

#### **FOCUS QUESTIONS**

• What is captive breeding and how is it used in the conservation of threatened and endangered species?

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- What are keystone species and how do they function in their environments?
- What conservation strategies can be implemented to restore a species that has been driven to near extinction in the wild?

#### OVERVIEW

"I think recovering ferrets recovers something in ourselves. Bringing a piece of the prairie puzzle that's been missing for many, many years back into place." - Kristy Bly, Black Footed Ferret Restoration Manager, World Wildlife Fund

"I just like being part of something that's bigger than myself. Something that helps us bring back a species that was almost extinct." - Weslyn Schilling, Water Research Technician, Aaniiih Nakoda College

In *America's BFF* we learn about one of North America's most endangered mammals, the black-footed ferret (BFF; *Mustela nigripes*). The black-footed ferret is the only ferret native to North America but they were once thought to be extinct. However, in 1981 a small population was discovered in Wyoming which ignited a decades-long effort to recover and restore breeding populations throughout their original range in North America's remaining prairie ecosystem. A large part of the most recent chapter of this effort is being led by wildlife biologist Kristy Bly who manages the Black Footed Ferret Restoration Project for the World Wildlife Fund. Bly coordinates with tribal, state, federal and private entities to restore habitat for and populations of, not only black-footed ferrets, but also black-tailed prairie dogs (*Cynomys ludovicianus*) and swift foxes (*Vulpes velox*).

# **KEY CONCEPTS**

- Threatened and Endangered Species: The International Union for the Conservation of Nature (IUCN) lists more than 47,000 species threatened with extinction, which includes more than one-fourth of the world's 6,500 mammal species. The black-footed ferret was first listed as endangered by the United States Fish and Wildlife Service in 1967 under the Endangered Species Preservation Act. The species was then re-listed in 1974, under the Endangered Species Act of 1973. In Canada, the ferret is functionally extinct, and so far, efforts to reintroduce it have failed.
- Extinction: Species extinction is the disappearance of a species from Earth and it is a natural process that occurs over time. However, its rate is currently accelerating due to human activities and is leading to a rapid decline in biodiversity. The black-footed ferret was once thought to be extinct in North America but was rediscovered in Wyoming in 1981; the species is still considered extinct in Canadian provinces.
- Ecosystem engineers: A species that directly or indirectly modifies, maintains, and/or creates habitat that modulates the availability of resources to other species is called an ecosystem engineer. Black-tailed prairie dogs are considered ecosystem engineers because they create burrows that are used by various other species like birds, amphibians, and reptiles, their plant foraging activities create habitat islands of early successional vegetation that attracts additional bird species and an abundance and diversity of arthropods. Their burrows also influence the hydrology of local landscapes by providing rainwater access to the water table and reducing the impact of flash flooding.
- Keystone species: Black-tailed prairie dogs are considered keystone species because the effects of their landscape alterations on other species are "outsized" relative to their abundance. While their role as a food resource for predators, including the black-footed ferret, is essential, prairie dogs also wield strong influence on other prairie habitat biodiversity through their activities as ecosystem engineers.
- Biodiversity: The burrowing and foraging activity of black-tailed prairie dogs disrupts the landscape in a way that makes it possible for other species to survive. However, because the black-tailed prairie dog is

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the primary prey of black-footed ferrets, the decline of prairie dogs to only 5% of their historical population sizes and ranges led directly to the crash of the North American ferret populations as well as the decline of many other species.

- Genetic diversity and *Ex Situ* breeding: The small population of ferrets that remained in the wild were experiencing a population bottleneck and inbreeding depression due to a lack of genetic diversity. A captive (*ex situ*) breeding program initiated in the 1980s brought genetic diversity back into the wild population allowing the ferrets to be better able to cope with environmental shifts.
- Food webs: Black-footed ferrets are near the top of a complex web of interconnected food chains. When a critical component of that food web, the black-tailed prairie dog, declined as a result of persecution, habitat loss, and disease, the ferret populations of North America nearly disappeared and many other species also experienced declines.
- Introduced diseases: Black-footed ferrets face significant challenges from diseases, particularly sylvatic plague which is caused by the bacterium *Yersinia pestis*. Sylvatic plague entered North America around 1900 by way of the fleas on rat-infested ships traveling from Europe and Asia. The disease impacts both the health of the ferrets and the health of their prairie dog prey. In *America's BFF* we learn about successful efforts to vaccinate ferrets against sylvatic plague and showering prairie dog habitats with special food pellets designed to help the prairie dogs reduce their flea load.
- Conservation biology: The practice of conservation biology recognizes the intrinsic value of the Earth's natural diversity of organisms. Conservation biology works to understand how the natural world operates, how humans affect nature, and how we can use collective scientific and cultural knowledge to conserve Earth's biological diversity.

# BACKGROUND

The black-footed ferret (*Mustela nigripes*), once widespread across the North American Great Plains, experienced a dramatic population collapse in the 20th century due to habitat loss, introduced disease, and the eradication of black-tailed prairie dogs (*Cynomys ludovicianus*), their primary prey. The black-footed ferret was first listed as endangered by the United States Fish and Wildlife Service in 1967 under the Endangered Species Preservation Act. The species was then re-listed in 1974, under the Endangered Species Act of 1973. Despite their listing, black-footed ferrets were declared extinct in the wild in 1979. However, the fate of the species changed in 1981 when a small wild population was discovered near Meeteetse, Wyoming. Conservation biologists quickly captured the remaining individuals for a captive breeding program after disease outbreaks threatened to wipe them out entirely. Just 18 ferrets formed the founding population of this intensive effort.

The U.S. Fish and Wildlife Service, in collaboration with zoos, conservation organizations, and Native American tribes, spearheaded the captive breeding and reintroduction program. The first successful reintroduction occurred in Shirley Basin, Wyoming, in 1991, followed by additional sites across the U.S., Canada, and Mexico. While challenges such as sylvatic plague and genetic bottlenecks have hobbled the conservation efforts, the program has still succeeded in establishing multiple self-sustaining populations.

In *America's BFF* we meet wildlife biologist Kristy Bly who manages the Black Footed Ferret Restoration Project for the World Wildlife Fund. The film highlights how Bly coordinates with tribal, state, federal and private entities to restore habitat for and populations of, not only black-footed ferrets, but also black-tailed prairie dogs. The conservation strategies we learn about in the film include dusting prairie dog burrows with insecticides and providing immunological food pellets for the prairie dogs to combat fleas that transmit the sylvatic plague caused by the bacterium *Yersinia pestis*. The ferrets are also part of a vaccination program to increase their immunity to the sylvatic plague disease as well as canine distemper.



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Today, the black-footed ferret is still considered endangered and, in Canada, the ferret is still functionally extinct, but it stands as a symbol of conservation success in several US states. Ongoing efforts focus on increasing genetic diversity, expanding reintroduction sites, and continuing to develop plague-resistant prairie dogs and ferrets. Although wild populations remain fragile, the species' survival is a testament to coordinated conservation science, interagency cooperation, and the resilience of one of North America's rarest mammals.

# **BIODIVERSITY THREATS**

The major threats to the Earth's biodiversity can be grouped into seven categories that spell the easily recalled acronym H.I.P.P.O.: Habitat destruction and fragmentation, Introduced species, Pollution, Population growth, and Overharvesting. Many species are threatened by a combination of these factors, but habitat loss is the greatest threat to biodiversity. In *America's BFF* we learn about the plight of the black-footed ferret and that prairie habitat loss, including the loss of the ferret's main food source, the prairie dog, has mostly led to their decline to near extinction.

#### **DISCUSSION QUESTIONS**

- [Before showing the film] Before showing the film or mentioning the film's title, have students brainstorm a list of all the mammals they can think of that live in the prairies of North America. From the list the students generate, have them discuss which species they think are threatened or endangered with extinction.
- After showing the film, have student groups construct a food web for the black-footed ferret. Once their food webs are complete, have students add to their webs the impacts that habitat loss, disease, and persecution of black-tailed prairie dogs has on the different species in their models. Finally, have student groups share their completed food webs with the class.
- The conservation of a species always requires a large and coordinated effort of several stakeholders and organizations. Have student groups create and share a concept map that shows how this phenomenon of coordination is playing out for the black-footed ferret.
- The Black Death (the bubonic plague) was a devastating human pandemic in the 14th century and it was also caused by the same bacterium, *Yersinia pestis*, that causes sylvatic plague in black-footed ferrets and black-tailed prairie dogs. As an extension activity, have students research the Black Death and investigate whether or not sylvatic plague can still cause bubonic plague in humans.
- The *ex situ* conservation of the black-footed ferret involved a complex artificial insemination program. Interested students may want to investigate how artificial insemination programs work and how an artificial insemination captive breeding project that began in 2008 used spermatozoa that had been cryo-stored (-196°C under liquid nitrogen) for 10–20 years were thawed and deposited endoscopically through the abdominal wall and directly into the uterine cornuae of two female black-footed ferrets. See the Howard et al. (2016) reference below for more information.

# **Curriculum Connections**

# NGSS

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS2.D: Social Interactions and Group Behavior
- LS4.D: Biodiversity and Humans
- HS-LS4 Biological Evolution: Unity and Diversity
  - LS4.C: Adaptation

ETS1.B: Developing Possible Solutions



# AP Biology (2021)

Big Ideas and Enduring Understandings

- Energetics (ENE)
  - ENE-4: Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.

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- Systems Interactions (SYI)
  - SYI-1: Living systems are organized in a hierarchy of structural levels that interact.
  - SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

# IB Biology (First Exam May 2025)

A. Unity and Diversity: Common ancestry has given living organisms many shared features while evolution has resulted in the rich biodiversity of life on Earth.

- A3.1 Diversity of organisms
- A4.2 Conservation of biodiversity

B. Form and Function: Adaptations are forms that correspond to function. These adaptations persist from generation to generation because they increase the chances of survival.

- B4.1 Adaptation to environment
- B4.2 Ecological niches

C. Interaction and Interdependence: Systems are based on interactions, interdependence and integration of components. Systems result in emergence of new properties at each level of biological organization.

- C3.2 Defence against disease
- C4.1 Populations and communities

D. Continuity and Change: Living things have mechanisms for maintaining equilibrium and for bringing about transformation. Environmental change is a driver of evolution by natural selection.

• D4.2 Stability and change

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# CREDIT

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