



2.7 HUMAN IMPACTS ON BIODIVERSITY AND ENDANGERED SPECIES (CB 9.8 to 9.10)

Related Reading: 280 -302

ENDURING UNDERSTANDING

EIN-4

The health of a species is closely tied to its ecosystem, and minor environmental changes can have a large impact.

LEARNING OBJECTIVE

EIN-4.A

Explain the environmental problems associated with invasive species and strategies to control them.

ESSENTIAL KNOWLEDGE

EIN-4.A.1

Invasive species are species that can live, and sometimes thrive, outside of their normal habitat. Invasive species can sometimes be beneficial, but they are considered invasive when they threaten native species.

EIN-4.A.2

Invasive species are often generalist, r-selected species and therefore may outcompete native species for resources.

EIN-4.A.3

Invasive species can be controlled through a variety of human interventions.

LEARNING OBJECTIVE

EIN-4.B

Explain how species become endangered and strategies to combat the problem.

ESSENTIAL KNOWLEDGE

EIN-4.B.1

A variety of factors can lead to a species becoming threatened with extinction, such as being extensively hunted, having limited diet, being outcompeted by invasive species, or having specific and limited habitat requirements.

EIN-4.B.2

Not all species will be in danger of extinction when exposed to the same changes in their ecosystem. Species that are able to adapt to changes in their environment or that are able to move to a new environment are less likely to face extinction.

EIN-4.B.3

Selective pressures are any factors that change the behaviors and fitness of organisms within an environment.

EIN-4.B.4

Species in a given ecosystem compete for resources like territory, food, mates, and habitat, and this competition may lead to endangerment or extinction.

EIN-4.B.5

Strategies to protect animal populations include criminalizing poaching, protecting animal habitats, and legislation.

LEARNING OBJECTIVE

EIN-4.C

Explain how human activities affect biodiversity and strategies to combat the problem.

ESSENTIAL KNOWLEDGE

EIN-4.C.1

HIPPCO (habitat destruction, invasive species, population growth, pollution, climate change, and over exploitation) describes the main factors leading to a decrease in biodiversity.

EIN-4.C.2

Habitat fragmentation occurs when large habitats are broken into smaller, isolated areas. Causes of habitat fragmentation include the construction of roads and pipelines, clearing for agriculture or development, and logging.

EIN-4.C.3

The scale of habitat fragmentation that has an adverse effect on the inhabitants of a given ecosystem will vary from species to species within that ecosystem.

EIN-4.C.4

Global climate change can cause habitat loss via changes in temperature, precipitation, and sea level rise.

EIN-4.C.5

Some organisms have been somewhat or completely domesticated and are now managed for economic returns, such as honeybee colonies and domestic livestock. This domestication can have a negative impact on the biodiversity of that organism.

ESSENTIAL KNOWLEDGE

EIN-4.C.6

Some ways humans can mitigate the impact of loss of biodiversity include creating protected areas, use of habitat corridors, promoting sustainable land use practices, and restoring lost habitats.

HIPPCO



Habitat Fragmentation/Loss

- Deforestation (lumber, cities, roads), Wetland draining (ag, urbanization), Damming of rivers

Invasive Species

- Invasives such as zebra mussel and kudzu vine outcompete native species for food/space, lowering populations

Population Growth

- Human pop. growth drives habitat loss
- Urbanization, agricultural expansion

Pollution (Pollutants)

- Oil spills reduce population sizes of marine organisms
- Pesticides (glyphosate, atrazine) kill non-target species



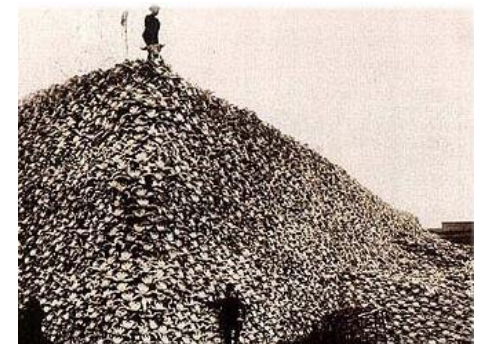
Climate Change

- Shifts biomes & therefore species habitat ranges
- can change temperature & precipitation patterns too rapidly for a species to adapt or migrate, causing pop. decline or extinction



Over Exploitation

- Excessive hunting or poaching (faster than reproductive rate) leads to pop. decline & potential extinction

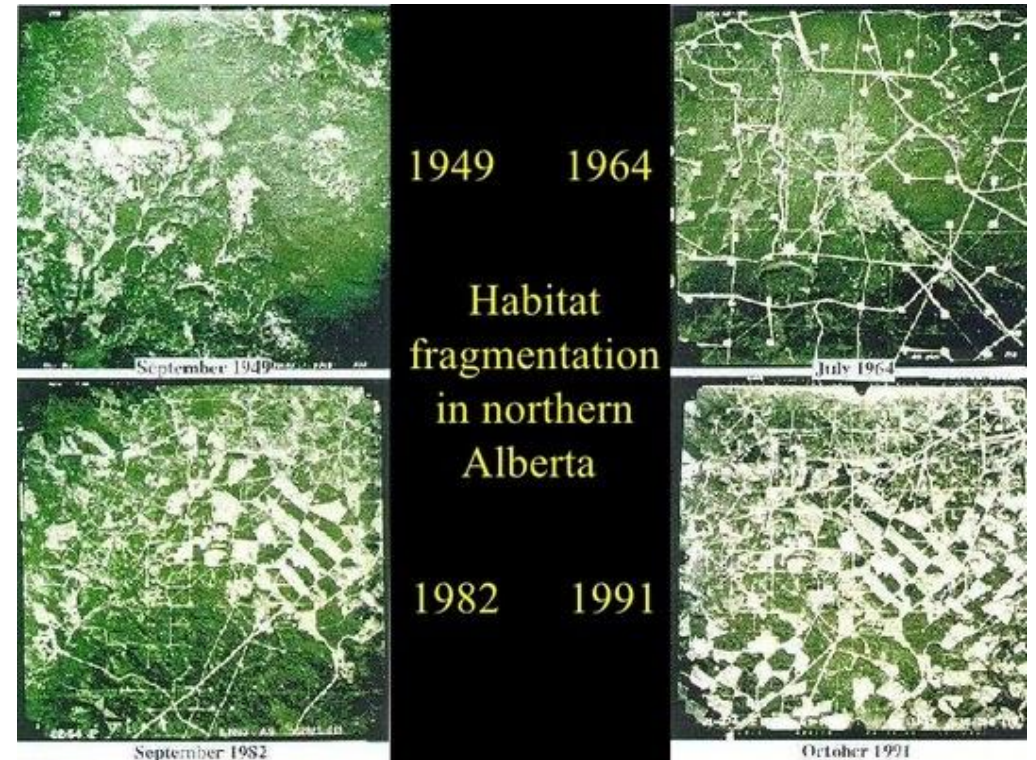


Habitat Loss and/or Fragmentation

- **Habitat Fragmentation** breaks larger, continuous habitats into smaller isolated patches and reduces overall biodiversity
 - Disrupts breeding, foraging/hunting, migration, mating of species.
 - Smaller islands of habitat have greater extinction / extirpation rates
 - Islands of habitat with greater distances between them have lower rates of immigration and gene flow

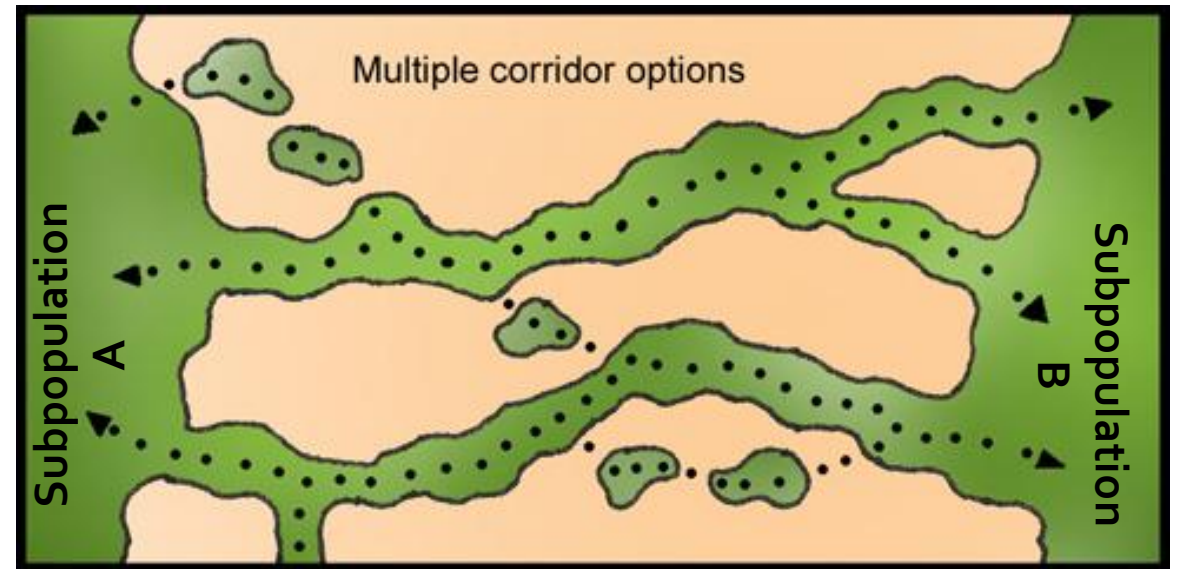
Causes of Habitat Fragmentation

- Changing Land Use
 - Suburban sprawl and urbanization
 - Increasing agricultural demand and growing preference for meat
- Logging and Mining
 - Disrupts and degrades habitat in areas where logging and mining occur
- Roads, pipelines, and fencing
 - Fragment habitats into smaller islands



Metapopulations

- Some species are more disrupted by habitat fragmentation than others.
 - Large predators who require large amounts of space to hunt
 - Smaller populations of large mammals may require large territories to find a mate.
- Habitat fragmentation creates smaller, isolated subpopulations
 - subpopulations have less genetic diversity, are more prone to inbreeding depression, and are less resilient to environmental disturbance or disease.
 - Subpopulations can be connected by **habitat corridors** to improve gene flow between them and create **metapopulations** with greater genetic diversity than the individual subpopulations.



Edge Effects

- Edge effects occur in ecotones.
 - **Ecotones** are transitional areas from one ecosystem to another.
 - **Edge effects** are ecological differences between an ecotone and the interiors of either habitat.
- Edge effects often result in increased biodiversity where two natural ecosystems meet in an ecotone (grassland to forest)
 - Due to greater diversity of food, shelter, and nutrient resources.
- Edge effects can have a negative effect on biodiversity when the ecotone occurs between areas of human disturbance and a natural ecosystem (urban areas and chaparral).
 - Conditions of the disturbed area (urban, suburban, agricultural fields) spill over into the patches of natural habitat and degrade conditions along its edge more than in the interior.



Adult brown-headed cowbirds are a common site in pastures and rangelands. They lay their eggs in the nests of other species of songbirds who nest in patches of forest surrounded by grazing lands (brood parasite). The edge effect created by brown-headed Cowbirds can reduce the diversity of song birds in the ecotone between these forested islands and the rangeland ecosystem.

Invasive Species

- **Invasive species** are species that are not native to a given area, and when introduced to an area, disrupt those ecosystems and the native species found within.
 - Invasive species displace native species from their niches and reduce biodiversity
 - Invasive species are introduced to new geographic regions by humans
 - accidentally; in raw materials, ballast water of cargo ships).
 - Intentionally; exotic pets or to control populations of other pest species
- Not all introduced species become invasive.
 - Some introduced species do not have the adaptations to thrive in the environments where they are introduced. Those environments are outside of their range of tolerance.



- Transported by ship ballast water
- Aggressive filter feeders, eating algae many other species rely on
- 1 mil. eggs/yr.



- Planted to limit soil erosion in US
- Grows up to 1ft/day
- Outcompetes natives for sunlight
- No herbivores eat Kudzu in US



- Brought to Florida as pets, released into wild
- Decimated mammal populations ~90%
- Aggressive hunters with no natural predators

- Common characteristics of invasive species:
 - Lack native predators adapted to their defenses.
 - Have predatory adaptations that native prey species lack defenses for
 - fast growing, early maturation, fast reproduction (r-selected)
 - Are generalists with a wide range of ecological tolerance and broad niches.

- **Temperature change**

- Warming temperatures can shift biomes.
- Tundra may shrink and coniferous forests may expand towards the poles
- Patches of habitat on mountain tops may be lost and mountain top species may not be able to migrate (pikas)

- **Precipitation change**

- Warming temperatures may increase evaporation and reduce precipitation in some regions, expanding deserts
- Warming temperatures may increase precipitation in other regions, expanding tropical ecosystems.

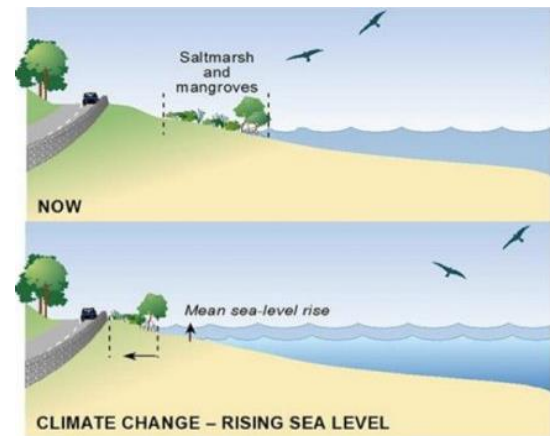
- **Sea Level Rise**

- Coastal ecosystems become submerged and more saline. Human development along many coastlines may prevent coastal species from migrating further inland.

Climate Change is Likely to Reduce Biodiversity



(b) Pikas are being forced upslope

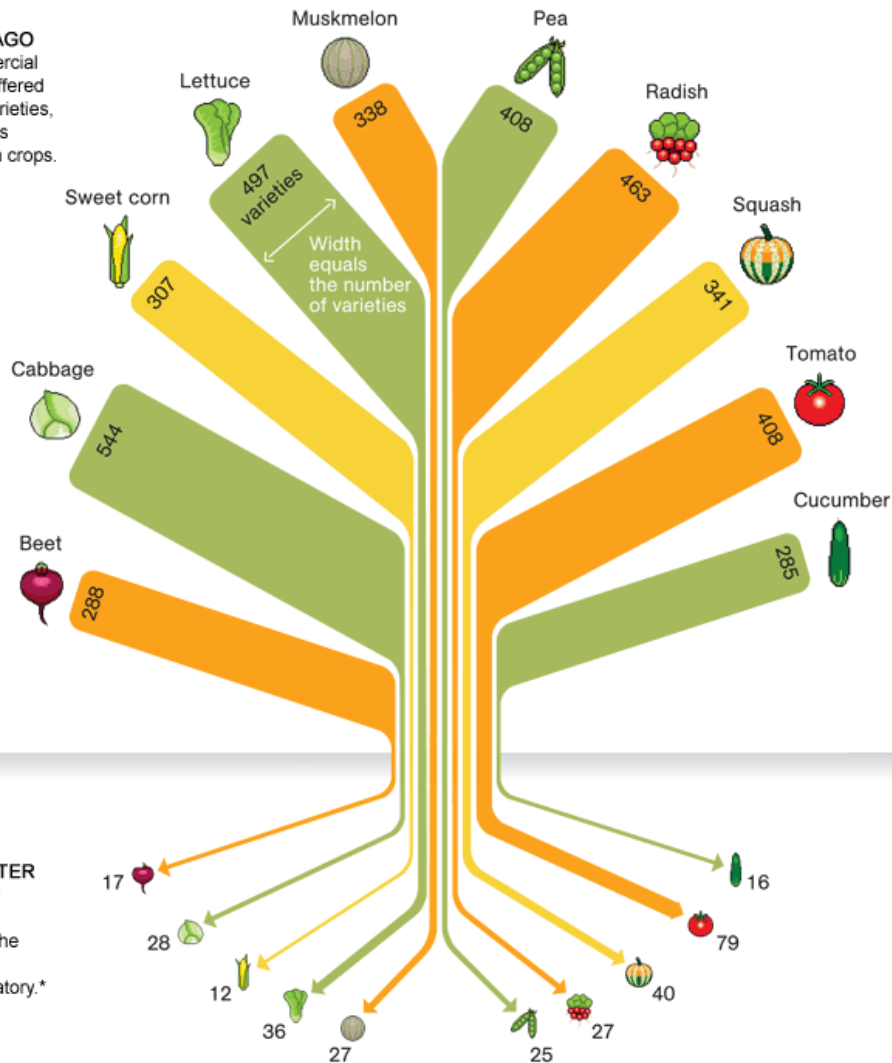


- **Frequency and intensity of natural disturbances are likely to increase, further reducing biodiversity**

- Areas of higher temperature and drought are likely to experience more frequent and intense fires (California wildfires)
- Areas of higher rainfall will experience increased flooding (Gulf Coast of the U.S)

Biodiversity is greatly reduced in many domesticated species

A CENTURY AGO
In 1903 commercial seed houses offered hundreds of varieties, as shown in this sampling of ten crops.



80 YEARS LATER
By 1983 few of those varieties were found in the National Seed Storage Laboratory.*

- Domestication generally decreases genetic and species biodiversity.
- Crops
 - Fewer plant species are grown as selective breeding and genetically modified species have higher yields
 - Selectively bred and GM crops also have very little genetic diversity within the crop variety
- Livestock
 - Historically, there have been over 8000 breeds of 11 species most commonly consumed by humans
 - Many breeds are now extinct or at risk of extinction, due to selection for the most productive breeds of each species

Characteristics of Endangered Species

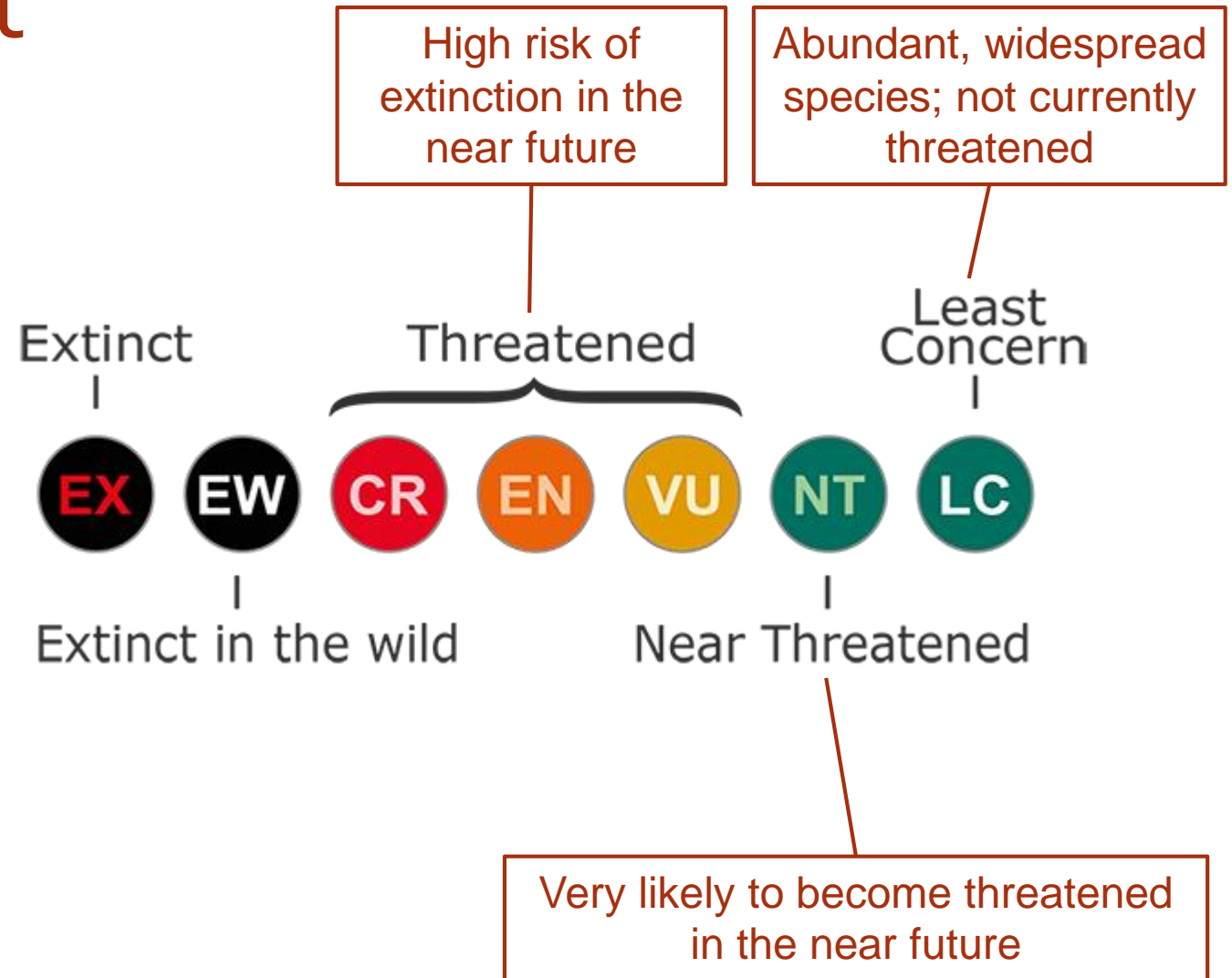


- Specialists adapted to specific diets and with a narrow range of tolerance for the specific conditions in their preferred habitat.
- Long-lived, slow-growing, slow-reproducing species (K-selected)
- Perceived threats to humans and their livestock (big carnivores, wolves, grizzly bear).
- Attractive coat or horns, tasty meat, or underground medicinal uses.
- High sensitivity to pollution (top predators, amphibians)



IUCN Red List

- *The International Union for the Conservation of Nature (IUCN)* maintains the “red list”
 - *The red list* is the most comprehensive list of endangered species world wide.
 - Many conservation organizations and governments use the red list as a guide to endangered species.



Endangerment by Taxon



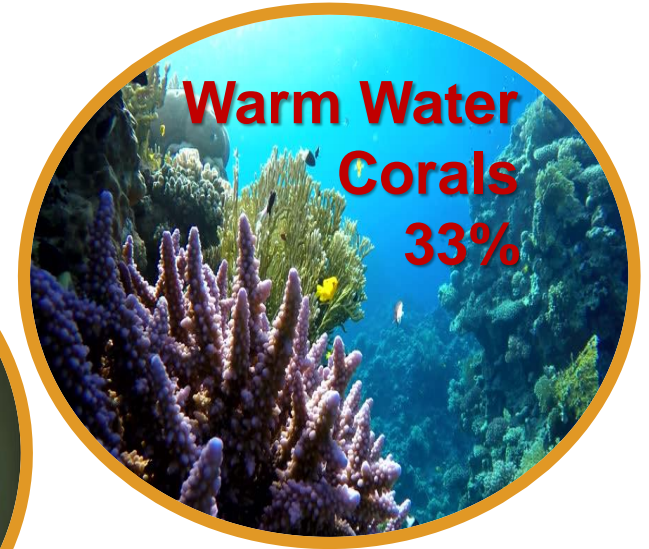
Especially vulnerable to climate change and pollution due to biphasic life (relying on water and land) and highly permeable skin



Many species have large habitat ranges, are hunted as food or killed because they are a perceived threat to humans and their livestock



Warming temperatures increase the threats caused by expanding ranges of avian viruses and insect pests



Threatened by changing ocean temperature and pH (ocean acidification from increasing atm. CO₂ levels and climate change)

Mitigating Biodiversity Loss – Parks and Preserves

- **Protecting and connecting habitats**

- Setting aside land to maintain healthy, intact, functional ecosystems capable of providing ecosystem services including the preservation of biodiversity (supporting)
- Creation of national parks, wilderness areas, and wildlife refuges
- Reconnecting fragmented habitats by establishing wildlife corridors

- **Sustainable land use**

- Reducing urban sprawl by promoting greater urban density (urban growth boundaries, infill development, building up, not out)
- Sustainable agriculture and reducing meat consumption / production

- **Restoring lost habitat**

- Reclaiming abandoned mining sites, replanting logged forests, or abandoned urban/suburban areas



Mitigating Biodiversity Loss – Legislation and Enforcement

- ***Endangered Species Act (1973)*** forbids harming species designated as endangered or their habitats.
 - Loopholes allow habitat destruction if other suitable habitat is set aside or restored by developer.
 - One of the most effect conservation laws ever passed in the U.S.
- ***Convention on International Trade in Endangered Species of Wild Flora and Fauna (1973 (CITES))***
 - International treaty banning the sale, transport, or possession of endangered species or their parts.

- **Local laws and enforcement to prevent poaching**
 - Hiring armed guards to monitor sensitive populations.
 - Using forensic science (DNA) to track the sale of endangered animal parts (ivory, meat, furs, etc)



Mitigating Biodiversity Loss – controlling invasive species

Controlling the spread of Invasives

- Laws preventing transport of invasives (e.g. firewood for emerald ash borer)
- Removal of hosts to reduce spread (e.g. dead ash trees for EAB)
- Inspection stations around areas of known introduction or sensitive habitats to prevent spread. (e.g. zebra mussels)
- Introduction of natural predator (biological control)
 - Chinese wasps to kill emerald ash borer
- Physical removal (hunting pythons, detaching z. mussels, pulling plants out, cutting trees down)



Mitigating Biodiversity Loss – Captive Breeding Programs



(b) Biologists use hand puppets to nurse condor chicks



(a) A black rhino is air-lifted into Serengeti National Park

- **Captive breeding of endangered species;** individuals are bred and raised in captivity so they can be reintroduced into the wild.
 - 65 U.S. plant and animal species exist *only* in captivity
 - Captive breeding of Condors was one of the first attempts and occurred at the San Diego Zoo Safari Park
 - Many zoos maintain sperm/egg banks and seed banks from endangered species breeding (white rhino)
- **Reintroductions can be controversial**
 - Ranchers opposed reintroducing wolves to Yellowstone National Park
 - Without ample habitat and protection in the wild, having captive breeding and cloning animals in a zoo does little good.