

## Lesson 5



Dry lake bed, Tule Valley, Utah

# Extinctions in the Present

**E**xtinguishment events are not confined to the ancient past of geologic time; most scientists believe we are currently living through a mass extinction event both in California and around the globe. This lesson addresses current and potential future extinctions in California, focusing on the role of humans in these real and hypothetical events.

In this lesson students engage in a discussion about how human activities alter the environments in which they live, and how these changes affect different types of life within these systems. In a whole-class discussion students organize their thoughts into categories of different types of human activities that can

influence extinction. Students then work in groups to read case studies of endangered species in California that have in the past experienced, or are currently experiencing, significant population changes. Next, students apply the class categories to an analysis of the factors that may have contributed to these changes.

This lesson prepares students to explore the current global Holocene Extinction Event in the culminating lesson of the unit.

### Background

Humans have dramatically changed natural systems since the Pleistocene, when they likely

## Learning Objective

Provide examples of human activities, and the resulting byproducts, that can cause rapid and/or significant changes to plant and animal life that might result in extinction.



extinction are rising rapidly, in conjunction with growing human populations. In California alone, 158 animal and 125 plant species are considered threatened or endangered by either state or federal agencies.

Scientists consider Mediterranean-type ecosystems, such as those found in California, to be among the most vulnerable to global climate change and other consequences of human activity. These experts warn that species may not be able to adapt to human-generated influences. Furthermore, significant habitat fragmentation makes it difficult for species to migrate in search of better conditions. If species cannot adapt or migrate, they risk extinction. The accumulation of all of these consequences of human activities may cause extinction rates in California to rise, a prediction many scientists have made about California's immediate future.

contributed to the extinction of numerous megafauna. Human activity influences rates of extinction in a variety of ways; conservation biologists summarize these ways with the acronym HIPPO (habitat destruction, introduced species, pollution, population growth, and overexploitation). Habitat destruction occurs when humans alter ecosystems to create communities to support their populations; to obtain resources, such as timber, coal, or minerals; and to control water systems through the construction and maintenance of dams and canals. In California, human activities have resulted in the loss of approximately 75% of original habitat. Introduced, or nonnative species influence food webs, endangering native species

as both competitors and predators. Pollution, such as the pesticide DDT, which has nearly destroyed many bird populations, alters the biochemical composition of systems, making them uninhabitable for some species. Population growth stresses ecosystems as humans use more resources and land for their growing needs. Overexploitation—illegal wildlife trade, overfishing, and other forms of overconsumption—have threatened species for thousands of years.

Combined, HIPPO factors place extraordinary stress on California's ecosystems and many species within them. Although scientists have tracked only a small percentage of species in California, data strongly supports the idea that rates of species endangerment and

## Key Vocabulary

**Endangered:** The legal status of a plant or animal species that is in danger of becoming extinct.

**Habitat destruction:** Damaging a habitat to the extent that it cannot meet the needs of organisms that live and meet their needs there.

**HIPPO:** An acronym for the phrase, "habitat destruction, introduced species, pollution, population growth, and overexploitation."

**Nonnative species:** Organisms that were not originally found in an area but were transported there through human activity.



Nimbus Dam, Folsom, California

# Toolbox



## Summary of Activities

Students think about human activities and how they can affect plant and animal life. As a class, they organize these ideas into categories. They read about endangered species in California and describe human activities that threaten the populations of these species.



## Instructional Support

See Extensions & Unit Resources, pages 30–31.

### Prerequisite Knowledge



#### Students should know:

- that energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and from organism to organism through food webs.
- that the number and types of organisms an ecosystem can support depend on the resources available and on abiotic factors, such as light and water availability, temperature, and soil composition.

### Advanced Preparation



#### Gather and prepare Materials Needed.

#### Gather and prepare A-V Materials.

#### Create a California Threatened and Endangered Species Display:

- Post the **View from Space** wall map in a location visible to all students.
- Affix **California Threatened and Endangered Species** (Information Cards #14–21) to the **View from Space** wall map with tape or thumbtacks at the appropriate location.



## Materials Needed



### A-V Equipment:

- projection system, screen

### Class Supplies:

- colored markers
- pencils or pens
- tape or thumbtacks
- writing paper

### Student Edition:

- **California Threatened and Endangered Species**, pages 14–17

### Student Workbook:

- **HIPPO in California: Endangering Species**, pages 13–15

## Audio-Visual Materials



### Information Cards:

- **California Threatened and Endangered Species**, Information Cards #14–21

### Visual Aids:

- **Human Activities and Extinction**, Visual Aid #13

## Duration



### Preparation Time

20 min.

### Instructional Time

50 min.



## Safety Notes

None

# Procedures

## Vocabulary Development

Redistribute the students' individual **Student Workbooks** and use the **Key Unit Vocabulary** to introduce new words to students as appropriate.

### Step 1

Distribute a sheet of writing paper to each student. Ask them to imagine that a group of people is moving to an area that has never had humans living there. Ask students to list on their paper things this group will do in the area to develop a community and survive. Give students two minutes to complete their lists. (*Humans will clear land to start farms, hunt animals for food, dig wells to get water, and cut down trees to build houses or use as fuel for cooking and heating.*)

Ask students to circle anything on their lists that might cause changes to the lives of the plants or animals already in the area. Give students two minutes to answer. If time permits, have a few students share their answers with the class. (*Humans may cut down trees to build houses, which takes away nesting sites for birds and other animals. Humans may clear and plow fields to farm, taking away places for animals to live.*)

### Step 2

Tell students that the items they circled on their lists would most likely result in habitat destruction. Ask students, “Did anyone circle an activity that involves ‘nonnative species’?” (*Answers will vary based on student lists.*)

Explain to students that when people farm an area, they usually grow and raise nonnative plants and animals, introducing them to an area that has not seen them before. Tell students that they will learn how the introduction of nonnative species to an area can affect the area’s native living things.

Tell students that endangered species populations have been dramatically reduced, and that scientists fear that with so few of the organisms left, the population will not be able to reproduce and will go extinct. Explain that scientists also label species that are getting close to being endangered. They call these species “threatened,” though scientists believe they will soon become endangered.

### Step 3

Project **Human Activities and Extinction** (Visual Aid #13). Explain to students that scientists use an acronym, HIPPO, to describe the different ways human activities can accelerate extinction rates. Review each of the categories on **Human Activities and Extinction**.

Ask students, “Which items from your list fit into each HIPPO category?” (*Answers will vary based on student lists.*) Record answers on the visual aid. If students do not provide a response for all categories, fill in the blank categories on the concept map. (*Note: An Answer Key and Sample Answer for **Human Activities and Extinction** are provided on page 116.*)



### Step 4

Call students' attention to the **California Threatened and Endangered Species Display** and emphasize that the organisms students will read about are all native species in California.

Organize students into eight groups. Distribute a **Student Edition** to each student. Tell them to turn to **California Threatened and Endangered Species** (Student Edition, pages 14–17) and **HIPPO in California: Endangering Species** (Student Workbook, pages 13–15).

Select one of the **California Threatened and Endangered Species** (Information Cards #14–21), for example, the California freshwater shrimp and read the story aloud to class. Use this example to model for students how to complete the chart on **HIPPO in California: Endangering Species**.

Tell students to take turns in their groups reading aloud about their assigned California threatened and endangered species. Explain that they are to work as a group to complete the chart on pages 1–2 of **HIPPO in California: Endangering Species**. Give the groups 20 minutes to complete this task.

### Step 5

When time is up, explain to students that the eight species they have just read about represent only a small sample of the endangered species in California. Write “54 extinct” and “283 endangered” on the board. Tell students that in the past 200 years, 54 species of plants and animals are known to have gone extinct in California and 283 species of plants and animals are now considered endangered in California. Ask students, “What is the main factor affecting the rate of extinction in California today?” (*Habitat destruction*)

Ask students: “What kinds of things people in California could do to prevent the threatened and endangered species from going extinct?” (*Limiting habitat alteration, creating parks and nature reserves, reducing pollution, and removing of nonnative species.*)

### Step 6

Tell students to complete the questions on page 3 of **HIPPO in California: Endangering Species**.

Gather **Student Editions**.

Collect **Student Workbooks** and use **HIPPO in California: Endangering Species** for assessment.





## Lesson Assessment

### Description

**HIPPO in California: Endangering Species** (Student Workbook, pages 13–15) assesses students' achievement of the learning objective: "Provide examples of human activities, and the resulting byproducts, that can cause rapid and/or significant changes to plant and animal life that might result in extinction." To demonstrate what they have learned, students complete a chart and provide written responses to questions.

### Suggested Scoring

An Answer Key and Sample Answers for **HIPPO in California: Endangering Species** are provided on pages 118–120. There are 34 total points possible.



**Answer Key and Sample Answers**

**HIPPO in California: Endangering Species**

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Name: \_\_\_\_\_

**Instructions:** Read each card about an endangered species in California. As a group, decide which human activities (HIPPO) have affected the rate of extinction of that species. Describe each activity under the HIPPO category it best relates to. (*Note: Not every cell must be completed.*) (1 point per cell)

Species	H (Habitat Destruction)	I (Introduced Species)	P (Pollution)	P (Population Growth)	O (Overconsumption)
<b>California freshwater shrimp</b>	<i>Habitats have been altered for timber harvesting, gravel mining, dams, and farming.</i>	<i>Introduced fish species prey on the shrimp.</i>	<i>Water pollution threatens the sensitive shrimp.</i>	<i>n/a</i>	<i>n/a</i>
<b>Salt marsh harvest mouse</b>	<i>Salt marshes have been changed to create city buildings, farms, and salt production facilities.</i>	<i>Red foxes and cats prey on these mice.</i>	<i>Treated wastewater lowers the salinity of the marsh.</i>	<i>n/a</i>	<i>n/a</i>
<b>San Joaquin antelope squirrel</b>	<i>Humans have altered their habitat for farming, mining, roads, and more.</i>	<i>n/a</i>	<i>Pesticides meant for other ground squirrels have killed the San Joaquin antelope squirrel.</i>	<i>Population in the San Joaquin Valley continues to grow.</i>	<i>n/a</i>
<b>Island fox</b>	<i>n/a</i>	<i>Introduced domestic dogs brought disease that killed foxes.</i>	<i>Pollution from DDT killed bald eagles, allowing golden eagles to move to the islands where they prey on foxes.</i>	<i>n/a</i>	<i>n/a</i>

Answer Key and Sample Answers

HIPPO in California: Endangering Species  
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Name: \_\_\_\_\_

Species	H (Habitat Destruction)	I (Introduced Species)	P (Pollution)	P (Population Growth)	O (Overconsumption)
<b>California golden trout</b>	<i>Cattle grazing destroys banks and vegetation that protect trout.</i>	<i>Humans introduced brown trout, which prey on golden trout. The brown trout and introduced rainbow trout also compete against the golden trout for food.</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Guadalupe fur seal</b>	<i>Oil drilling threatens its habitat.</i>	<i>n/a</i>	<i>Noise pollution from the space shuttle program threatens this animal.</i>	<i>n/a</i>	<i>Hunting almost caused the fur seal's extinction.</i>
<b>San Joaquin kit fox</b>	<i>Humans have destroyed the kit fox's habitat, changing it to farmland.</i>	<i>Coyotes, domestic dogs, and introduced red foxes prey on kit foxes.</i>	<i>Pesticides have polluted the fox's habitat.</i>	<i>Human population continues to grow in the San Joaquin Valley.</i>	<i>n/a</i>
<b>Grizzly bear</b>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>Human population grew with the Gold Rush and expanded into grizzly bear habitats.</i>	<i>Humans hunted all grizzly bears in California by 1922.</i>

## Answer Key and Sample Answers

### HIPPO in California: Endangering Species

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Name: \_\_\_\_\_

**Instructions:** Working independently, answer the following questions in the spaces provided.

1. Humans alter the environment in many ways and the changes they bring can affect extinction rates. Explain how each of the following activities can endanger species other than humans. (2 points each)

**Habitat destruction:** *Land areas are changed to build roads, farms, and buildings that humans use. This development means less space and habitat for other animals and plants.*

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**Introduced (nonnative) species:** *Introduced animals might eat all of the native animals. Introduced plant species might take over an area and not let the seeds of native plants sprout.*

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**Pollution:** *Pesticides (poisons) used to kill off one kind of living thing can kill off other living things, too.*

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**Population growth:** *More people need more space, water, and food to live, so people end up using more habitat or killing off animals and plants they think are dangerous or not useful.*

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**Overconsumption:** *Overhunting animals and harvesting plants too quickly or frequently prevents them from reproducing.*

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2. Which of the human activities listed above has had the greatest effect on the species extinction rates in California? (2 points)

*Habitat destruction*

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**14** California Threatened and Endangered Species  
Information Card | card 1 of 8

**California Freshwater Shrimp**

The California freshwater shrimp eats decaying plants and animals. It requires clean fresh water to survive. This shrimp lives in coastal streams in Marin, Sonoma, and Napa counties. These counties are north of San Francisco and contain cities, such as Santa Rosa, San Rafael, and Napa. Many factors have endangered this shrimp. Humans have altered habitat by mining for gravel in the shrimp's streams, harvesting timber along banks, and building farms and dams in these counties. The shrimp are also threatened by nonnative fish species that people have stocked in streams. These fish eat the shrimp. Water pollution poses another threat, since the shrimp require clear, clean water to survive.

**Status:** endangered



**California Golden Trout**

The California golden trout lives in cold, clear mountain streams and pools in Inyo National Forest in the eastern Sierra Nevada mountains. This forest sits next to the town of Mammoth Lakes. The trout feeds on insects and their larvae. People have introduced brown trout and rainbow trout into the golden trout's habitat. The golden trout cannot compete with these other fish for the same food resources. In addition, brown trout often eat golden trout. Cattle ranching has also hurt the California golden trout. When cattle graze in meadows next to streams, they often strip the streams of plants or damage the banks that help hide the golden trout from predators.

**Status:** threatened. Conservationists are working to get the trout added to the endangered species list.

**15** California Threatened and Endangered Species  
Information Card | card 2 of 8

### Grizzly Bear

The grizzly bear lived in hills and mountains throughout California. The grizzly bear eats both plants and animals, but is most famous as a fierce top predator. When large numbers of people came to California during the Gold Rush in 1849, they moved into grizzly bear habitat. People were afraid of the grizzly bear and did not want it to kill their livestock, so they began to hunt the bear. By 1922, fewer than 75 years after the discovery of gold, the last grizzly bear in California was killed. The grizzly bear still lives in North America, mostly in and around Canada, American national parks, and other and protected areas of the United States.

**Status:** threatened. Removed from the endangered species list in March 2007.



### Guadalupe Fur Seal

The Guadalupe fur seal used to live along the coast of California. In the 1800s, fur seal hunters killed most of the 30,000 seals that lived in the ocean. In fact, so many were killed that scientists thought the seals were extinct. Some seals survived, however, and were rediscovered in 1954. Several thousand seals now breed in Mexico and swim off the coast of Southern California. They eat the plentiful squid and mackerel. Noise pollution from the space shuttle program harms the seals. In addition, oil exploration in the ocean disturbs its habitat.

**Status:** threatened. Conservationists are working to get it added to the endangered species list.

**18** California Threatened and Endangered Species  
Information Card | card 5 of 8

**Island Fox**

The island fox lives on the Channel Islands off the coast of California. This fox is the largest mammal native to the Channel Islands. It is only about the size of a house cat and eats mostly insects and fruit. It faces a variety of human threats. Golden eagles, which arrived in the islands in 1999, now kill and eat island foxes. Before 1999, bald eagles lived on the islands and scared away the golden eagles. Bald eagles ate fish instead of foxes, so the foxes had no natural predators on the islands. Pollution from DDT, a pesticide humans used in farming, killed off the bald eagle population on the islands. Golden eagles arrived after the bald eagles disappeared. In addition, dogs that humans introduced to the islands have brought diseases that kill some foxes.

**Status:** endangered. The population has dropped at least 50% since the 1990s. On Santa Cruz Island the population has dropped from 1,300 in 1995 to fewer than 100 today.



**Status:** endangered. Population has declined 50–90% in the past 150 years.

The salt marsh harvest mouse lives in the marshes of the San Francisco, San Pablo, and Suisun bays in Northern California. This small mouse lives around marsh plants, such as pickleweed and saltgrass. About 84% of the salt marshes around these bays have disappeared since 1850 because humans have converted this land for city buildings, agriculture, and salt production. In addition, people destroy some marshes when they treat wastewater and drain the clean fresh water into the bay. The addition of fresh water makes the marshes less salty, changing the types of plants that can live there. Without the right kinds of plants, the harvest mouse cannot survive. This mouse swims well but needs high land at the marsh's edge so it has a place to go during high tide. People have developed a lot of marshland into houses and city buildings. Nonnative red foxes also prey on the harvest mouse, as do stray cats that live in nearby human developments. These threats are just some of many threats faced by the salt marsh harvest mouse.

**Salt Marsh Harvest Mouse**



**19** California Threatened and Endangered Species  
Information Card | card 6 of 8

### San Joaquin Antelope Squirrel

The San Joaquin antelope squirrel is a small ground squirrel with a stripe on its side. This squirrel eats plants, fungi, seeds, and insects. It lives in the San Joaquin Valley, an area significantly changed by humans in the past century. This squirrel used to live in a range of 3.5 million acres. Now it has only 102,000 acres of available habitat. Humans have altered the rest of this animal's habitat for farming, mining, building roads, and more. More humans continue to move to the San Joaquin Valley every year. Pesticides designed to kill other ground squirrels have also killed the San Joaquin antelope squirrel.

**Status:** threatened. Conservationists are working to get the squirrel added to the endangered species list.

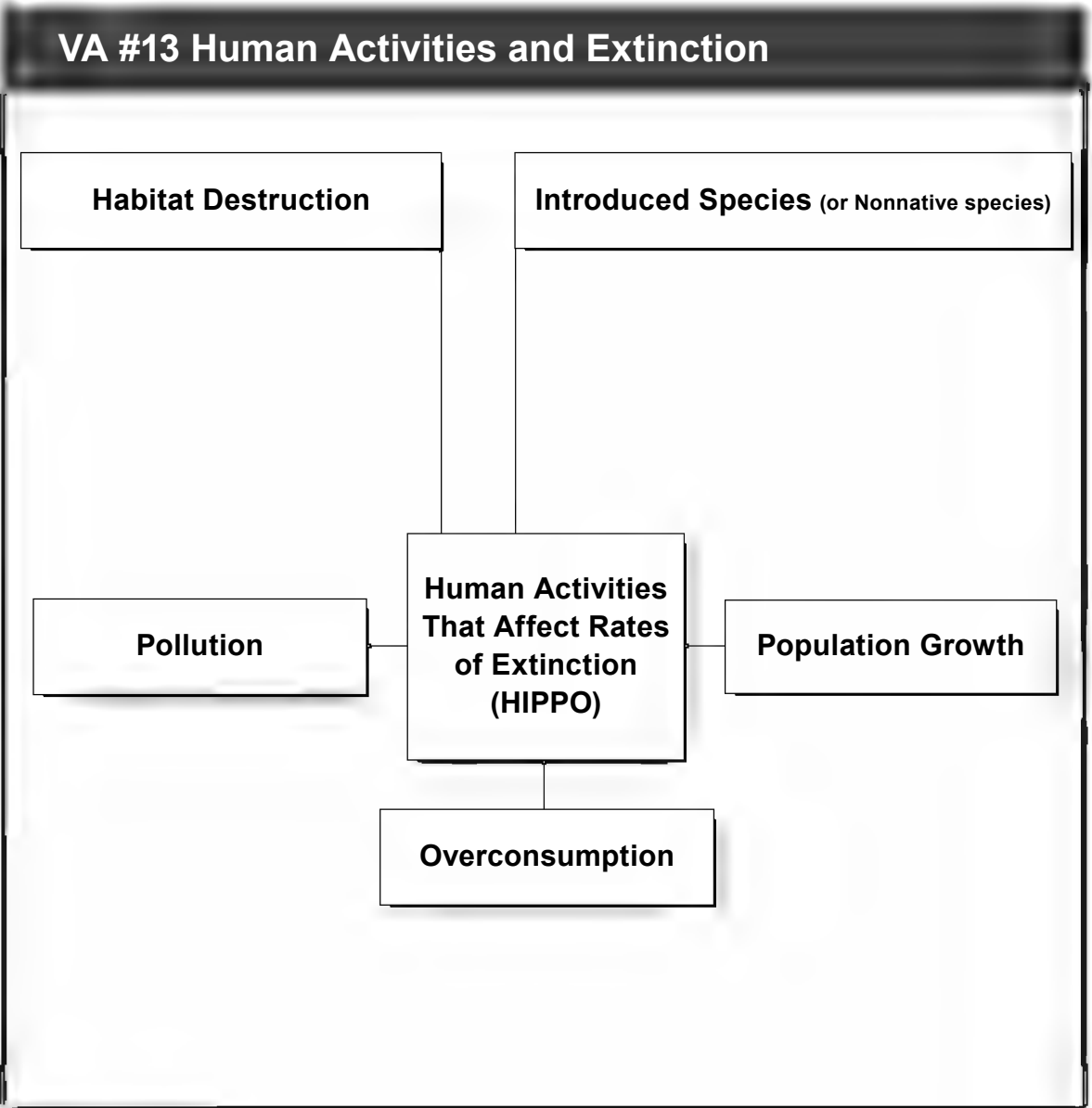


### San Joaquin Kit Fox

The San Joaquin kit fox is the smallest fox in North America. As its name suggests, it lives in the San Joaquin Valley. It eats different species of squirrels and other rodents, as well as birds and insects. The kit fox population has gone down as a result of many human activities. In the 1900s, much of the kit fox habitat was altered for farming and polluted with pesticides. By 1979, more than 93% of the San Joaquin Valley's land had been developed. People continue to move into the San Joaquin Valley. They threaten the kit fox population with their new farms, buildings, and more. In addition, nonnative species, such as the coyote, the red fox, and domestic dogs prey on the kit fox.

**Status:** threatened. Conservationists are working to get the fox added to the endangered species list.

**13** Human Activities and Extinction  
Visual Aid





## California Threatened and Endangered Species

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### 1. California Freshwater Shrimp

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The California freshwater shrimp eats decaying plants and animals. It requires clean fresh water to survive. This shrimp lives in coastal streams in Marin, Sonoma, and Napa counties. These counties are north of San Francisco and contain cities, such as Santa Rosa, San Rafael, and Napa. Many factors have endangered this shrimp. Humans have altered habitat by mining for gravel in the shrimp's streams, harvesting timber along banks, and building farms and dams in these counties. The shrimp are also threatened by nonnative fish species that people have stocked in streams. These fish eat the shrimp. Water pollution poses another threat, since the shrimp require clear, clean water to survive.

**Status:** endangered



### 2. California Golden Trout

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The California golden trout lives in cold, clear mountain streams and pools in Inyo National Forest in the eastern Sierra Nevada mountains. This forest sits next to the town of Mammoth Lakes. The trout feeds on insects and their larvae. People have introduced brown trout and rainbow trout into the golden trout's habitat. The golden trout cannot compete with these other fish for the same food resources. In addition, brown trout often eat golden trout. Cattle ranching has also hurt the California golden trout. When cattle graze in meadows next to streams, they often strip the streams of plants or damage the banks that help hide the golden trout from predators.

**Status:** threatened. Conservationists are working to get the trout added to the endangered species list.

**California Threatened and Endangered Species**Lesson 5 | page 2 of 4

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**3. Grizzly Bear**

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The grizzly bear lived in hills and mountains throughout California. The grizzly bear eats both plants and animals, but is most famous as a fierce top predator. When large numbers of people came to California during the Gold Rush in 1849, they moved into grizzly bear habitat. People were afraid of the grizzly bear and did not want it to kill their livestock, so they began to hunt the bear. By 1922, fewer than 75 years after the discovery of gold, the last grizzly bear in California was killed. The grizzly bear still lives in North America, mostly in and around Canada, American national parks, and other and protected areas of the United States.

**Status:** threatened. Removed from the endangered species list in March 2007.

**4. Guadalupe Fur Seal**

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The Guadalupe fur seal used to live along the coast of California. In the 1800s, fur seal hunters killed most of the 30,000 seals that lived in the ocean. In fact, so many were killed that scientists thought the seals were extinct. Some seals survived, however, and were rediscovered in 1954. Several thousand seals now breed in Mexico and swim off the coast of Southern California. They eat the plentiful squid and mackerel. Noise pollution from the space shuttle program harms the seals. In addition, oil exploration in the ocean disturbs its habitat.

**Status:** threatened. Conservationists are working to get it added to the endangered species list.

## 5. Island Fox

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The island fox lives on the Channel Islands off the coast of California. This fox is the largest mammal native to the Channel Islands. It is only about the size of a house cat and eats mostly insects and fruit. It faces a variety of human threats. Golden eagles, which arrived in the islands in 1999, now kill and eat island foxes. Before 1999, bald eagles lived on the islands and scared away the golden eagles. Bald eagles ate fish instead of foxes, so the foxes had no natural predators on the islands. Pollution from DDT, a pesticide humans used in farming, killed off the bald eagle population on the islands. Golden eagles arrived after the bald eagles disappeared. In addition, dogs that humans introduced to the islands have brought diseases that kill some foxes.

**Status:** endangered. The population has dropped at least 50% since the 1990s. On Santa Cruz Island the population has dropped from 1,300 in 1995 to fewer than 100 today.



## 6. Salt Marsh Harvest Mouse

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The salt marsh harvest mouse lives in the marshes of the San Francisco, San Pablo, and Suisun bays in northern California. About 84% of the salt marshes by these bays has disappeared since 1850 as humans have developed this land for cities, agriculture, and salt production. People have also affected the marshes by putting fresh water from wastewater treatment plants into the bay—adding fresh water makes marshes less salty and changes the plants that live there. The salt marsh harvest mouse needs marsh plants, such as pickleweed and saltgrass—without the right plants harvest mice cannot survive. Stray cats from the nearby houses prey on the harvest mouse. These are among the many threats faced by salt marsh harvest mice.

**Status:** endangered. Population has declined 50–90% in the past 150 years.

**California Threatened and Endangered Species**Lesson 5 | page 4 of 4

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**7. San Joaquin Antelope Squirrel**

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The San Joaquin antelope squirrel is a small ground squirrel with a stripe on its side. This squirrel eats plants, fungi, seeds, and insects. It lives in the San Joaquin Valley, an area significantly changed by humans in the past century. This squirrel used to live in a range of 3.5 million acres. Now it has only 102,000 acres of available habitat. Humans have altered the rest of this animal's habitat for farming, mining, building roads, and more. More humans continue to move to the San Joaquin Valley every year. Pesticides designed to kill other ground squirrels have also killed the San Joaquin antelope squirrel.

**Status:** threatened. Conservationists are working to get the squirrel added to the endangered species list.

**8. San Joaquin Kit Fox**

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**Status:** threatened. Conservationists are working to get the fox added to the endangered species list.