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# Sustaining Biodiversity: the Species Approach

## Chapter 9

# Chapter Overview Questions

- How do biologists estimate extinction rates, and how do human activities affect these rates?
- Why should we care about protecting wild species?
- Which human activities endanger wildlife?
- How can we help prevent premature extinction of species?
- What is reconciliation ecology, and how can it help prevent premature extinction of species?

# Core Case Study: The Passenger Pigeon - Gone Forever



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- Once the most numerous bird on earth.
- In 1858, Passenger Pigeon hunting became a big business.
- By 1900 they became extinct from over-harvest and habitat loss.

Figure 11-1

# Three Types of Species Extinction

1. **Local extinction:** when a species is no longer found in area it once inhabited, but is still found elsewhere.
2. **Ecological extinction:** when so few individuals of a species are left that a species no longer plays a significant ecological role in the communities where it is found.
3. **Biological extinction (globally):** when individuals of a species no longer exist on Earth. FOREVER!

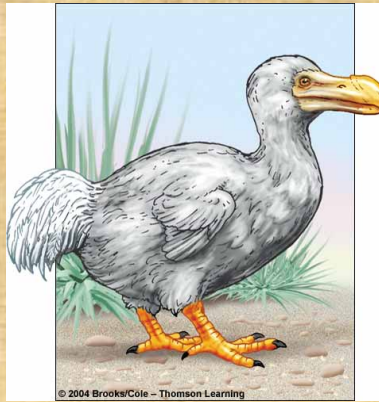
# Premature Extinction



Passenger  
pigeon



Great auk



Dodo



Dusky seaside  
sparrow



Aepyornis  
(Madagascar)

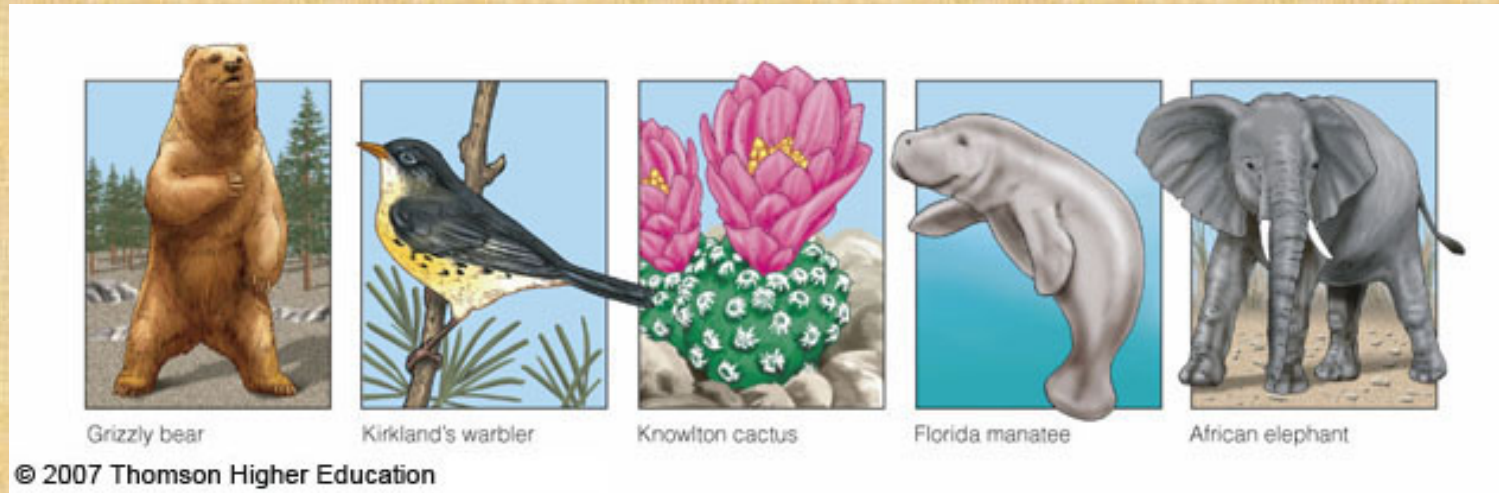
Humans activities (habitat destruction and overhunting) have caused the premature extinction of various species

# Current Crisis of Extinction

*Why do conservation biologists believe there is a mass extinction crisis?*

- \* Natural rate of extinction can be observed in the fossil record (called *background extinction*);
- \* Mass extinction events, involving widespread extinction of large numbers of species, have been observed to occur five times in the fossil record (20 to 60 million years apart)
- While difficult to document, estimates show that humans are causing extinction rates much higher than natural rates.

# Endangered and Threatened Species: Ecological Smoke Alarms



- ***Endangered species***: so few individual survivors that it could soon become extinct.
- ***Threatened species***: still abundant in its natural range but is likely to become endangered in the near future.

# Threatened and Endangered Species

*Some species are endangered or threatened because of human activities.*

*Populations of some species are recovering (such as the bald eagle and peregrine falcon).*



**Florida manatee**



**Northern spotted owl**



**Gray wolf**



**Florida panther**



**Hyacinth macaw (threatened)**



**American bison**



**Snow leopard**



**Black footed ferret**



**Symphonia (Madagascar)**



**Utah prairie dog (threatened)**



# SPECIES EXTINCTION

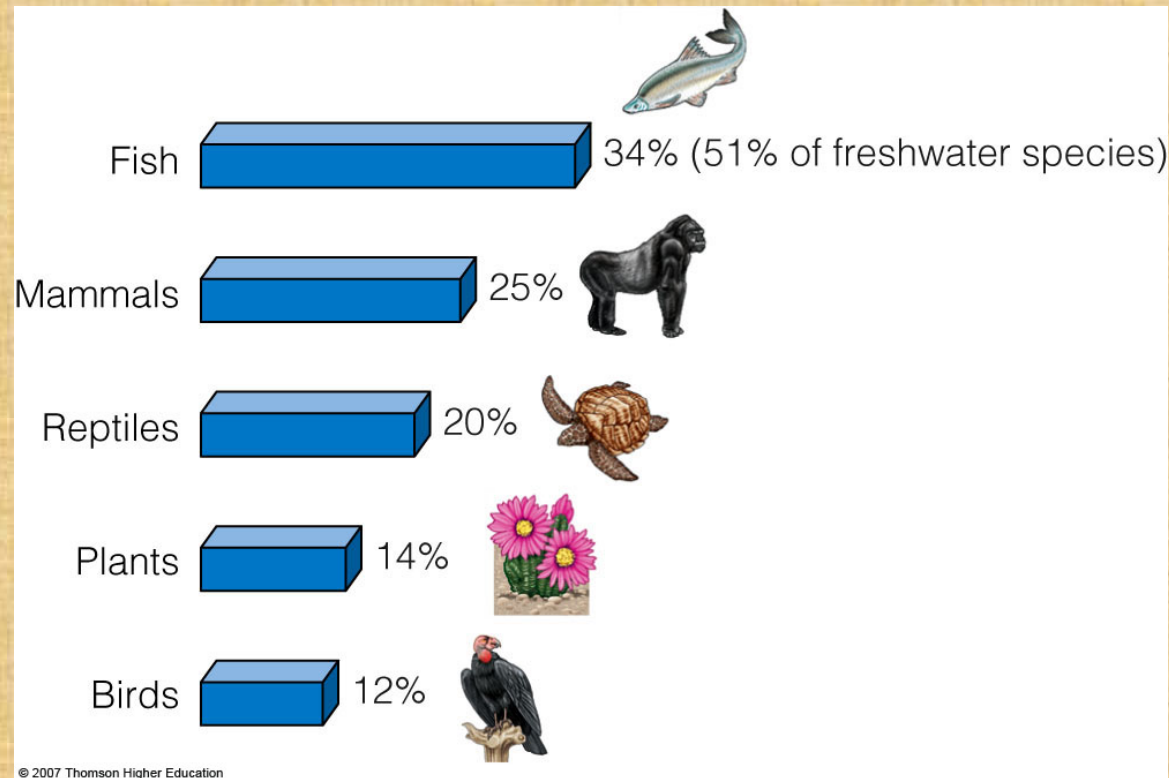
- Some species have characteristics that make them vulnerable to ecological and biological extinction.

Characteristic	Examples
Low reproductive rate (K-strategist)	Blue whale, giant panda, rhinoceros
Specialized niche	Blue whale, giant panda, Everglades kite
Narrow distribution	Many island species, elephant seal, desert pupfish
Feeds at high trophic level	Bengal tiger, bald eagle, grizzly bear
Fixed migratory patterns	Blue whale, whooping crane, sea turtles
Rare	Many island species, African violet, some orchids
Commercially valuable	Snow leopard, tiger, elephant, rhinoceros, rare plants and birds
Large territories	California condor, grizzly bear, Florida panther

# SPECIES EXTINCTION

- The International Union for the Conservation of Nature and Natural Resources (IUCN) publishes an annual Red List, listing the world's threatened species.
- The 2010 Red List contains 18,351 species at risk for extinction.
- US – listed by the Fish and Wildlife Service
  - [www.fws.gov](http://www.fws.gov)

# SPECIES EXTINCTION



- Percentage of various species types threatened with premature extinction from human activities.

Figure 11-5



# Why Preserve Wild Species?

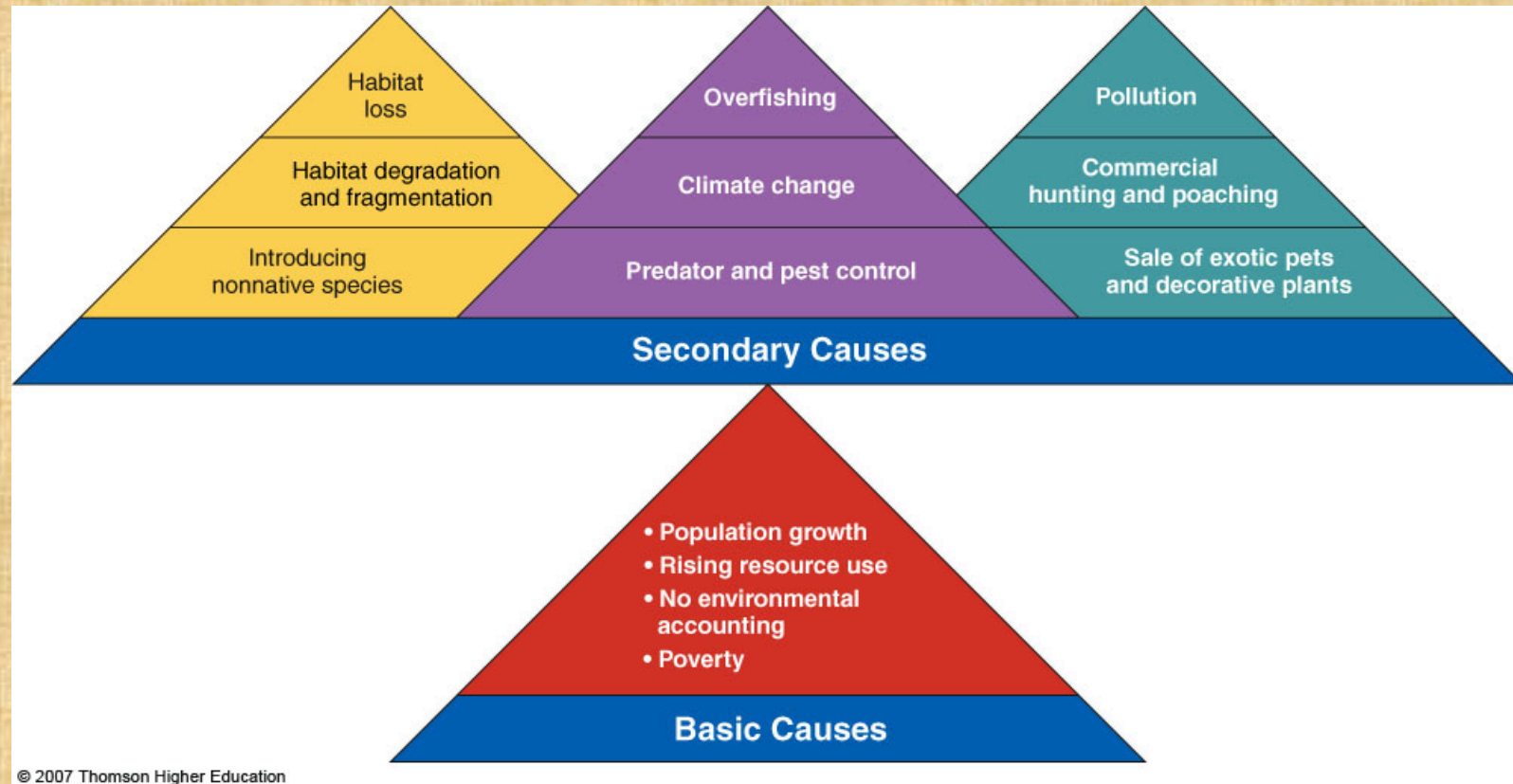
Why should we work to prevent the premature extinction of wild species?

- A. Economic and medical importance:** wild plants and animals provide a huge number of economic products and medicines;
- B. Scientific and ecological importance:** scientific understanding comes from study of wild species; ecological services include nutrient recycling, watershed value, production of oxygen, moderating climate, and detoxifying toxic substances;
- C. Aesthetic and recreational importance:** source of beauty, wonder, inspiration, and enjoyment;
- D. Ethical importance:** some believe that each species has an inherent right to exist.

# HABITAT LOSS, DEGRADATION, AND FRAGMENTATION

- Conservation biologists summarize the most important causes of premature extinction as “HIPPO”:
  - Habitat destruction, degradation, and fragmentation
  - Invasive species
  - Population growth
  - Pollution
  - Overharvest

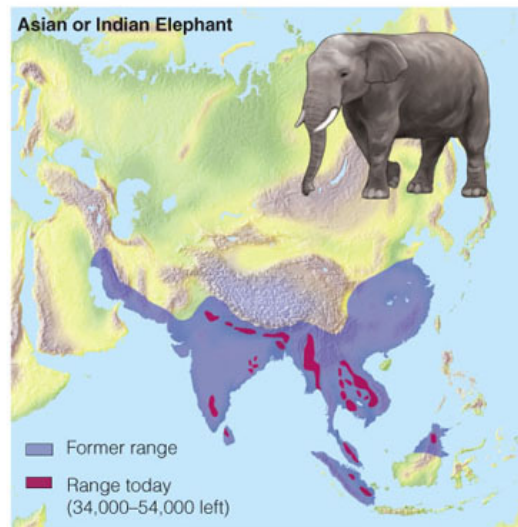
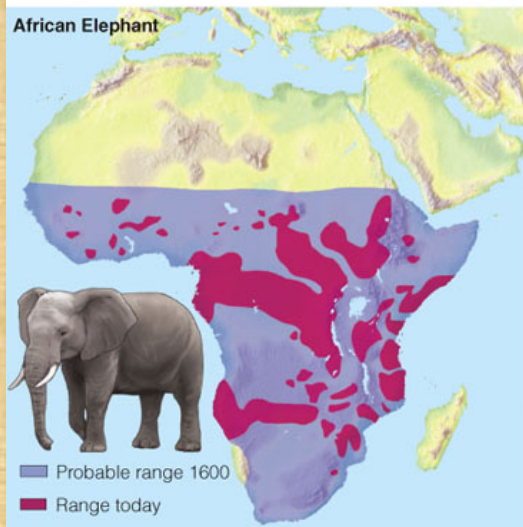
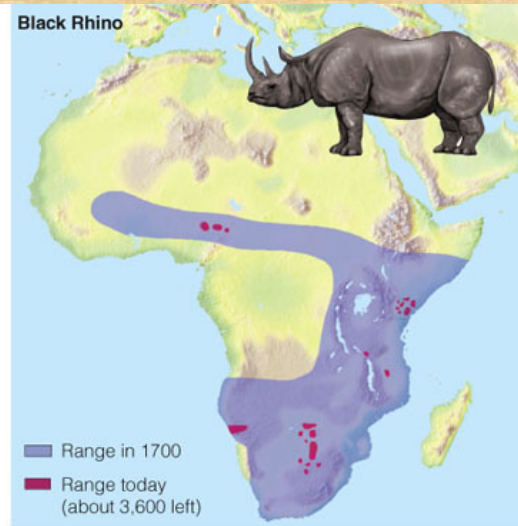
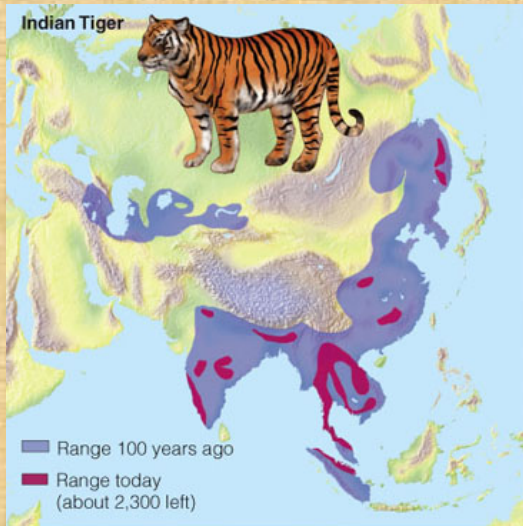
# HABITAT LOSS, DEGRADATION, AND FRAGMENTATION



- The greatest threat to a species is the loss, degradation, and fragmentation of where it lives.

Figure 11-7

# HABITAT LOSS, DEGRADATION, AND FRAGMENTATION



- Reduction in ranges of four wildlife species, mostly due to loss of critical habitat loss (areas of habitat critical to a species' survival) and overharvest



# SPECIES EXTINCTION

- Scientists use measurements and models to estimate extinction rates.
  - The International Union for the Conservation of Nature and Natural Resources (IUCN) publishes an annual Red List, listing the world's threatened species.
  - The 2004 Red List contains 15,589 species at risk for extinction.
  - The 2009 Red List contains 17,291 species at risk for extinction.

# Habitat Destruction in the U.S. & Endangered Species

1. Agriculture
2. Commercial Development
3. Water Development: Dams
4. Outdoor Recreation
5. Livestock Grazing
6. Pollution- Peregrine Falcon
7. Logging of old growth forests- Northern Spotted Owl

# Extinction Threats From Smuggling, Poaching, and Hunting

1. Illegal smuggling of endangered species; 3<sup>rd</sup> to smuggling of drugs and weapons. Sadly, most animals die in transit.
2. Exotic Pets- birds, reptiles, amphibians
3. Illegal Poaching- many animals are worth \$\$\$.

Rhino horn- \$13,000/lb



# Causes of Extinction and Depletion

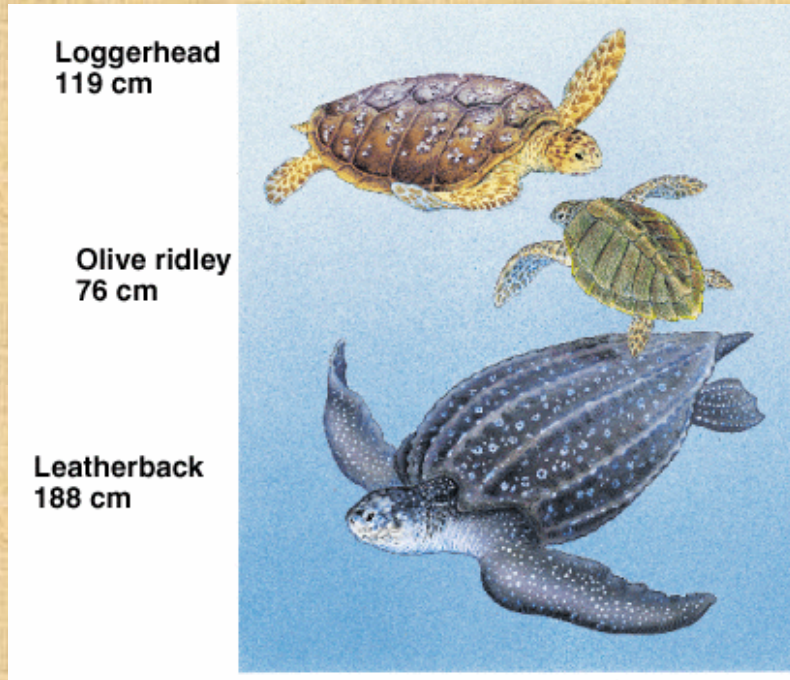
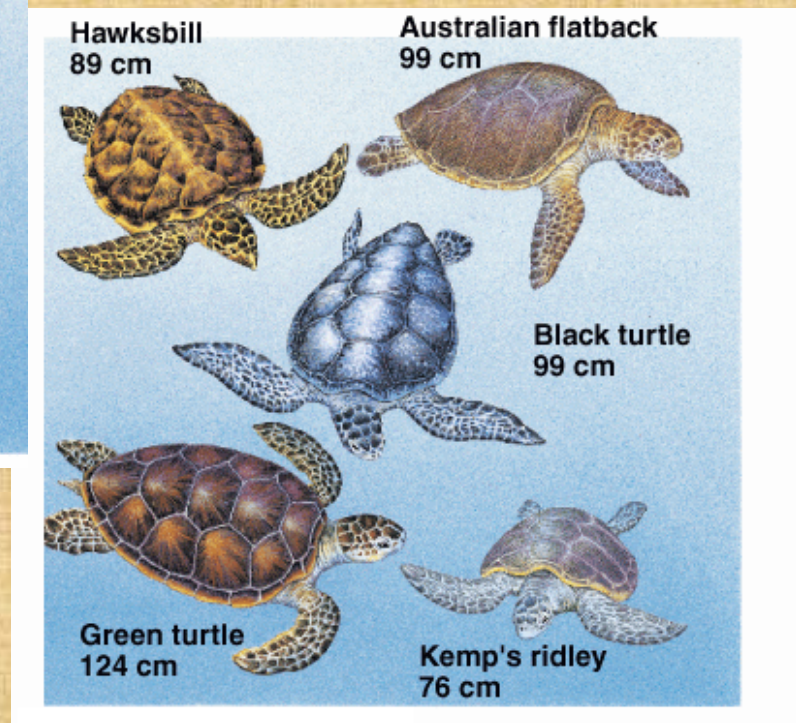
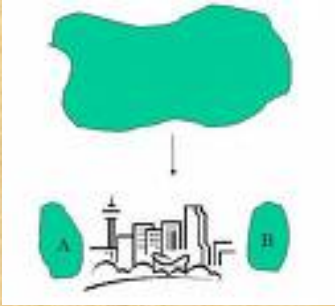


Fig. 25-13



*Many species of sea turtles are becoming endangered because of loss of beach habitat for laying eggs, taking of eggs for food, and unintentional capture by fishing boats.*

[Saving Sea Turtles With a Lights-Out Policy in Florida](#)



## Habitat Fragmentation



- Occurs when a large area of habitat is divided into smaller, scattered, and isolated patches (“habitat islands”)
- Populations divided into smaller groups that are more prone to predators and disease.
- Ex: Bobcats, Wolves, Sandpiper, Wood thrush

# Causes of Extinction and Depletion

*Deliberate or accidental introduction of nonnative species is the second biggest cause of animal and plant extinctions (after habitat loss and degradation).*

- example: introduction of fire ants in 1930s from South America to Alabama; subsequently spread throughout south, Texas, and various states in western U.S.; where established up to 90% of local ant populations reduced or eliminated;
- example: introduction to Great Lakes of zebra mussels from Europe and quagga mussels from Russia (in ship ballast water) has depleted food for other lake species and caused major property damage.

# INVASIVE SPECIES



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Kudzu vine was introduced in the southeastern U.S. to control erosion. It has taken over native species habitats.

- Many nonnative species provide us with food, medicine, and other benefits but a few can wipe out native species, disrupt ecosystems, and cause large economic losses.



Purple loosestrife



European starling



African honeybee  
("Killer bee")



Nutria



Salt cedar  
(Tamarisk)



Marine toad



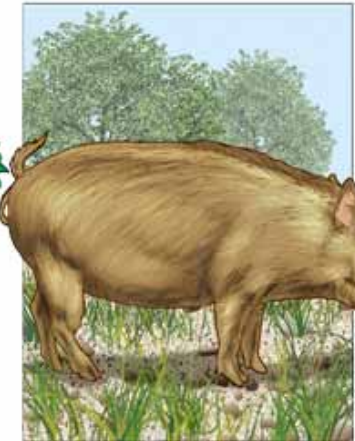
Water hyacinth



Japanese beetle



Hydrilla

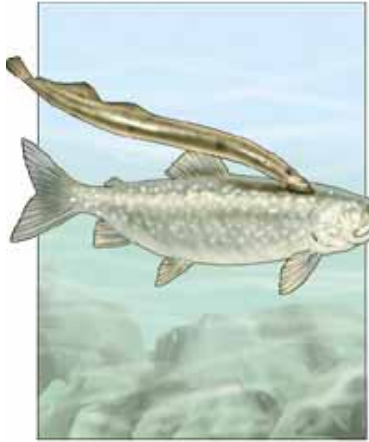


European wild boar  
(Feral pig)

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**Deliberately introduced Species**





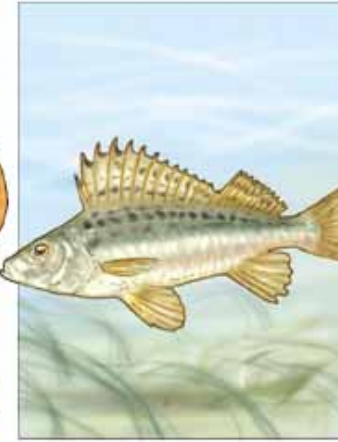
**Sea lamprey  
(attached to lake trout)**



**Argentina fire ant**



**Brown tree snake**



**Eurasian muffle**



**Common pigeon  
(Rock dove)**



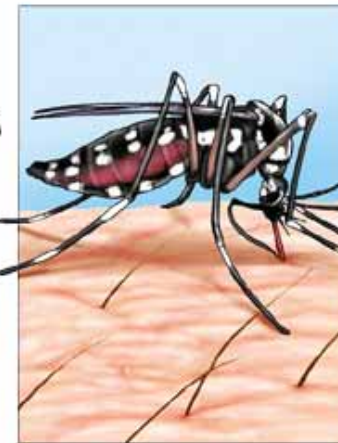
**Formosan termite**



**Zebra mussel**



**Asian long-horned  
beetle**



**Asian tiger mosquito**



**Gypsy moth larvae**

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**Accidentally introduced Species**

# Problems with Invasive Species

1. Cause premature extinction of native species. Hawaii impacted the most.
2. Have no natural predators or competitors; sometimes predators are introduced. Worsens the problem.
3. Reduce biodiversity.

Examples: kudzu, zebra mussels, feral pigs, brown tree snakes, fire ant, etc.

## What Can You Do?

### Invasive Species

- Do not allow wild animals to escape.
- Do not spread wild plants to other areas.
- Do not dump the contents of an aquarium into waterways, wetlands, or storm drains.
- When camping use wood near your campsite instead of bringing firewood from somewhere else.
- Do not dump unused bait into the water.
- After dogs visit woods or the water brush them before taking them home.
- After each use clean your vehicle, mountain bike, surfboard, kayaks, canoes, boats, tent, hiking boots, and other gear before heading for home.
- Empty all water from canoes, kayaks, dive gear, and other outdoor equipment before heading home.
- Plant a variety of trees, shrubs, and other plants in your yard to reduce losses from invasive species.
- Do not buy plants from overseas or swap them with others using the Internet.

# INVASIVE SPECIES

- Prevention is the best way to reduce threats from invasive species, because once they arrive it is almost impossible to slow their spread.

### **Characteristics of Successful Invader Species**

- High reproductive rate, short generation time (r-selected species)
- Pioneer species
- Long lived
- High dispersal rate
- Release growth-inhibiting chemicals into soil
- Generalists
- High genetic variability

### **Characteristics of Ecosystems Vulnerable to Invader Species**

- Similar climate to habitat of invader
- Absence of predators on invading species
- Early successional systems
- Low diversity of native species
- Absence of fire
- Disturbed by human activities

# Protecting Native Species (Wild Species)

*Three approaches to protecting wild species:*

- **Ecosystem approach:** aims to preserve balanced populations of species in their native habitats;
- **Species approach:** based on identifying and protecting endangered species on a case-by-case basis;
- **Wildlife management approach:** manages game species for sustained yield.

# Protecting Native Species

- International Treaties- helped reduce the illegal trade, but difficult to enforce.
  - Convention on International Trade in Endangered Species: CITES (1975) 160 countries signed; 900 species listed that cannot be traded live or as products due to their near extinction status.
  - Convention on Biological Diversity: -186 countries agreed to reduce the global decline of biological diversity and create a plan for managing and preserving biological diversity. United States has not participated in this- considered a weak treaty.

# Case Study:

## The U.S. Endangered Species Act

- One of the world's most far-reaching and controversial environmental laws is the 1973 U.S. Endangered Species Act (ESA).
  - ESA forbids federal agencies (besides defense department) to carry out / fund projects that would jeopardize an endangered species.
  - ESA makes it illegal for Americans to engage in commerce associated with or hunt / kill / collect endangered or threatened species.

# Endangered Species

- Congress has amended the ESA to help landowners protect species on their land.
- Some believe that the ESA should be weakened or repealed while others believe it should be strengthened and modified to focus on protecting ecosystems.
- Many scientists believe that we should focus on protecting and sustaining biodiversity and ecosystem function as the best way to protect species.



# PROTECTING WILD SPECIES: THE SANCTUARY APPROACH



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- The U.S. has set aside 544 federal refuges for wildlife, but many refuges are suffering from environmental degradation.

Pelican Island was the nation's first wildlife refuge.

# PROTECTING WILD SPECIES: THE SANCTUARY APPROACH

- Gene banks, botanical gardens and using farms to raise threatened species can help prevent extinction, but these options lack funding and storage space.
- Zoos and aquariums can help protect endangered animal species by preserving some individuals with the long-term goal of reintroduction, but suffer from lack of space and money.

# RECONCILIATION ECOLOGY

- Reconciliation ecology involves finding ways to share places we dominate with other species.
  - Replacing monoculture grasses with native species.
  - Maintaining habitats for insect eating bats can keep down unwanted insects.
  - Reduction and elimination of pesticides to protect non-target organisms (such as vital insect pollinators).

# Using Reconciliation Ecology to Protect Bluebirds



- Putting up bluebird boxes with holes too small for (nonnative) competitors in areas where trees have been cut down have helped reestablish populations.

[Building Wildlife Habitats  
Builds Community Pride |  
UANews.org](#)

Figure 11-B

## What Can You Do?

### Protecting Species

- **Do not buy furs, ivory products, and other materials made from endangered or threatened animal species.**
- **Do not buy wood and paper products produced by cutting remaining old-growth forests in the tropics.**
- **Do not buy birds, snakes, turtles, tropical fish, and other animals that are taken from the wild.**
- **Do not buy orchids, cacti, and other plants that are taken from the wild.**
- **Spread the word. Talk to your friends and relatives about this problem and what they can do about it.**