



FOCUS QUESTIONS

- What are umbrella species and what effect does their conservation have on biodiversity?
- What is habitat fragmentation and what effects does it have on wildlife?
- In what ways can we reconnect landscapes that have been fragmented by roads and highways?

OVERVIEW

"I didn't believe it at first. I was like, there was no way a mountain lion is living in the middle of Los Angeles."
"The reason this project and P-22 really captured people's imaginations around the world is it's a hopeful one. This is one we're going to win. This is one that we solve the problem." - Beth Pratt, California Regional Executive Director for the National Wildlife Federation

In *Cougar Crossing* we learn that humans aren't the only celebrities from Southern California. For a decade beginning in 2012 a Los Angeles county mountain lion named P-22 held the attention of the region and beyond. In the film we learn that after years of research and outreach by local biologists and advocates like Beth Pratt, the vital location for a wildlife crossing was located that could restitch the entire ecosystem. In the end, P-22 inspired an effort to build the world's largest wildlife crossing and helped spark a national campaign to support crossings and corridors everywhere.

KEY CONCEPTS

- **Habitat loss and fragmentation:** Over the last century an estimated 60-90% of California's coastal sage scrub habitat has been lost, making it one of the most endangered ecosystems globally. Road and highway building has also made it increasingly dangerous for animals to move among the fragments as they search for food, mates, and other resources.
- **Ecosystem ecology:** Understanding how living organisms interact with each other and their physical environment within a specific natural system is essential for reversing and restoring the Earth's degraded habitats and the essential functions they provide for wildlife.
- **Corridor ecology:** Wildlife have many reasons for needing to travel across large swaths of land but human activity has removed that ability by fragmenting large contiguous ecosystems into small isolated island habitats while also bisecting the fragments with roads and highways which create dangerous barriers to animal movement. Corridor ecology studies how and why animals move throughout the Earth's landscapes and how we can restore this essential ecosystem process.
- **Biodiversity:** Habitat fragmentation has created barriers to the movement of wildlife across landscapes which reduces the genetic diversity and health of isolated populations. Many species that find themselves in small isolated patches are unable to maintain large enough populations and species with more fragmentation are at greater risk of extinction. For example, nearly 30% of mammal species are globally at risk of extinction and habitat fragmentation is a primary driver of this risk.
- **Genetic diversity:** Habitat fragmentation negatively impacts genetic diversity within populations. This reduction in genetic diversity can lead to decreased fitness, reduced evolutionary potential, and increased risk of extinction. The isolation prevents gene flow between populations, leading to increased inbreeding and genetic drift, which further exacerbates the problem.
- **Apex predators:** Animals that are at the top of their food chains and have no natural predators of their own are known as apex predators. Mountain lions are at the top of their food web. As apex predators, mountain lions help control the populations of their prey species, such as deer, elk, and smaller mammals. By regulating prey populations, mountain lions help maintain the health and balance of their ecosystems. This regulation includes preventing overgrazing, which can impact plant diversity, and influencing the behavior of other predators.



- **Umbrella species:** An umbrella species is a species whose conservation efforts indirectly protect other species that share its habitat or ecosystem. This critical indirect effect is because umbrella species often have large home ranges, broad habitat needs, or specific habitat requirements that, when protected, also benefit other species in the same area. Umbrella species often serve as flagship species because, like the mountain lions that play a central role in *Cougar Crossing*, flagship species are usually large and charismatic, and efforts focused on saving them have a wide-ranging positive impact on other species.
- **Conservation biology:** The practice of conservation biology recognizes the intrinsic value of the Earth's natural diversity of organisms. Conservation biology explores 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. Building wildlife crossing structures like overpasses, underpasses, and canopy bridges can restore some of the natural migration patterns of animals. The ability to move safely among fragments can ensure access to resources as well as maintain gene flow among populations.

BACKGROUND

Southern California was once an uninterrupted mosaic of diverse ecosystems including coastal sage scrub, chaparral, oak woodlands, wetlands, and desert habitats. These ecosystems supported a rich variety of plant and animal species adapted to the region's Mediterranean climate, including species like the grizzly bear (*Ursus arctos*) that are now extinct in the region. The area was historically home to Indigenous communities, such as the Tongva and Chumash, who lived sustainably within these ecosystems for thousands of years. Spanish colonization in the 18th century marked the beginning of significant landscape transformation, introducing non-native species and agriculture. The ecological impact intensified with Mexican and, later, American expansion, culminating in rapid industrialization, water diversion projects, and extensive land development by the late 19th and early 20th centuries. These changes fragmented habitats, decimated native species populations, and reshaped the region's natural systems. In the 20th century Southern California began to transition into one of the most densely populated urban areas on the planet, driven by economic growth, the entertainment industry, and the allure of the climate. Massive infrastructure projects, including highways, aqueducts, and sprawling suburban developments, replaced vast swaths of natural landscape with impervious surfaces and engineered environments.

The growing expansion of roads and highways in Southern California has led to significant habitat fragmentation and has led to an increase in vehicle collisions with wildlife. Studies show that there are more than 100,000 vehicle collisions with large mammals on California's roadways each year, driving down wildlife populations and costing over \$225 million annually. Mountain lions (*Puma concolor*) are particularly vulnerable to being hit by vehicles—an average of 77 mountain lions per year are killed on California's roads—because of their large home ranges and their behavior of moving several miles per day across large landscapes. Fortunately, efforts are being made to protect California's large mammal populations, including the mountain lions, which is the focus of the *Cougar Crossing* film.

In *Cougar Crossing* we meet Beth Pratt, the California Regional Executive Director for the National Wildlife Federation. Pratt leads the #SaveLACougars campaign to build the Wallis Annenberg Wildlife Crossing, which, we learn in the film, broke ground on Earth Day in 2022. When it opens, the Wallis Annenberg Wildlife Crossing will be the largest wildlife crossing of its kind in the world and it will help save a population of mountain lions from extinction from Southern California. Wildlife crossing structures, such as overpasses and underpasses, have been scientifically tested and can be impactful solutions that reconnect fragmented habitats. For example, the Banff Wildlife Crossings Project in Canada that was completed in 1997 has reduced wildlife-vehicle collisions by over 80% compared to data from before the project was implemented. In Colorado (US) vehicle-wildlife collisions cost an average of \$80 million in property damage per year, including \$66.3 million annually in medical expenses. With 97% reduction in crashes in some locations, where there might have been an average of 100



crashes in a year, there are now only three. Given their proven success in saving lives, preserving biodiversity, and reducing long-term costs, wildlife crossing structures like the Wallis Annenberg Wildlife Crossing will hopefully become a common feature throughout the World's road systems.

In ***Cougar Crossing*** we also meet National Park Service Wildlife Biologist, Jeff Sikich, who explains that beyond promoting both ecological and public safety, wildlife crossings play a crucial role in maintaining genetic diversity within animal populations. Fragmented habitats often isolate groups, leading to inbreeding and weakened species resilience. For example, highways across western Canada and the northern United States have been shown to be genetically isolating black and grizzly bear populations but the installment of wildlife crossing structures have promoted the movement of individual bears necessary to maintain genetically healthy populations. The fragmentation of Southern California habitats has also begun to cause inbreeding a loss of genetic diversity in the mountain lion population and the Wallis Annenberg Wildlife Crossing will likely reverse this trend. The most important character in ***Cougar Crossing*** is P-22, a Los Angeles County mountain lion that held the attention of the region and beyond. In the film we learn that after years of research and outreach by local biologists and advocates like Beth Pratt, the vital location for the Wallis Annenberg Wildlife Crossing was located and could restitch the entire ecosystem. In the end, P-22 inspired an effort to build the world's largest wildlife crossing and helped spark a national campaign to support crossings and corridors everywhere.

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.: **H**abitat destruction and fragmentation, **I**ntroduced species, **P**ollution, **P**opulation growth, and **O**verharvesting. Many species are threatened by a combination of these factors, but habitat loss is the greatest threat to biodiversity. In ***Cougar Crossing*** we learn that explosive urbanization and human population growth, coupled with road and highway expansion has led to extensive habitat loss and fragmentation and has created barriers to movement for animals, including apex predators like mountain lions in search of food, water, and mates.

DISCUSSION QUESTIONS

- [Before showing the film] Have students list all the different types of wildlife they have seen crossing roads and highways and brainstorm what structures they know about or could construct that could make it easier and safer for wildlife to move across a landscape that is crisscrossed by roads.
- After showing the film, have students identify where in their local area they think there might be high wildlife crossing traffic and discuss what kind of crossing might work best for that location.
- In the film we briefly meet Alan Salazar, a traditional storyteller, native educator, and a tribal elder in both the Fernandeano Tataviam and Ventureño Chumash tribes of California. Salazar argues that it is our job to protect species like eagles, bears, and mountain lions. Have students discuss how storytelling like that of P-22 can have such a large impact on public policy and decision making. Ask students to also discuss what role storytelling through social media plays in their lives and what effect it may have on public decision making.
- As an extension activity for interested students, suggest going online and searching for local, state, or federal/country guidelines on building wildlife crossing structures. For example, in the United States the search term "wildlife crossing structures guidelines" will bring up the U.S. Department of Transportation Federal Highway Administration's publication "Wildlife Crossing Structure Handbook: Design and Evaluation in North America." Here, interested students can learn more about the overall wildlife-vehicle collision problem in the U.S., the needs that must be addressed, and the numerous creative solutions to plan, design, construct, monitor, and maintain effective animal crossings in places where roads are dangerous barriers.



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-LS3 Heredity: Inheritance and Variation of Traits

- LS3.A: Inheritance of Traits
- LS3.B: Variation of Traits

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.
- Information Storage and Transmission (IST)
 - IST-1: Heritable information provides for continuity of life.
- 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.

- 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.

- D3.1 Reproduction
- D3.2 Inheritance
- D3.3 Homeostasis
- D4.1 Natural selection
- D4.2 Stability and change
- D4.3 Climate change



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CREDIT

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