of his superiors and biologist Jerry Hassinger, plans were developed to manage the area for elk. This was a major turning point for the elk herd. By the early 1980s, the Game Commission and the Bureau of Forestry were working together to manage land for the elk herd and to plant food plots in the elk range. These plots provided the elk with quality grasses and forbs and helped draw them away from farms. The continued efforts of these two state agencies, along with interested citizens and conservation organizations, like the Rocky Mountain Elk Foundation, the Keystone Elk Country Alliance, and the National Wild Turkey Federation, enabled the elk population to expand to more than 830 animals by 2013.



The elk range is located on the Allegheny Plateau, a heavily forested area and transition zone between the mixed oak and hickory forest to the south and northern hardwood forests. Forest openings, natural meadows, and reclaimed strip-mined lands are primary elk foraging areas. Elk prefer to feed on forbs, legumes, and grasses, and will browse on trees and shrubs when ground vegetation is not available.

Elk Management in Pennsylvania:

The Pennsylvania Game Commission is responsible for elk management and accomplishes this task with the cooperation of the state Department of Conservation and Natural Resources' Bureau of Forestry, conservation groups, and private landowners. Public land comprises 35 percent of the present elk range and is the core of the primary elk range.

Pennsylvania's elk management goal is to maintain a self-sustaining population in a natural state for public benefit. Habitat management objectives are designed to hold elk on public lands, thus minimizing conflicts on private lands. To accomplish this, the Game Commission has fenced agricultural lands to exclude elk, public agencies have purchased additional lands, and habitat enhancements have improved public and private lands south of Saint Marys and Emporium. Habitat improvements include planting forage crops such as clover, birds-foot trefoil, timothy, oats, rye, and winter wheat to benefit elk and other wildlife. These projects have helped increase elk numbers and hold more animals on public lands.

The Game Commission, in cooperation with the Department of Conservation and Natural Resources, annually conducts a winter population survey, and also records data on elk mortality, reproduction, movements, and calf survival. Elk are classified as a big game animal. An elk season was established in 2000 and elk have been hunted each year since 2001.

Elk are highly social animals. Usually the only time cows seek isolation is during calving in May and June. Adult bulls, which generally do not associate with the cow-calf groups during spring, summer, or winter, form bachelor groups. These groups disband when the bulls start forming harems for the rut (breeding season) in September and October.

Procedure:

1. Prior to this activity, draw a line on the large sheet of paper and indicate the dates 1850 to current year in increments of 10 or 20 years. Students will be adding to this time line so leave space above and below the line for index cards.
2. Ask the students what they know about elk. Where would they go if they wanted to see elk? Do we have any elk in Pennsylvania? Are elk larger or smaller than white-tailed deer? Tell students a little about elk natural history, such as their habitat and food preferences and explain that elk have had a very mixed history in Pennsylvania. Explain to students that during this activity they will be exploring the history of elk in Pennsylvania.
3. Divide students into five groups. Assign each group one of the *History of Pennsylvania Elk Cards*. (It is recommended that each student have a copy of the assigned card.)
4. Ask students to read their cards and highlight the dates and events that they think are important in the history of elk in Pennsylvania. Discuss these within their group and select two to five key dates/events to share with the class.
5. Give each group at least six large index cards and 10 small index cards.
6. Ask students to record their chosen dates and events on the large index cards, recording one date/event per card. To save space on the time line, it is best if the students orient the cards vertically with the date highlighted at the top and the key event/activity under it. Have groups arrange their completed cards in chronological order and label the date with the event that occurred. They should use a new card for each date/event.
7. On the smaller index cards ask students to come up with a word or phrase that describes how they feel people viewed or treated elk at the time of each date/event they selected. They can also use the smaller cards to add drawings. For example, the group that has the date 1913 when elk were reintroduced might write "hopeful" or "celebrate elk". Then on another card they might draw a train with an elk.
8. Starting with the group that has *History of Pennsylvania Elk Card 1*, have students report their information to the class and then lay out their cards (along with the cards of associated words, phrases and drawings) in chronological order along the time line. Do not yet permanently attach the cards to the time line.
9. Using spare index cards, ask students to record important facts, if any, about the elk that might not be included on the time line. This could include natural information about the elk such as what an elk eats or that a male elk bugles to find a mate. Students can use index cards to add drawings or print photographs to add to the time line.
10. Once the time line is completed, ask students to examine the time line. Discuss the following questions: How did people view elk? Did all people value elk in the same way? Were there any time periods that were more beneficial to elk or any that were more detrimental?
11. Ask student to divide the time line into "eras" or "ages" and give these time periods a name based on what was happening to the elk. (For example: "The Golden Age of Elk" or "Era of the Brainworm".)

Wrap-up and class discussion: Ask students the following questions:

- What contributed to the loss of elk in Pennsylvania?
- How were elk reintroduced into the state?
- Do you think elk should have been reintroduced into the state? Why or why not?
- If you had to pick a date that was most important for Pennsylvania elk, which date would it be and why?

Evaluation

1. Student presentation can be used as an evaluation tool.
2. Have students write a short essay on the last wrap-up question.

Extensions:

1. Students can research the history of another species that was reintroduced into Pennsylvania, such as the osprey, eagle, fisher, peregrine falcon, or river otter and create a time line for that animal or add the information to the elk time line.
2. Students can investigate the importance of elk as a resource for Native Americans and early settlers.

History of Pennsylvania Elk Card 1

Eastern elk (*Cervus elaphus canadensis*) once ranged throughout Pennsylvania, but rapid settlement and use by early immigrants decimated the state's herds. By 1867, elk had been completely extirpated (gone from an area) from the state. Unregulated subsistence hunting and habitat loss were the biggest factors leading to the Pennsylvania elk's demise.

In 1895, The Pennsylvania Game Commission was created to protect the remaining wildlife and replenish the species that had dramatically low populations. In 1912, the Commission began discussions of re-introducing elk into Pennsylvania. At the time, there was an overpopulation of elk in Yellowstone National Park (in Wyoming, Idaho and Montana) and Jackson Hole Refuge (in Wyoming). The United States Department of Agriculture was examining ways to reduce the herds at these sites. Relocating animals to another state was one of the options.

In an effort to re-establish a Pennsylvania elk population, the Game Commission introduced Rocky Mountain elk (*Cervus elaphus nelsoni*) into several counties in the northeastern and northcentral sections of the state. The first shipment of 50 elk arrived in 1913. From 1913 through 1926, 177 elk were trapped and transferred from Yellowstone National Park and South Dakota and released in central and northeastern Pennsylvania. Approximately 20 eastern elk from a private reserve in Monroe County, Pennsylvania were also released into the wild.

At first, elk prospered in all the areas where they were released. As the elk population increased, these large animals started to wander into yards, roads, and farm fields. Complaints of crop damage started to grow. (Elk can cause much damage to crops such as corn). The elk that were damaging crops were either relocated or killed. An elk hunting season was established in 1923. This season was for bull elk with four or more points per antler. As pressures on the elk grew, the population began to decline and, ultimately, elk remained in only Cameron and Elk counties.

History of Pennsylvania Elk Card 2

By the 1930s the elk population was in decline. The hunting season was stopped in 1931. Elk only remained in Elk and Cameron counties.

From 1931 to 1971 very little is known about elk in Pennsylvania. In 1952, the Pennsylvania Game News (the Commission's magazine) reported that the elk population numbered in the 50s. By 1965 the population of elk in Cameron and Elk counties was estimated to be 35 animals.

In the early 1970s there was renewed interest in the elk population. A meeting was held in October, 1970 to discuss the elk population. The Pennsylvania Game Commission, legislators, farmers, hunters, economic development offices, and other government agencies participated in the meeting. Hunters and wildlife viewers enjoyed watching the elk found in the northcentral part of the state, concentrated in the area of Dents Run. Farmers continued to be concerned about the sometimes extensive damage to their crops. Although all of the issues were not resolved at this meeting, the need for a management plan became very apparent. Soon after the meeting, the Game Commission pledged to improve habitat for elk and became involved in elk research and management.

In 1970, the Pennsylvania Game Commission became actively involved in an elk study being conducted by the Pennsylvania State University. This study lasted from 1970 to 1974 and provided the first in-depth study of elk in Pennsylvania, including a formal elk census for a more accurate population count. In 1971, based on the first official elk census, the elk population numbered 65. A year later, the population declined to 38 animals. Through the Pennsylvania State University study, brainworm was identified as a large factor in this population decline as well as the continued shooting of elk due to crop damage. (Brainworm is a parasite that causes damages to the nervous system. The larvae of the brainworm infest slugs and snails that can then be taken up by the elk when they feed. In 1972, an extended period of wet weather may have increased the presence of brainworm.)

History of Pennsylvania Elk Card 3

In 1976, the Pennsylvania Game Commission increased its management efforts and partnered with the Bureau of Forestry to begin major efforts in improving habitat for elk in Elk and Cameron counties. Ralph Harrison, a local citizen who worked for the Bureau of Forestry, and biologist, Jerry Hassinger, who at first worked for the Bureau of Forestry and then later joined the Pennsylvania Game Commission, played vital roles in focusing interest on elk and elk management during this time period. This was a major turning point for the elk herd.

By the early 1980s, the Pennsylvania Game Commission and the Bureau of Forestry were working together to manage land for the elk herd and to plant food plots in the elk range. These plots provided the elk with quality grasses and forbs and helped draw the elk away from farms. Between 1973 and 1981 the elk population rebounded to 135 animals. Although biologists do not fully understand all the reasons for this amazing rebound, habitat improvement definitely helped. During the 1980s additional research occurred including using telemetry to track elk movement. By 1987, Game Commission biologists were able to report the habitat preferences and movements for bull and cow elk. This study reinforced the need to create habitat that elk would actually use — herbaceous openings (fields) in spring, summer, and fall, and clear-cuts in forested areas in the winter.

During the 1980s the elk population remained somewhat steady and by the end of the decade, the elk population ranged between 130 and 150 animals. Elk killed by poachers, for crop damage, and by cars prevented the population from further growth.

Today, the elk in Pennsylvania are flourishing. Interest and excitement about our elk continue to grow. In October, 2010 the Elk Country Visitor Center opened its doors, welcoming more than 100,000 visitors in its first year of operation.

History of Pennsylvania Elk Card 4

Research continued throughout the 1990s with studies focusing on herd reproduction, calf mortality, and herd profiles (such as cow/elk ratios and blood analysis). In addition, biologists developed and implemented a new census technique—a total aerial survey—that provided even more reliable population estimates. During the 1990s, the Rocky Mountain Elk Foundation, a non-profit organization supporting elk, contributed funds to the Game Commission to purchase lands in the Winslow Hill area of Elk County — a hot spot for elk. They also provided funds to the Commission to purchase and erect electric fences for farmers to help prevent crop damage. The Game Commission also started to develop elk viewing areas and education programs to allow the public more opportunity to view and learn about these majestic animals. All of these management strategies combined to enable the elk population to grow to more than 400 animals by 2001.

With this increase in the elk population, a new management project was initiated in 1998 — an elk trap and transfer project. Between 1998 and 2000, 63 elk were trapped and relocated to Clinton County, mostly on the Sproul State Forest. The managed elk range was expanded from 350 to 800 square miles. The trap and transfer project provided additional elk habitat and encouraged elk to stay on public lands. This helped prevent further conflicts between people and elk. By 2000, the elk population had grown large enough to sustain an elk hunt. A Pennsylvania elk hunt has continued every year since 2001.

Managing elk is the responsibility of the Pennsylvania Game Commission. However, this management continues to involve a variety of partners. The Commission works closely with the Department of Conservation and Natural Resources, especially the Bureaus of Forestry and State Parks. Conservation organizations such as the Rocky Mountain Elk Foundation and Nature Conservancy also partner with the Commission. In 2009, a new organization was formed specifically to help support the conservation of elk in Pennsylvania — the Keystone Elk Country Alliance. Working together has benefited the elk and the wildlife that share the elk's home range.

History of Pennsylvania Elk Card 5

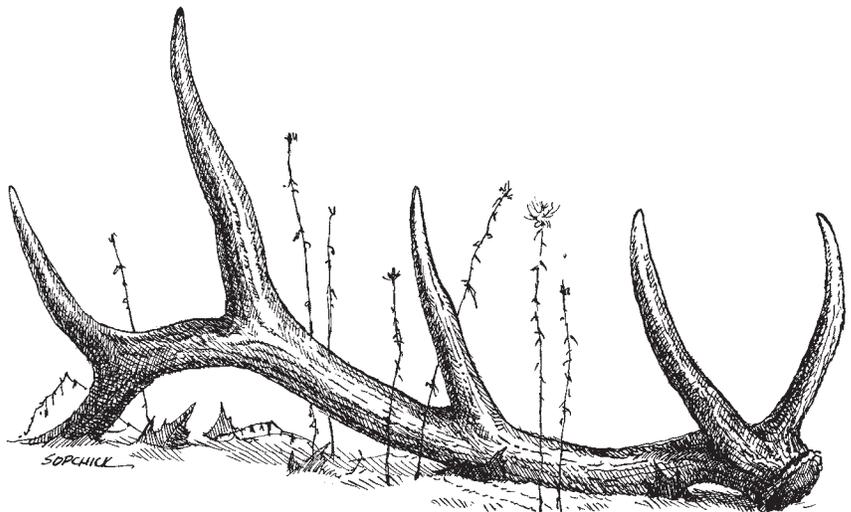
The elk population continued to grow and expand its range during the 2000s. By 2002, biologists recommended that the elk population survey be expanded to include the Quehanna Wild Area and southern Potter County — areas where elk have been sighted on a continual basis.

In order to obtain a more accurate count of elk, especially those living in the expanded elk range, a new census method was initiated. The minimum-number-alive method is a variation of the mark-recapture method and uses ground-based sightings and radio-collared elk. In 2003, this method was tested to survey elk populations for the first time. To support elk survey methods, elk continue to be fitted with radio-collars. In 2004, the aerial elk survey was discontinued and the ground-survey became the method to survey elk in Pennsylvania.

In the summer of 2005, biologists began two new research projects. The objectives of these projects were to discover recruitment (the number of calves (young elk) produced during the season) and to examine calf survival rates. Radio-collared cows (female elk) were monitored to see if they produced a calf. Once verified, the newborn calves were captured and fitted with an expandable and breakaway radio collars. Cows and calves were then monitored over the next year.

Recruitment and calf-survival studies continued. From 2005 to 2007, 65 calves were collared. Of these calves, seven died during their first year. The average weight of the calves was 42 pounds as newborns. Seventy-one percent of radio-collared cows produced calves.

All of the habitat improvement, education, research, and partnerships have been successful. In 1954, the Game News declared the reintroduction to have failed and it almost did. However, the dedication of many people and organizations as well as the work hours and funds to purchase lands and finance habitat improvements have led to the ultimate success of this elk reintroduction. As of 2014, there were at least 900 elk in Pennsylvania's healthy, thriving elk herd.





Elk Through the Seasons



Objectives: Students will be able to:

- describe the behavior of elk through the seasons
- identify and describe adaptations that help elk survive through the seasons

Suggested Grades: 5-10

Materials: colored pencils/markers, *Elk Through the Seasons Student Background Sheet*, student answer sheet, student worksheet, *Pennsylvania Elk: Celebrating 100 Years* film

Background: Elk habits, behaviors, and diets change throughout the year. The changes in diet occur with the changes in food availability. In the spring, elk eat the young grasses and plants coming up after the snow melts. During the summer, elk feast on the grasses and small plants growing in fields and meadows. They will also browse on twigs, shrubs, and young tree leaves. In the fall elk will feed on dried grasses, twigs, and eat other foods such as acorns and mushrooms. During this time the elk will eat as much as they can to gain weight to last through the winter. Food in the winter is more difficult to find, especially if the snow is deep and long lasting. Elk will paw through the snow to find grasses, but typically they end up eating twigs, bark, and needles from a variety of trees and shrubs. Elk behavior changes with the seasons as well.

Spring-Summer: In the spring and summer, bull elk live by themselves or in small groups with other bulls. During this time, bulls are growing their new antlers. Cow elk and yearlings (the young from the year before) also gather together to form groups. The winter coat is replaced by reddish-brown short, thin fur.

Spring is the time for young to be born. Calves are born in May and June. When a cow is ready to give birth, she will go off on her own and find a safe, sheltered area. The newborn calf remains hidden under shrubs or trees and stays very still. To avoid leading predators to the calf, the mother grazes away from the calf and returns to nurse the calf a few times a day. The cow is never very far from the calf and will attack a predator or try to lead a predator away from the calf. By July, the cows, calves, and yearlings form a herd called a nursery group. An old cow will lead the herd and bark out alarm calls to guide the group away from intruders.

Fall: By September, antlers are fully grown and bulls scrape the velvet (skin covering the antlers) off their antlers by rubbing their antlers against small trees and shrubs. While rubbing a tree with his antlers, a bull is also leaving behind his scent to let other elk know he is around. Autumn is mating season. The bulls start to bugle to attract cows and warn other bulls. They will also bugle to announce or accept a challenge from another male. A mature bull will move in among a group of cows and calves to form a group called a harem. Yearling males are driven from the group and are often seen wandering near a harem. During the mating season, bulls will challenge each other for the right to mate with the cows. Younger bulls usually retreat rather than fight. Bulls more equal in size will sometimes fight. Before the

fight, the bulls will bugle and thrash the ground with their antlers. As the fight begins, the bulls will lock antlers and then shove each other. The fight is a show of strength, not a battle to the death, but bulls can and do get injured by the other's antlers. Once the mating season is over, the harems disband. Bulls of all ages will gather into bachelor groups. Cows will regroup. Both bulls and cows will eat as much as they can before winter.

Winter: By winter, elk have their "winter" coat that is brownish-gray with long, coarse guard hairs over a woolly underfur to help keep them warm. During the winter the bulls will stay in a separate group from the cows and calves. They may even go to

different areas. Through the winter elk eat less and spend more time resting in areas with trees to shelter them from wind and cold. Winter can be difficult for all animals, including elk. If the winter is extremely cold and the snow lasts a very long time, an elk can use up its fat reserve and may even starve to death.

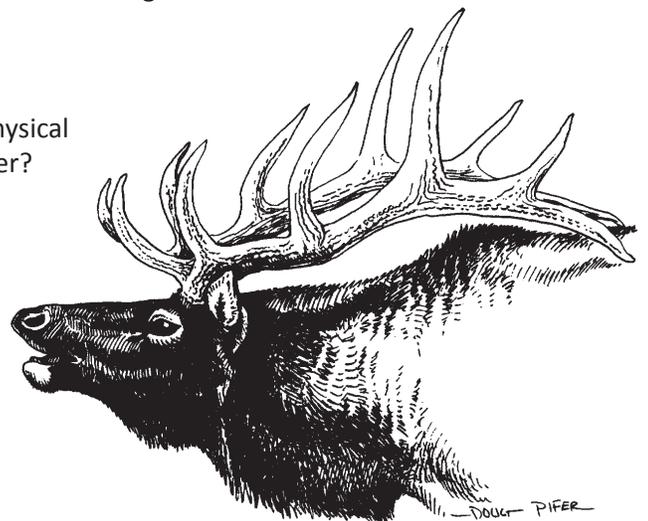
In the western United States, some elk populations migrate with the changes in seasons. Going from higher elevations in the spring and summer to lower elevations in the winter. However, other elk populations, like those in Pennsylvania, stay in the same general locations year round if they can find enough food, water, shelter, and space.

Procedure:

1. Ask students if animals behave the same way all year? Do they look the same? Do they eat the same food? Is there anytime of year when an animal might hibernate, make a nest, or grow antlers. Students will hopefully be able to give examples of how animals change in appearance or behavior throughout the year, for example, groundhogs hibernate, deer grow a heavier coat, and some birds migrate. Explain to students that they are going to read about *Elk Through the Seasons* to explore how elk adapt to survive the changing seasons.
2. Provide each student with *Elk Through the Seasons* student background and worksheet. Ask each student to read *Elk Through the Seasons* and to complete the *Elk Through the Seasons Chart 1* on the worksheet. Once completed, discuss the information on the *Elk Through the Seasons* worksheet
3. Have students focus on how elk meet their need for food through the seasons and ask them to complete the *Eating Through the Seasons Chart 2*.
4. Ask students to depict the life of a cow or bull elk through the seasons by drawing a cartoon or diagram depicting one of the story lines on the second page of the worksheet.
5. Wrap-up: Explain to students that adaptations can be physical and behavioral. Discuss various elk adaptations that help them survive. Example questions might include (depending on the grade of the students):
 - Why do elk have to change their food through the seasons?
 - Why might bulls stay separate from cows and calves?
 - How does the elk population benefit from females mating with the stronger bulls?
 - What are the benefits of forming a nursery group?
 - How do elk adapt to the cold weather and snow of winter?
 - How do you think elk would change (both in behavior and physical appearance) if Pennsylvania did not have a cold, snowy winter?

Assessment: Teacher assesses student's completion of worksheet and participation in discussions.

Extension: Have students select another wild animal and explore its life through the seasons. Present to the class in the form of a poster, Power Point, or cartoon.



Elk Through the Seasons

Your name: _____ Date: _____

Directions:

1. Read the *Elk Through the Seasons* background information.
2. Complete the *Elk Behavior Through the Seasons Chart 1*.
3. Complete the *Eating Through the Seasons Chart 2*.
4. Choose either a bull elk or a cow and draw a diagram of their behavior through a year.

Chart 1 Elk Behavior Through the Seasons: record key behaviors in the spaces provided.

Season	Bull Behavior	Cow Behavior	Calf Behavior
Winter			
Spring			
Summer			
Fall			

Chart 2 Eating Through the Seasons: Elk must change their eating habits through the seasons to survive. Place an 'X' in the boxes indicating the months elk most likely will find and eat the following foods. See examples below.

Food	Winter	Spring	Summer	Fall
Acorns				
Bark	X			
Evergreen needles				
Young grasses		X		
Grasses and other green plants				
Clovers				
Mushrooms				

Directions:

Imagine that you write and design natural history cartoons. Your assignment is to describe some key characteristics of elk behavior through the seasons. Choose a story line for either the bull or the cow elk to guide your drawings. Through drawings and words, tell the story of what elk do through the seasons. **Remember to identify the seasons.**

Story lines: Choose one

1. Cow: resting with others in the snow under a tree, then with a newborn calf, forming a nursery group, and lastly, in a harem.
2. Bull: resting under a tree in the snow in a bachelor group, then with no antlers, in velvet, and lastly, in full antlers challenging another bull.

Draw your cartoon here.



Elk Through the Seasons

Student Background Sheet

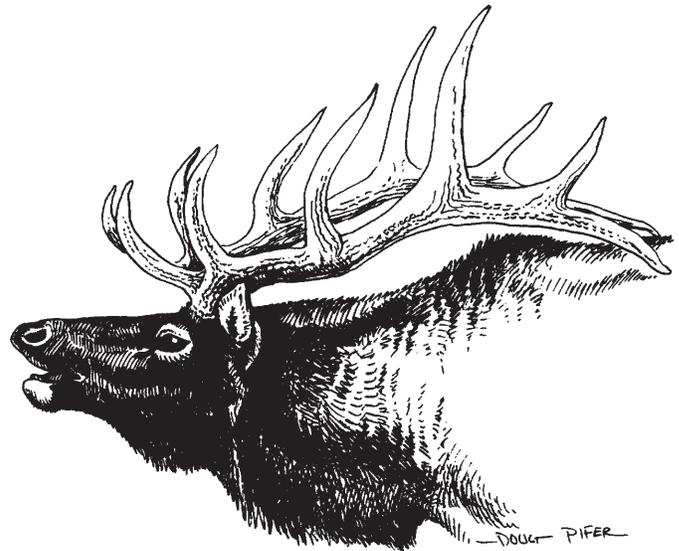
Spring and Summer: Pennsylvania elk live in forests with clearings in the northcentral mountains. In the spring, elk eat the young grasses and plants coming up after the snow melts. During the summer, elk feast on the grasses, clovers and small green plants growing in fields and meadows. They will also eat the young leaves and new growth twigs of trees and shrubs. During the spring and summer, bull elk live by themselves or in small groups with other bulls. During this time, the winter coat is replaced by reddish-brown short, thin hair and bulls grow a new set of antlers.

Cow elk and yearlings (the young from the year before) gather together to form groups. Spring is the time for young to be born. Calves are born in May and June. When a cow is ready to give birth, she will go off on her own and find a safe, sheltered place. Once born, the calf will remain hidden under shrubs, trees, or grasses and stays very still. To avoid leading predators to the calf, the mother stays away from the calf and only returns to nurse the calf a few times a day. The cow is never far from the calf and will attack a predator or try to lead a predator away from the calf.

By July, the cows, calves, and yearlings form a herd called a nursery group. An old cow will lead the herd and bark out alarm calls to guide the group away from intruders.

Fall: In the fall, elk are eating any remaining grasses and plants. They will also eat mushrooms, dried grasses, and acorns and other nuts.

By September, antlers are fully grown and bulls scrape the velvet (skin covering the antlers) off their antlers by rubbing their antlers against small trees and shrubs. While rubbing the tree with his antlers, the bull is also leaving behind his scent to let other elk know he is around. Autumn is mating season. The bulls throw their heads back and bugle to attract cows and warn other bulls. They will also bugle to announce or accept a challenge from other males. A mature bull will move



in among a group of cows and calves to form a group called a harem. Yearling males are driven from the group and are often seen wandering near a harem.

During the mating seasons, bulls will challenge each other for the right to mate with cows. Younger bulls usually retreat rather than fight. Bulls more equal in size will sometimes fight. Before the fight, the bulls will bugle and thrash the ground with their antlers. As the fight begins, the bulls will lock antlers and then shove each other. The fight is a show of strength, not a battle to the death, but bulls can and do get injured by the other's antlers. Once the mating season is over, the harems disband. Bulls of all ages gather into bachelor groups. Cows will reform their groups. Both bulls and cows will eat as much as they can before winter.

Winter: Through the winter elk conserve energy and stay warm by spending most of their time resting in areas with trees to shelter them from the wind and cold. The short, thin coat is replaced by the winter coat of brown-gray long, coarse hair over a woolly fur. Bulls stay in a separate group from the cows and calves. They may even go to different areas to find shelter and rest. Food is difficult to find so elk must survive on less. Elk will paw through snow to find grasses, but typically eat twigs, bark and needles from a variety of trees and shrubs. Winters in Pennsylvania are usually difficult for all animals, including elk. If the winter is extremely cold and the snow lasts a very long time, an elk can use up its fat reserve and can even starve to death.



How Many Elk Can Live Here?

Objectives: Students will be able to:

- describe the food needs of elk
- identify a limiting factor

Subjects: Math, Science, Physical Education

Suggested Grades: 4-12

Materials: Large playing field or gymnasium (about 50 x 50 feet); yellow, green and brown construction paper (three to four sheets of each color) or poker chips; one black marker; chalk or rope; one envelope per student

Background: Elk, like all wildlife, have basic needs that their habitat must meet. These needs include food, water, shelter, and space. These habitat components are all important, and must be available in an arrangement suitable to meet the animals' needs. When one of these components is unavailable, or when not enough of it is available, then it is known as a *limiting factor* because it limits the ability of the particular species to survive in the habitat. (Disease, predation, pollution, car accidents, hunting, or poaching may also be limiting factors.)

The average adult elk weighs more than 500 pounds and eats about 15 pounds of food per day in the spring, summer, and fall, and about 10 pounds per day in the winter. These amounts, and the kinds of plants elk eat, vary with different areas of the country. In spring and summer, elk eat a mixture of grasses and forbs (small flowering plants). In winter, elk eat more browse because that is all that might be available. Because browse is difficult to chew, an elk eats fewer pounds of food in the winter than other times of the year.

This activity is based on the following figures, which represent the yearly average of a typical adult elk's diet in Idaho. The components of an actual elk's diet will vary depending on the size of the animal and the area, season, and year.

Grasses	2,000 pounds	=	40%
Forbs	1,250 pounds	=	25%
Browse	1,750 pounds	=	35%
TOTAL	5,000 pounds	=	100%

Color	Food	Label	Number of Cards per Approximate Number of Students				
			10 students	20 students	30 students	40 students	50 students
Yellow	Grasses	G-2000	5	10	15	20	25
Yellow	Grasses	G-1000	15	30	45	60	75
Green	Forbs	F-1250	5	10	15	20	25
Green	Forbs	F-625	15	30	45	60	75
Brown	Browse	B-1750	5	10	15	20	25
Brown	Browse	B-875	15	30	45	60	75

Procedure:

1. Before doing this activity, cut the construction paper into 2-by-2-inch cards. For a class of 30 students make 60 cards of each of the three colors. Mark the cards as follows (the number after each letter tells how many pounds of that kind of food the card represents):
 - Yellow (Grasses) - Mark 15 cards **G-2000** and 45 cards **G-1000**
 - Green (Forbs) - Mark 15 cards **F-1250** and 45 cards **F-625**
 - Brown (Browse) - Mark 15 cards **B-1750** and 45 cards **B-875**
2. Scatter the cards in the playing field. Using chalk or a rope, mark one side of the area as the starting line.
3. Have each student write his or her name on an envelope. This will represent the animals' stomachs.
4. Have students line up on the starting line, leaving their envelopes between their feet on the ground. Explain that they are elk looking for food and that their envelopes represent their stomachs. Do not tell them what the colors, letters, and numbers on the cards represent. Tell them only that the cards represent various kinds of elk food. Since elk eat different kinds of food at different times of the year, students should gather different colored squares to represent a variety of food.
5. Explain to students that they must **walk** because elk do not run down their food, they graze for it. When students find a colored square, they should pick it up and return it to their envelope (their stomach) before picking up another colored square. (Elk actually eat food as they find it, returning to the envelope mimics grazing).
6. After students understand what they are to do, have them begin gathering food. When all the colored squares have been picked up, the food gathering is over. Ask students to pick up their envelopes containing the food they gathered and return to class.
7. In class, explain what the colors and numbers represent. Ask each student to add up the total pounds of food he or she gathered and write the amount on his or her envelope.
8. Tell the students each elk needs 5,000 pounds a year to survive. Which elk survived? Is there enough to feed all the elk?
9. Ask each student to tally how many pounds of each of the three categories of food he or she gathered and to convert these numbers into percentages of the total poundage of food he or she gathered.
10. Explain the typical percentages and seasonal diets described in the background information for this activity. Ask students to think about how healthy their elk would be and whether they would have survived the winter on the diet they were able to collect.
11. Help students calculate a class total for all the pound of food they gathered. Divide the total by the 5,000 pounds needed by an individual elk to survive in a year, then discuss the following:
 - How many elk could the habitat support?
 - Why did only that number survive in the activity?
 - What percentage of the elk survived?
 - What percentage would have survived had the food been evenly divided?



Assessment: What are some of the limiting factors that may affect the survival of elk?

Extension: Have an "injured" elk that must hop on one leg, or blindfold an elk. Have a pregnant cow, which needs twice as much food.



Let's Ruminare

Objectives: Students will describe an elk's digestive system and its adaptations to help an elk survive in its environment.

Method: Students explore the digestive system of an elk by placing the organs of the digestive system in order and completing the student worksheet.

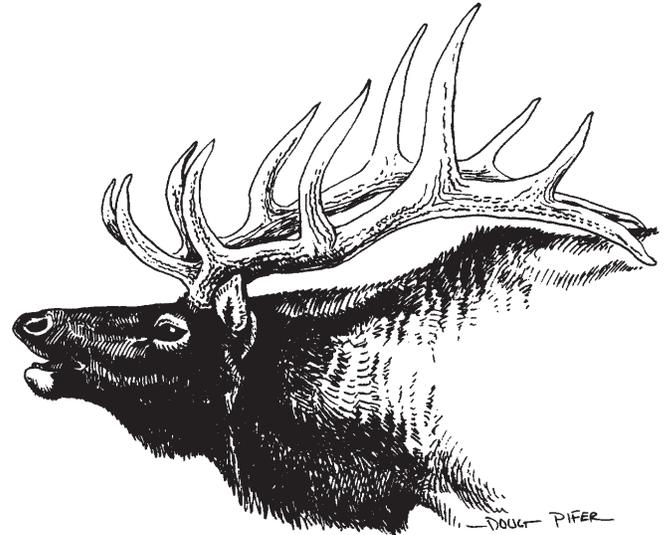
Subjects: Science, Environment, and Ecology

Suggested Grades: 4-8

Skills: description, observation, systems-thinking

Duration: one 30-minute class period

Vocabulary: digestive tract, cud, ruminant



Materials: diagram of elk with digestive system, student worksheet, *Let's Ruminare Student Sheet*, *Let's Ruminare Student Cards*

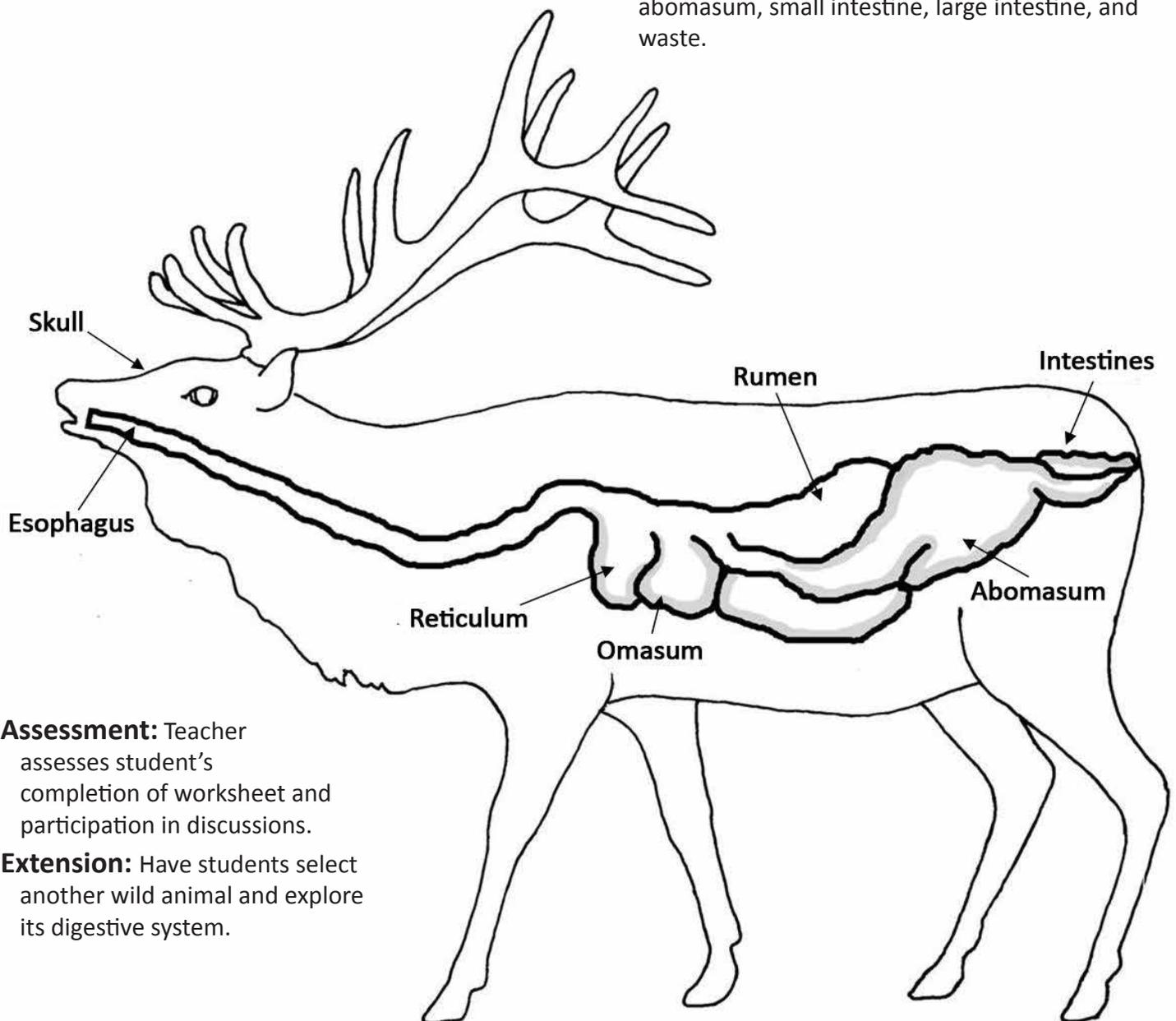
Background: Elk are members of the deer or *Cervidae* family which includes moose, caribou, white-tailed deer, and mule deer. These animals also belong to a group called the ungulates (hoofed mammals). The members of the deer family all have an even number of toes on their hooves. They are also all herbivores (plant eaters). Elk are similar to domestic cattle in that they are primarily grazers, which feed mostly on grasses and forbs (low-growing short-stemmed plants) as well as shrubs and trees (including the bark and twigs). The elk has a multi-chambered stomach that helps it to digest some of the tough grasses, forbs, twigs, and bark. This stomach is identical to those of cows, sheep, and goats. The four-chambered stomach is called a ruminant stomach and it enables the elk to digest tough plant materials and get the most nutritional value out of them.

Being a ruminant animal really helps the elk out in a number of ways. The four-chambered stomach breaks down tough plant fibers and turn them into a nutritious meal for the elk. Being a ruminant also allows the elk to eat a large quantity of plant materials at one time and then, when the elk stops feeding, to slowly regurgitate or cough back up small quantities of the feed and re-chew it to break it down even further. This process of re-chewing its feed is called chewing its cud. The cud is the small portion of feed that gets sent back up from the first chamber of the stomach called the rumen into the mouth and then re-chewed and swallowed again. The elk chews its cud several times a day when it feels safe and is usually in a resting state. This ability to eat a lot at one time and then go and rest enables the elk to keep a better eye out for predators and not have to be out in the open feeding all day.

Procedure: Part 1

1. Explain to students that elk are ruminants, which means they have a multi-chambered stomach (four chambers or compartments) and chew their cud. Cud is a food portion or *bolus* that is regurgitated, re-chewed, and then swallowed again.
2. Divide students into small groups. Pass out the *Let's Ruminare Student Sheet* to students. Allow time for students to read the sheet. Have students highlight information they think is important.
3. Once completed, provide each group with the *Let's Ruminare Student Cards*. Have students pass out the cards until each person in their group has a card. There are 12 cards, so some of the students in each group may have two or more cards to read. Ask students to place the cards in an order that represents the elk digestive system. The student with the food card should start first. Students with the next card should do the same until all cards have been read in the correct order.

****Note:** The order for this activity is food, skull, esophagus, rumen, VFAs, reticulum, cud, omasum, abomasum, small intestine, large intestine, and waste.



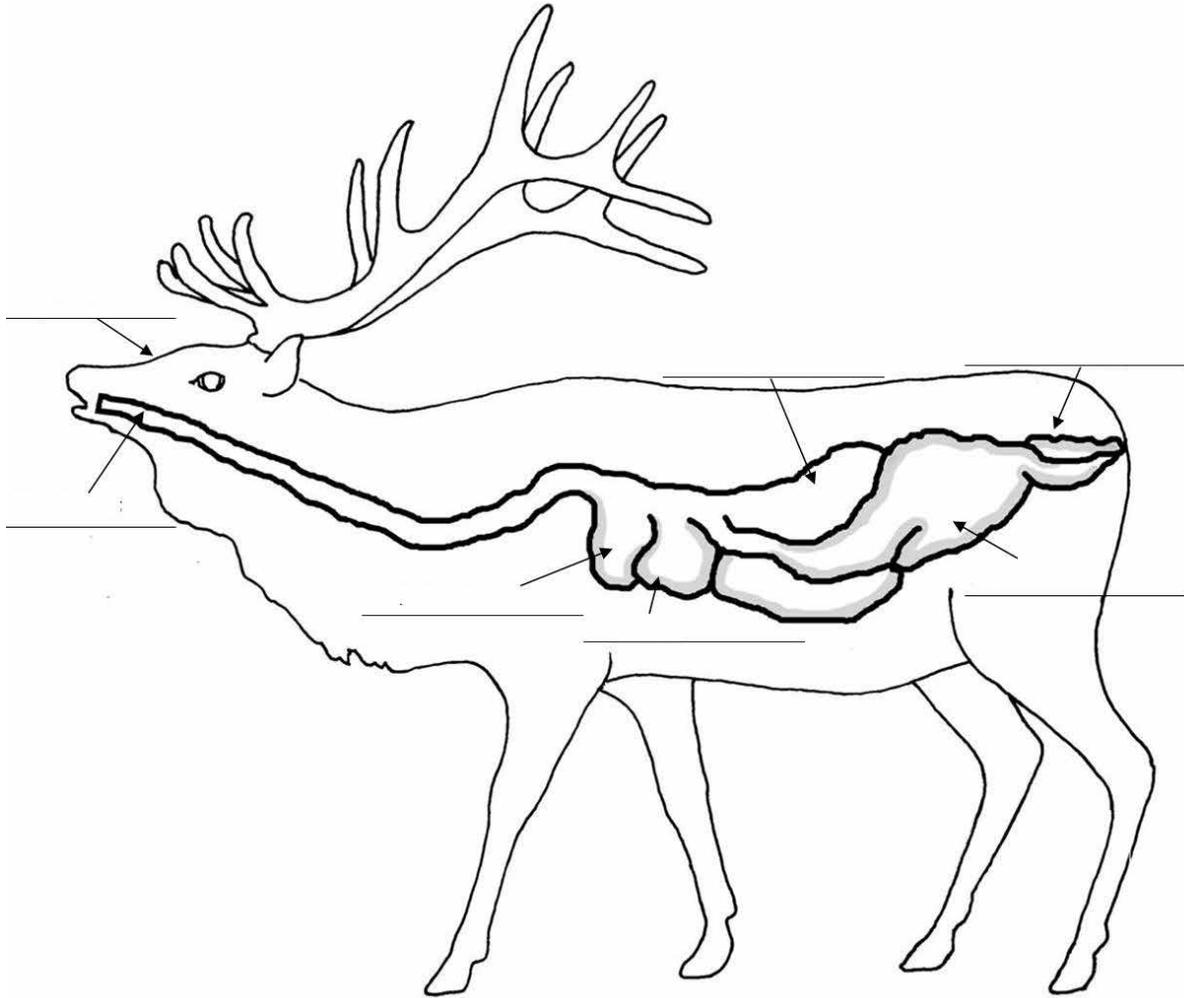
Assessment: Teacher assesses student's completion of worksheet and participation in discussions.

Extension: Have students select another wild animal and explore its digestive system.

Let's Ruminant

Your name: _____ Date: _____

1. Using the elk digestive diagram below, label the following parts of the elk digestive system. Label the skull, omasum, esophagus, reticulum, abomasum, intestines, rumen.



2. Why is it important for elk and other ruminants to chew their cud?
3. Elk are able to eat large quantities of food at one time and digest this food later. How does this adaptation help elk survive in their environment?



Let's Ruminant Student Sheet

Food	Elk eat a variety of plants in their diet. They chew on many types of grasses, forbs (which are low growing soft-stemmed shrubs), and the twigs, buds, and bark of many trees including aspen, birch, red maple, cherry, oak, and witch hazel.
Skull	On the bottom front of an elk's jaw are incisor teeth for biting off grasses and forbs. Molars for grinding food are on the top and bottom in the back of the jaw. Elk also have two canine teeth on the top of the jaw close to the front. These canines, also called tusks, ivories, whistlers, or buglers have no real purpose today but were once longer and served as a protection function millions of years ago. The number of teeth and wear of the teeth in an elk's mouth help to indicate a particular elk's age.
Esophagus	The esophagus is a long hollow tube that carries food from the mouth to the stomach.
Ruminant	A ruminant is an animal with a multi-chambered stomach. The elk has a four-chambered stomach. The elk has the ability to eat large amounts of food at one time without fully digesting this food. When an elk is grazing on grass or twigs it eats as much as it can while also keeping alert for danger and predators. Later, when the elk finds a place to lie down in safety, it will regurgitate its food and spend time digesting it.
Rumen	The rumen is the first chamber of the stomach. It is like a large storage compartment that stirs and partially digests the food. Microorganisms that live in this part of the stomach act on the food to produce something called Volatile Fatty Acids or VFAs.
VFAs	The Volatile Fatty Acids are absorbed through the wall of the rumen via finger-like projections called villi, and yield energy for the elk. This is the only nutrient absorbed from the rumen. Food is passed from this chamber to the second chamber called the reticulum.
Reticulum*	The reticulum or second chamber is also called the honeycomb because of its shape and texture. The reticulum keeps foreign material like rocks and larger sticks from entering the rest of the stomach. Food is partially broken down in the reticulum and then regurgitated back up to the mouth where it is further chewed and broken down into smaller pieces. <i>* Domestic cattle are fed large magnets that are swallowed and end up in the reticulum where they trap metal objects like bolts, wire, and small tools that might accidentally end up in the feed and be swallowed by a cow. This practice keeps these objects from punching through a cow's stomach and causing a situation known as hardware disease, which can be fatal.</i>
Cud	The regurgitated food on its way up and down the esophagus is known as bolus or cud. Seeing a ruminant chewing its cud is a sign that it is normal. When a ruminant does not chew its cud, there is usually something wrong internally.
Omasum	The omasum is the third chamber of the stomach and is also known as manyplies. The manyplies refers to the many folds of tissue that make up this chamber. The omasum grinds the food and squeezes water out of it.
Abomasum	The abomasum is the fourth chamber and is also called the true stomach. It has digestive juices like acids and enzymes that further break down food into usable nutrients for elk.
Small Intestine	After food leaves the stomach, it travels through the small intestine where most of the nutrients are absorbed.
Large Intestine	The large intestine absorbs most of the water that is still in the food.
Waste	The unused food is then passed through the anus as waste.



Let's Ruminant Student Cards: Cut and fold over so description is on the back.

Food

Elk eat a variety of plants in their diet. They chew on many types of grasses, forbs (which are low growing soft-stemmed shrubs), and the twigs, buds, and bark of many trees including aspen, birch, red maple, cherry, oak, and witch hazel.

Skull

On the bottom front of an elk's jaw are incisor teeth for biting off grasses and forbs. Molars for grinding food are on the top and bottom in the back of the jaw. Elk also have two canine teeth on the top of the jaw close to the front. These canines, also called tusks, ivories, whistlers, or buglers have no real purpose today but were once longer and served as a protection function millions of years ago. The number of teeth and wear of the teeth in an elk's mouth help to indicate a particular elk's age.

Esophagus

The esophagus is a long, hollow tube that carries food from the mouth to the stomach.

Rumen

The rumen is the first chamber of the stomach. It is like a large storage compartment that stirs and partially digests the food. Microorganisms that live in this part of the stomach act on the food to produce something called Volatile Fatty Acids or VFAs.

VFAs

The Volatile Fatty Acids are absorbed through the wall of the rumen via finger-like projections called villi, and yield energy for the elk. This is the only nutrient absorbed from the rumen. Food is passed from the rumen chamber to the second chamber called the reticulum.

Reticulum

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The regurgitated food on its way up and down the esophagus is known as bolus or cud. Seeing a ruminant chewing its cud is a sign that it is normal. When a ruminant does not chew its cud, there is usually something wrong internally.

Omasum

The omasum is the third chamber of the stomach and is also known as manyplies. The manyplies refers to the many folds of tissue that make up this chamber. The omasum grinds the food and squeezes water out of it.

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The abomasum is the fourth chamber and is also called the true stomach. It has digestive juices like acids and enzymes that further break down food into usable nutrients for the elk.

Small Intestine

After food leaves the stomach, it travels through the small intestine where most of the nutrients are absorbed.

Large Intestine

The large intestine absorbs most of the water that is still in the food.

Waste

The unused food is then passed through the anus as waste.



Elk

Before settlers arrived in Pennsylvania, elk (*Cervus elaphus*) lived throughout the state, with concentrations in the northcentral and Pocono mountains. By 1867, the species had been extirpated. Ultimately it became extinct throughout its range, which included New York and New England.

Today, elk inhabit portions of Elk, Cameron, Clinton, Clearfield and Potter counties. The animals are descendants of elk released by the Pennsylvania Game Commission between 1913 and 1926.

The word “elk” comes from the German “elch,” the name for the European moose. The elk is also called “wapiti,” an Indian word meaning “white deer,” probably referring to animal’s sun-bleached spring coat or its light-colored rump.

The elk is the second-largest member of the deer family in North America; only the moose is larger. Many Western states, several Canadian provinces, and a few eastern states – including Pennsylvania – support thriving elk populations, and in those places the elk is a popular big-game animal.

Biology

Elk are much larger and heavier than white-tailed deer. A mature male elk, called a bull, stands 50 to 60 inches at the shoulder and weighs 600 to 1,000 pounds. Females, or cows, weigh 500 to 600 pounds.

Elk have a summer and a winter coat. The summer pelage is short, thin and colored reddish brown. In winter, long, coarse guard hairs overlay woolly underfur. At this time, an elk’s body is tawny brown or brownish gray, with the neck, chest and legs dark brown, and the underparts darker than the back. Buffy or whitish fur covers the rump and the 4- to 5-inch tail. Sexes are colored essentially alike. Young elk, called calves, are dappled with spots.

Strong muscular animals, elk can run 30 mph for short distances, and can trot for miles. They jump well and swim readily. Their senses of smell and hearing are keen.

Cow elk often bark and grunt to communicate with their calves, and calves make a sharp squealing sound. The best known elk call, however, is the bull’s bugling. Bugling occurs primarily during the mating season. It consists of a low bellow that ascends to a high note, which is held until the animal runs out of breath, followed by guttural grunts. Cows also bugle at times.

Each year, a bull grows large branching antlers that sweep up and back from the head. In May, two bumps start to swell on the animal’s skull, pushing up about half an inch per day. The growing antlers are covered with a soft skin called velvet. This covering contains blood vessels which supply growth materials to the enlarging antlers.

Yearlings usually grow single spikes 10 to 24 inches in length, while older bulls may produce racks with main beams 4 to 5 feet in length and having five to nine tines to a side. An elk with a total of 12 antler points is called a “royal” bull; one with 14 points is an “imperial.” Before the autumn rutting season, the velvet dries and is shed or rubbed off. Bulls carry their antlers into late winter or early spring.

Elk primarily are grazers, eating a variety of grasses and forbs. In winter, they paw through snow to reach grass, or turn to twigs, buds and the bark of trees. Among trees and shrubs, early successional species such as aspen, willow, and flowering dogwood are important

to Pennsylvania elk. When available, acorns will make up a portion of elk's fall diet. They also browse oak, striped maple, black cherry, Juneberry and witch hazel. They drink from streams and springs and, if necessary, during the winter they get water by eating snow.

The mating season is September and October. Bulls bugle invitations to cows and challenges to other bulls. Bulls fight with each other, joining antlers and pushing and shoving. Battles rarely end in serious injury; the weaker bull usually breaks off the confrontation and trots away.

Like their western counterparts, Pennsylvania bull elk amass harems of 15 to 20 cows. Most harems are controlled by large mature bulls, although younger males, which hang around on the fringes of the groups, may also share in the breeding.

About 8½ months after she is bred, a cow in May or June will give birth to a single calf, rarely twins. A calf weighs about 30 pounds and can stand when only 20 minutes old. Within an hour, it starts to nurse, and it begins feeding on vegetation when less than a month old.

In spring and summer, bulls go off by themselves, living alone or in small groups. Cows and calves tend to remain in family units composed of a mature cow, her calf, and yearlings. Sometimes several families band together. An old cow will lead the group, barking out alarm calls and guiding the band away from intruders. In hot weather, elk bed in the shade of dense timber. They prefer not to move about in heavy wind.

Potential lifespan for an elk is more than 20 years. Pennsylvania elk die from hunting, old age, disease, vehicle collisions and poaching.

Brainworm is a parasitic nematode (*Parelaphostrongylus tenuis*) that sometimes kills Pennsylvania elk. The nematode is common in the eastern United States and



Canada. Its primary host is the white-tailed deer, which it does not normally harm. Elk pick up the parasite from snails – an intermediate host – which they inadvertently consume while grazing. The worm eventually reaches the brain and spinal column, causing death.

Habitat

Elk are attracted to forest clearcuts, revegetated strip mines, grassy meadows, open stream bottoms, and agricultural lands. Shy animals, they tend to avoid contact with humans, although they will venture into settled areas to reach favored food sources.

Pennsylvania's elk live in northcentral Pennsylvania.

The Game Commission and state Department of Conservation and Natural Resources (DCNR) manage public lands to make them more attractive to elk. The agencies create and maintain high-quality foraging areas and limit disturbance by humans. Elk habitat enhancement projects also benefit deer, wild turkeys, grouse and other wildlife.

Population

From 1913 to 1926 the Game Commission released a total of 177 elk in Blair, Cameron, Carbon, Centre, Clearfield, Clinton, Elk, Forest, Monroe and Potter counties. From 1923 to 1931, hunting seasons on antlered bulls were held, and hunters took 98 of them.

However, a decline in elk numbers, due in part to the animals being killed illegally for crop damage, closed the 1932 hunting season. And by 1936, only 14 elk remained statewide – all of them in Elk and Cameron counties, which, interestingly, is the area where the last native elk was killed.

Following a reintroduction effort, the herd slowly rebounded. In the first elk survey conducted by the Game Commission and DCNR in 1971, 65 were counted by ground and aerial spotters. By 1980, the number rose to 114. In 1992, the ground spotters were eliminated from the survey and the herd was estimated to number 183.

A three-year trap-and-transfer program launched by the Game Commission in 1998 expanded the elk's range from 350 to 800 square miles.

In 2001, survey work indicated the herd contained more than 700 elk. That same year, the Game Commission once again had an open, but highly regulated elk hunt.

Today, Pennsylvania's elk herd continues to thrive and provide hunting opportunities for a limited number of hunters each year. One-hundred years after restoration efforts began, the herd numbered about 950 animals.



Wildlife Reintroduction: Back for the Future

Objectives: Students will be able to:

- explain the reasons for the decline of specific wildlife species in Pennsylvania
- identify at least three species that were reintroduced into the state and describe their reintroduction and management practices
- describe different jobs, resources and organizations needed to reintroduce wildlife

Subjects: Environment and Ecology, Science, Social Studies, English/Language Arts

Suggested Grades: 6-12

Vocabulary: market hunting, hacking, reintroduction, extirpated, endangered, threatened, wildlife management units

Procedure: This activity is a series of questions and tasks designed to help students investigate the decline and recovery of several species in Pennsylvania. Teachers can select the questions and tasks to be assigned. All of the animals used in this activity were re-introduced into Pennsylvania.

1. Divide students into groups. Assign each group one of the animals featured on the wildlife cards.
2. Allow students time to read their wildlife card and conduct further research on the animal, if possible.
3. Assign questions for students to answer.
4. Discuss answers to the questions under each section in groups or as a class.
5. Assign tasks that you would like each student or group to complete.
6. Have students or groups present or display their completed assignment for the class.

Background: When European settlers first arrived in Pennsylvania, wetlands, rivers, and streams interspersed a land almost totally covered in forest. As more people arrived, forests were cleared for farms, towns, and cities. Timber, coal, iron, market hunting, and textile businesses boomed. By the early 1900s our waterways were polluted, land was deforested, and many wildlife species were in decline, some even extinct or extirpated from the state. Around this time many current conservation agencies and organizations came into being — the Pennsylvania Game Commission was established in 1895. During the 20th century environmental problems still occurred, but citizens, government agencies, conservation groups, businesses, and industries also began to work together to clean up the environment. Habitat loss still remains a huge concern for wildlife, but many of our forests have returned and our waterways are recovering. For more information about wildlife and conservation history, visit the Game Commission's website at www.pgc.state.pa.us.



Part 1 Species History

Questions for Student Groups:

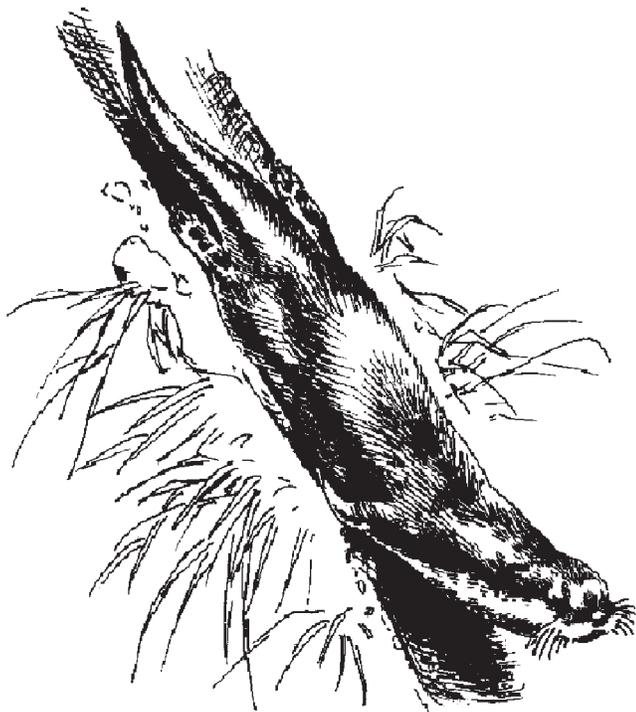
1. What was the historic range/distribution of the animal (where it could be found) in Pennsylvania?
2. What is the animal's preferred habitat?
3. What contributed to the loss of the animal in Pennsylvania?
4. How did the loss of the animal affect people and the environment?

Questions for Class Discussion:

1. Compare and contrast the factors that led to the decline of the species.
2. Were there one or two major factors that led to the decline of several species?
3. How did the loss of species affect people and the environment?

Tasks

1. Students develop a mini time line depicting the history of their animal in Pennsylvania.
2. Students create a poster, pamphlet, or Power Point portraying the animal's physical description, habitat, preferred food, adaptations, and population decline and recovery in Pennsylvania.



Part 2 Reintroduction and Management

Questions for Student Groups:

1. What changes had to occur before the animal could be reintroduced?
2. How was the animal reintroduced?
3. What information do you think wildlife biologists would need to gather before starting a reintroduction project?
4. What jobs had to be done during the reintroduction project? Who would probably perform these jobs?
5. How are biologists currently managing for this species?

Questions for Class Discussion:

1. What were significant factors that led to the possibility of reintroducing these animals?
2. What methods were used to reintroduce these animals?
3. Have the reintroductions been successful for all of the animals?
4. Given the time and cost of reintroductions, is reintroducing an animal back into its native area important for people and the environment?

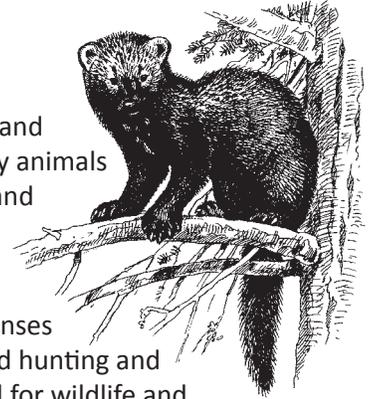
Tasks

1. As a class, construct a chart summarizing the following information: reintroduced animal, reason for loss, reintroduction method, and why reintroduction was able to occur. Compare and contrast among the species.
2. In groups, have students construct a personnel chart that includes all the job categories that might be needed in the reintroduction of their animals. Describe the role of each position and indicate possible employers.

Extension: Identify other rare or extirpated wildlife species of Pennsylvania. Develop a plan to reintroduce one of these species. How would you determine if reintroduction is feasible? What reintroduction method would you use? How would you justify this reintroduction? How would you involve Pennsylvania citizens and resolve concerns?

Fishers *Martes pennanti*

Fishers are large members of the weasel family that regularly prey on porcupines. Although fishers spend a lot of time foraging on the ground, they are agile climbers and will pursue their prey in the treetops. Before Pennsylvania was settled, these solitary animals lived throughout the state's forests. Unrestricted trapping, massive timber cutting, and development during the 1800s decimated the population. By 1921, fishers were extirpated from the state.



Throughout the 1900s, forestry and land-use practices changed, allowing large expanses of forest to regrow. The Pennsylvania Game Commission, founded in 1895, regulated hunting and trapping. By the 1980s, large expanses of public forested lands were being managed for wildlife and several surrounding states were successful in reintroducing fishers. The stage was set for fisher reintroduction in Pennsylvania.

From 1994 to 1998, 189 fishers were live-trapped in New York and New Hampshire then released in the northern forests of Pennsylvania. The U.S. Forest Service, Wild Resource Conservation Fund, and Frostburg State University worked with the Game Commission and Pennsylvania State University on this cooperative project. In 2005, there were more than 300 sightings of fishers. By 2009 there were more than 600 fisher sightings and more than 1,000 captured and released by trappers.

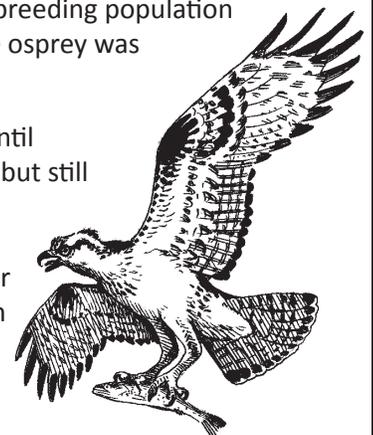
Today our fisher population appears to be rapidly growing and expanding into southwestern forests. Populations are monitored through a variety of methods including direct observation, remotely-viewed baiting stations, accidental capture, and highway mortality records. By 2010 the population was large enough to allow a limited trapping season in several wildlife management areas in the state.

Osprey *Pandion haliaetus*

Ospreys can be found on every continent except Antarctica. These large birds of prey feed almost exclusively on fish and live by large bodies of water. Although never found in large numbers in Pennsylvania, up until the early 1900s ospreys nested along most of the state's larger rivers, lakes, and streams. Then the population began a decline, at first gradually, and then more rapidly after the 1950s. By 1979, osprey were considered extirpated from our state. This population decline was due to development along lakes, rivers, and streams, pollution of our waterways, and the use of the pesticide DDT. DDT affected reproduction in large birds of prey such as ospreys, eagles, and peregrine falcons.

Between 1980 and 1996, 265 osprey were reintroduced into Pennsylvania through a process called hacking. This project was a cooperative effort of the Pennsylvania Game Commission, East Stroudsburg State University, and several chapters of the Pennsylvania Audubon Society. For this project, young birds were obtained from the large osprey population in the Chesapeake Bay. These nestlings were hand raised, then placed in hacking towers for release. Although the osprey was never on the federal Endangered and Threatened species list, the osprey was listed as endangered in Pennsylvania. Because of the reintroduction, the breeding population in Pennsylvania increased from a single nest in 1986 to 40 nests by 1998. In 1997, the osprey was upgraded from endangered to threatened in Pennsylvania.

Osprey nests continued to be monitored by the Game Commission and its partners until 2005. Then due to budget constraints, the agency stopped actively monitoring nests, but still maintained incidental observations. In 2010, the Game Commission embarked on an intensive monitoring program to determine the number of nesting sites in the state and found more than 115 active nest sites. Although active monitoring does not occur every year, biologists have recommended that yearly monitoring be reinstated to gain a better understanding of the status of the osprey population in our state. Ospreys continue to be listed as threatened in Pennsylvania as of 2014 and can be found nesting in approximately 20 of Pennsylvania's 67 counties.



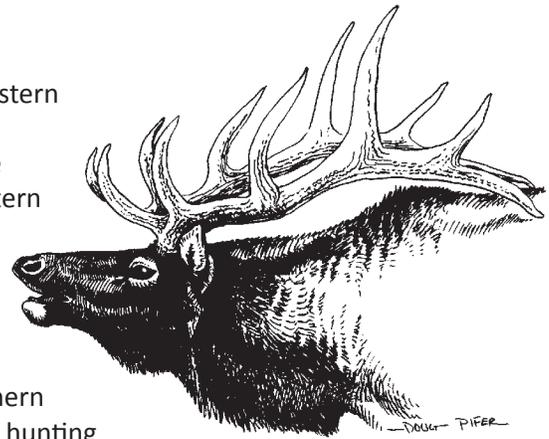
Elk *Cervus elaphus*

Elk are the largest wild mammals found in Pennsylvania today. Eastern Elk once lived in forests interspersed with clearings throughout Pennsylvania but market hunting and rapid settlement during the 1700s and 1800s decimated the elk population. By 1867, the eastern elk was extirpated from the state. In 1895, the Pennsylvania Game Commission was established to conserve wildlife and elk reintroduction discussions soon began.

From 1913 to 1926, 177 Rocky Mountain elk were transported by train from Yellowstone National Park and released in the northern mountains of Pennsylvania. At first the elk population grew and a hunting season was established. However, the population decreased dramatically and the hunting season was closed in 1931. Between the 1930s and 1976, elk were left pretty much on their own, with the population increasing and decreasing, reaching a low of 35 animals.

During the 1980s and 1990s, the Game Commission worked with the Department of Forestry and conservation organizations to actively manage elk, developing food plots and working with farmers to fence in fields. By 1989, the population was 150 and growing. In 1999, the Game Commission embarked on a trap and transfer project to move elk to additional public lands where there was room for the population to expand. By 2000, the elk population was more than 500 and large enough to, once again, establish a limited elk hunting season.

Managing elk is a cooperative, ongoing venture. The Game Commission works with the Department of Conservation and Natural Resources, the Rocky Mountain Elk Foundation, and the Keystone Elk Country Alliance to monitor elk populations, update management practices, improve habitat, and conduct education programs. As of 2014, Pennsylvania's elk population numbers more than 900 and is stable. Hunters and wildlife enthusiasts continue to support elk and visit the Elk Visitor Center to learn more about these majestic animals.



Bald Eagle *Haliaeetus leucocephalus*

Bald Eagles are large birds of prey with a wingspan of 6 to 8 feet. When declared the national symbol in 1782, there were more than 25,000 eagles in the lower 48 states. By the mid-1900s, the population had plummeted. Through the 1960s and '70s there were only three active nest sites in Pennsylvania. This decline was partly due to land development and increasing human disturbances, but mostly due to the use of the pesticide DDT. DDT affects reproduction in eagles and other large birds of prey.

The bald eagle was listed as endangered in 1967 under the Endangered Species Preservation Act, later replaced by the Endangered Species Act of 1973. This act not only protects the listed species and their habitats, it requires a plan for species recovery. In 1972, DDT was banned from use in the U.S. These factors, as well as public interest, paved the way for eagle reintroduction.

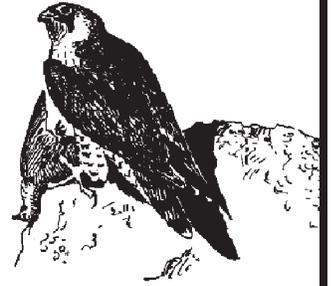
From 1983 to 1989, the Pennsylvania Game Commission reintroduced 88 eaglets. These young birds were transferred from nests in Canada and flown to Pennsylvania to be released through a process called hacking. The reintroduction worked. In 1999, there were 41 nests. These increased to 100 nests in 2007 and more than 200 nests in 2012. Eagles are now nesting throughout Pennsylvania.

The bald eagle was removed from the federal endangered species list in 2007 but remains protected by the Bald and Golden Eagle Protection Act passed in 1940 and amended in 1962. Managing for eagles continues to include monitoring the population, protecting nest sites, and conducting public education. The bald eagle was removed from Pennsylvania's endangered and threatened species lists in 2014.



Peregrine Falcon: *Falco peregrinus*

Peregrine falcons are the fastest birds in the world. They have been clocked at more than 200 miles per hour while stooping (diving through the air) to catch their prey of small birds in flight. Although never common, peregrines were known to nest on cliffs and tall city buildings at 36 sites in Pennsylvania. By the early 1960s, there were no nesting peregrines east of the Mississippi River. Although egg collecting and shooting (now illegal) did affect peregrine populations, the widespread use of the pesticide DDT was the main reason for the decline of this bird. DDT affected reproduction in large birds of prey such as ospreys, eagles, and peregrine falcons. DDT was banned from use in the U.S. in 1972.



The peregrine was federally listed as endangered in 1970 under the Endangered Species Protection Act of 1966. This was replaced by the Endangered Species Act of 1973 which protects the listed species, as well as their habitats, and requires a plan for recovery for the listed species. The peregrine was also listed as endangered in Pennsylvania.

From 1992 to 1997, the Pennsylvania Game Commission, in cooperation with other organizations, reintroduced 64 young peregrines into Pennsylvania using a process called hacking. For this project, eggs were collected from traditionally unsuccessful nesting sites on bridges along the Delaware River. Young birds and eggs were also purchased from states with higher populations. Eggs were hatched and young were raised in captivity by a mature female peregrine until ready for release.

Each year surveys are conducted to monitor nest sites and reproduction status and educational programs are done for the public and school groups. In 1999, 14 young peregrines fledged from five nest sites located in Philadelphia, Pittsburgh, and Wilkes-Barre. By 2003, there were 11 nest sites established in Pennsylvania, including a site along a cliff. By 2012, there were 32 active nest sites in the state, producing 62 young. Peregrines were removed from the federal endangered species list in August, 1999 and continue to be listed as endangered in Pennsylvania in 2014.

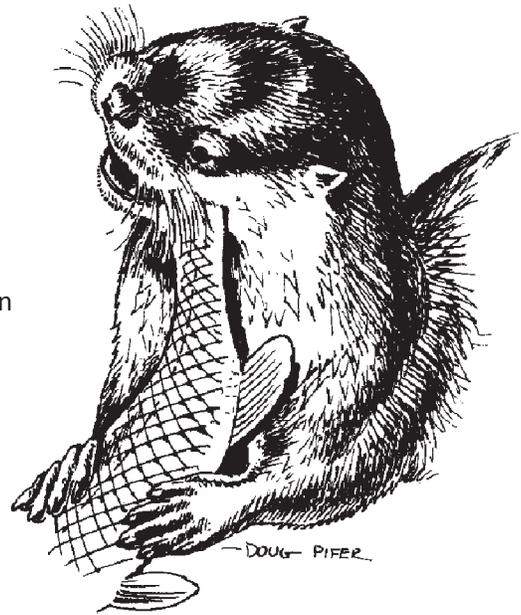
River Otters *Lutra canadensis*

River otters are mustelids with streamlined bodies designed for swimming. These playful predators were once common in streams, rivers, and lakes throughout Pennsylvania. However, water pollution, land development, and unregulated trapping in the 1700s and 1800s drastically reduced river otter populations in Pennsylvania. By the early 1900s, otters were found only in the northeastern part of the state. In 1952, river otters were protected, with no trapping permitted.

The Clean Water Act passed in 1972, along with organizations and individuals interested in conservation, paved the way to improve waterways throughout our state. As rivers improved, otter populations started to grow and otters from surrounding states began to disperse into Pennsylvania.

To boost this otter re-population, the Pennsylvania River Otter Reintroduction Project was initiated. This was a cooperative project of the Pennsylvania Game Commission, the Wild Resource Conservation Fund, Pennsylvania Trappers Association, East Stroudsburg University, Pennsylvania State University, and Frostburg University. In 1982, four river otters were reintroduced into Kettle Creek followed by additional introductions into Pine and Loyalstock creeks. By 2004, 153 otters were released into waterways in central and western Pennsylvania. Otters used in the reintroduction came from northeastern Pennsylvania, Maryland, New York, New Hampshire, Michigan, New Jersey, and Louisiana.

Determining the size of the otter population is difficult due to their secretive and nocturnal habits. Biologists monitor the otter population using several methods including a survey of Wildlife Conservation Officers (WCOs). In 1995 river otters were reported in 49% of WCO districts; by 2011 otters were reported in 88% of the districts. These reports, combined with highway mortality and accidental trapping reports, indicate that the river otter population is growing. The Game Commission is currently developing a new management plan to ensure the future of the river otter in Pennsylvania. In January 2014, the river otter continues to be protected, with no trapping season in the state.



Vocabulary:

Adaptation: An adjustment to a structure or habit that enables an individual or species to better survive in its environment. Adaptations typically take place over time and are passed down to the next generation.

Bioaccumulation: the storage and build-up of chemicals in the bodies of organisms as it goes through the food chain

Biomagnification: the accumulation of a chemical in increasingly higher does as it goes through the food chain to higher trophic levels

Carnivore: an organism that primarily eats meat

DDT: The pesticide dichlorodiphenyltrichloroethane was first introduced in the 1940s to control mosquitoes, gypsy moths, the Colorado potato beetle, and other insects that cause disease or attack valuable crops. Eagles, peregrine falcons, ospreys, and other birds of prey accumulated DDT in their bodies when they ate contaminated prey. DDT did not usually kill these large birds of prey but it did interfere with egg formation, causing the eggs to be formed with thin shells. These fragile eggs would break during incubation. Unable to reproduce, these bird populations soon declined. DDT was banned from use in the United States in 1972, however it is still being made in the U. S. and used in other countries.

Diurnal: organisms most activity during the day

Endangered: legal classification for the Endangered and Threatened Species list for a species that is very close to extinction

Extinct: species that can no longer be found living on earth

Extirpated: classification for a species that is no longer found in an area it once lived

Food chain: the transfer of energy from the sun to organisms, each organism being consumed by another. Example: Sun to green plant to rabbit to coyote.

Food web: the interlocking of many different food chains

Hacking: A reintroduction process where young birds are raised in captivity in a semi-wild state. Right before they are ready to fledge (leave the nest) they are taken to the release site (hack site) and placed in a special hacking box. This is opened when the birds are ready to fledge. Food and water are provided until the birds are ready to fend for themselves. Throughout this procedure, contact with people is kept to a minimum. Hacking is often used for large birds of prey because they tend to return to the general area where they fledged.

Herbivore: an organism that primarily eats plants

Market Hunting: This is unregulated hunting conducted by commercial hunters to supply venison, elk, and other meat to restaurants and towns. This was done in Pennsylvania prior to the establishment of the Pennsylvania Game Commission, in 1895, and the passing of wildlife protection laws.

Nocturnal: organisms most active during the night

Omnivore: an organism that eats both plant and animal matter

Pesticide: a chemical that is used to control the populations of organisms: insecticides control insects, herbicides control plants

Predator: an animal that kills and eats other animals

Reintroduction: the process of returning a species to a state or other area where it used to be found prior to being extirpated

Ruminant: an animal with a four-chambered stomach such as a deer, elk, cow, or sheep

Scavenger: an organism that usually feeds on carrion or refuse

Threatened: legal classification for the Endangered and Threatened Species list for a species whose population number is low and is close to becoming endangered

Trophic level: A group of organisms that share the same level of a food chain or web. For example producers (green plants) are one trophic level while the consumers that eat the plants are another trophic level.

Wildlife Management Units (WMU): the division of land in Pennsylvania based on land-use and ecosystems used to better manage wildlife species. Pennsylvania is divided into Wildlife Management Units.

Pennsylvania Game Commission

State Headquarters
2001 Elmerton Ave.
Harrisburg, PA 17110-9797
717-787-4250

Northwest Region

Butler, Clarion, Crawford, Erie, Forest,
Jefferson, Lawrence, Mercer, Venango &
Warren counties

P.O. Box 31
Franklin 16323
814-432-3187, 814-432-3188,
814-432-3189

Southwest Region

Allegheny, Armstrong, Beaver,
Cambria, Fayette, Greene, Indiana,
Somerset, Washington &
Westmoreland counties

4820 Route 711
Bolivar 15923-2420
724-238-9523, 724-238-9524,
724-238-5639

Northcentral Region

Cameron, Centre, Clearfield, Clinton, Elk,
Lycoming, McKean, Potter, Tioga & Union
counties

1566 South Route 44 Hwy.,
P.O. Box 5038
Jersey Shore 17740-5038
570-398-4744, 570-398-4745,
570-398-3423

Southcentral Region

Adams, Bedford, Blair, Cumberland,
Franklin, Fulton, Huntingdon, Juniata,
Mifflin, Perry, Snyder & York counties

8627 William Penn Hwy.
Huntingdon 16652
814-643-1831, 814-643-9635

Northeast Region

Bradford, Carbon, Columbia,
Lackawanna, Luzerne, Monroe, Montour,
Northumberland, Pike, Sullivan,
Susquehanna, Wayne &
Wyoming counties

3917 Memorial Highway
Dallas, 18612
570-675-1143, 570-675-1144

Southeast Region

Berks, Bucks, Chester, Dauphin,
Delaware, Lancaster, Lebanon,
Lehigh, Montgomery, Northampton,
Philadelphia & Schuylkill counties

253 Snyder Rd.
Reading 19605-9254
610-926-3136, 610-926-3137,
610-926-1966