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16

Biological Resources

Overview of Chapter 16

- Biological Diversity
- Extinction and Species Endangerment
 - Endangered and Threatened Species
 - Where and why species are endangered
- Conservation Biology
- Conservation Policies and Laws
- Wildlife Management

Tigers in India

- ~3,200 tigers left in wild from ~100,000 100 years ago
- Many sanctuaries across India
- Still illegally hunted
 - ▣ Traditional medicines
 - ▣ Few deterrents for poachers
 - ▣ Enforcement difficult



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Biological Diversity

- Biological Diversity
 - ▣ Number, variety and variability of Earth's organisms
- Consists of three components:
 - ▣ Genetic diversity
 - ▣ Species richness
 - ▣ Ecosystem diversity



Why We Need Organisms

- Example contributions to human life:
 - ▣ Food
 - ▣ Clothing
 - ▣ Shelter
 - ▣ Pollination of crops
 - ▣ Antibiotics and medicines
 - ▣ Biological processes (nitrogen fixation)
- Biological diversity represents an untapped resource for future uses

Ecosystem Services and Species Richness

- All organisms are interrelated and connected
 - ▣ Remove one and others will respond
- Ecosystem services
 - ▣ Important environmental benefits that ecosystems provide to people
 - ▣ Removal of a species from a community can decrease ecosystem services



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Scientific Importance of Genetic Diversity

- Variation is critical for species survival
- Humans can also perform genetic engineering
 - ▣ Incorporation of genes from one organism into a different species
 - ▣ Provided:
 - New vaccines
 - More productive farm animals
 - Agricultural plants with desirable characteristics
- Depends on genetic diversity (cannot create genes)
 - ▣ Important to protect this diversity

Medicinal Importance of Organisms

- Genetic resources are important to pharmaceutical industry
- Examples
 - ▣ Rosy Periwinkle – Cancer drug (right)
 - ▣ Aquatic sponge – AIDS drug



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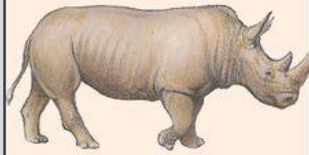




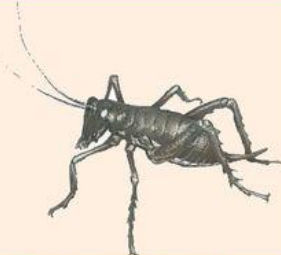




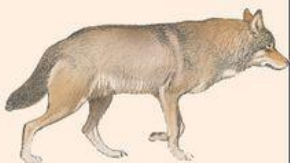


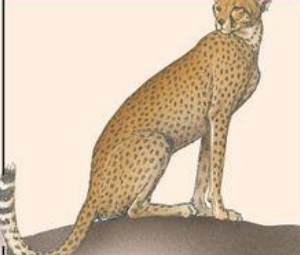
Importance of Organisms

- Agricultural Importance
 - ▣ Numerous species that are nutritionally superior to the food we eat
- Industrial Importance
 - ▣ Industry depends on products from organisms
 - Oils and lubricants
 - Paper and lumber
- Ethical and Aesthetic Importance
 - ▣ Mental health, inspiration, recreation




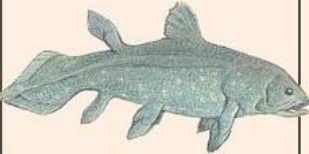










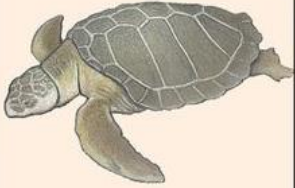



Extinction

- Extinction – death of the last individual of a species
- Elimination of species from earth
 - ▣ Irreversible
 - ▣ Eventual fate of all species
- Background extinction
 - ▣ Continuous, low level extinction of species
- Mass extinction
 - ▣ Numerous species disappear in a relatively short period of geologic history
 - ▣ 5-6 mass extinctions in history

Endangered & Extinct Species

San Joaquin kit fox 	Dusky seaside sparrow 	Monterey manzanita 	Atitlan giant pied-billed grebe 	Black rhinoceros 	Pitcher plant 
Iguana 	Mountain gorilla 	Trumpeter swan 	Giant weta 	Golden lion tamarin 	Whooping crane 
Green turtle 	Bladderpod 	Red wolf 	Abingdon tortoise 	Partula snail 	Cheetah 

Endangered & Extinct Species

Arizona century plant 	Dodo 	Tiger 	Coelacanth 	White rhinoceros 	Kiwi 
Snow leopard 	Cyanea 	Saddle-backed tamarin 	Black mammoth 	Grizzly bear 	Great auk 
Hawaii 'o'o 	Ivory-billed woodpecker 	Kemp's ridley sea turtle 	Texas snowball 	Black-footed ferret 	Horned guan 

Endangered and Threatened Species

- Earth's biological diversity is disappearing at an unprecedented rate
- Endangered Species
 - Species that faces threats that may cause it to become extinct within a short period
- Threatened Species
 - Species whose population has declined to the point that it may be at risk of extinction

Characteristic of Endangered Species

- Extremely small (localized) range
- Requiring a large territory
- Living on an island
- Having a low reproductive success
- Small population size
- Low reproductive rates
- Requiring specialized breeding areas
- Having specialized feeding habitats



Jeffrey Lepore/Science Source

California Condor

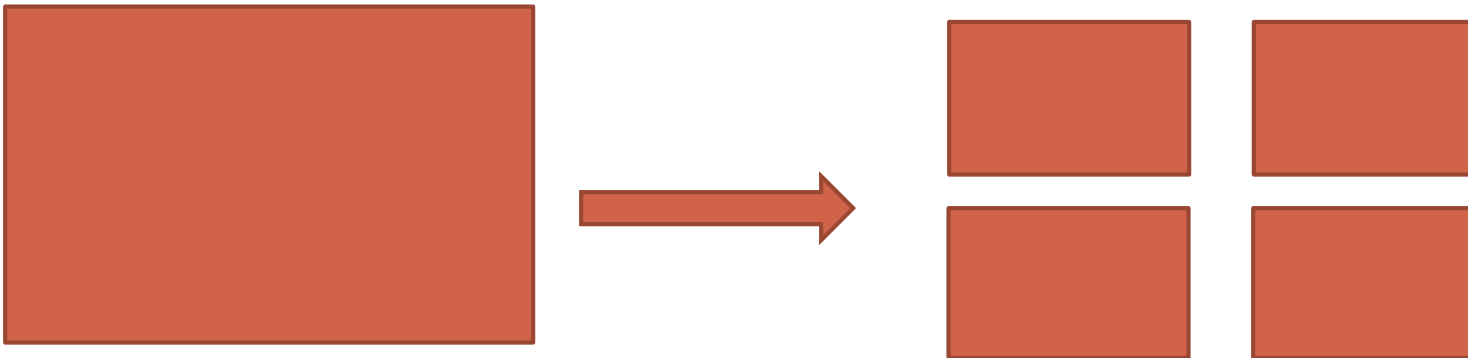
- Scavenger bird
- Requires large, undisturbed territory
- 1983 - only 22 birds
- 1987–1992 - no longer found in nature
- 1992 - reintroduced to nature from zoos
- 412 condors in nature (2013)



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Habitat Fragmentation

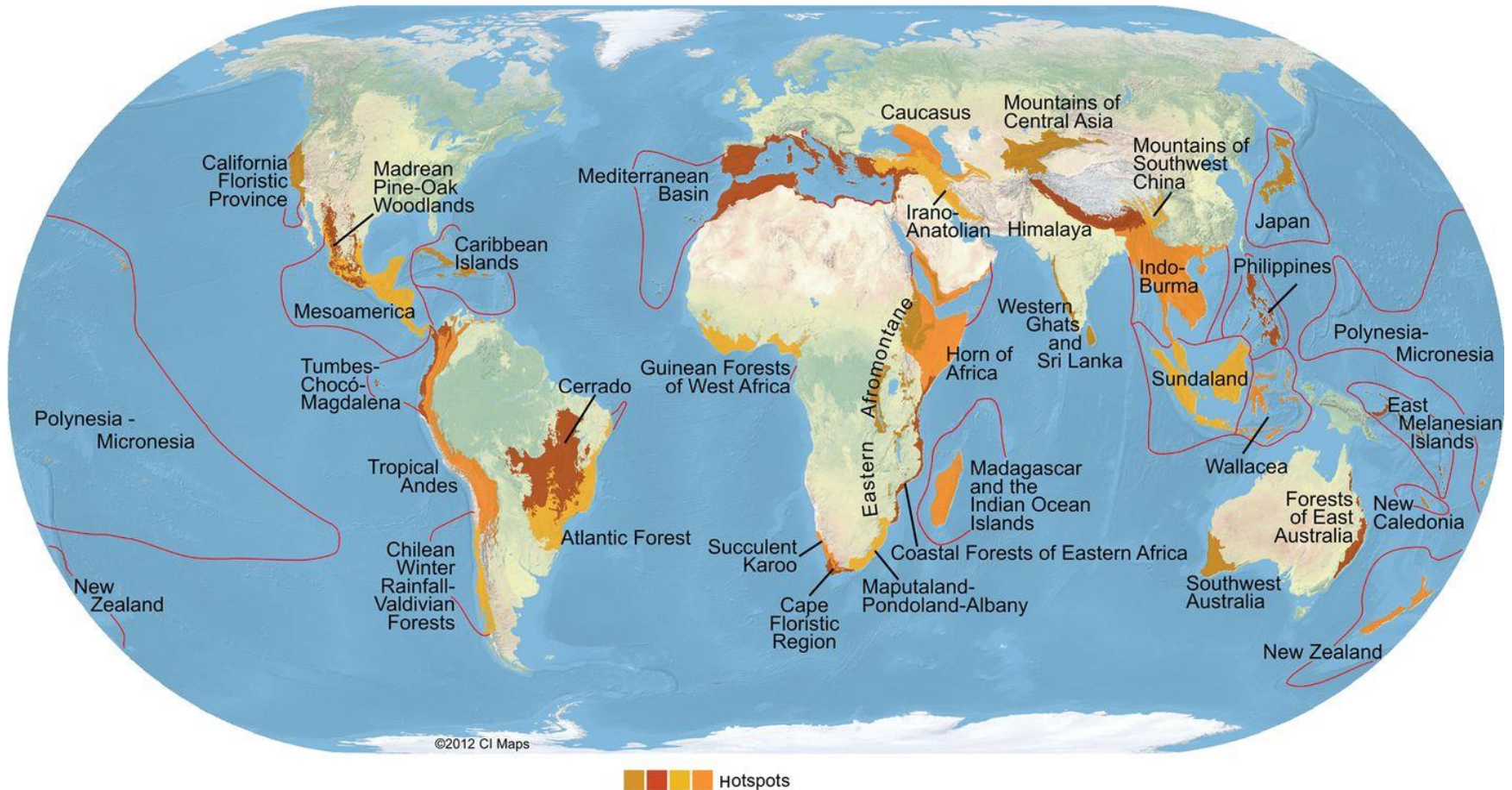
- Break up of large areas of habitat into small, isolated patches
- Many species need larger ranges
- Affects gene transfer
- Examples: roads, houses



Where is Declining Biological Diversity the Greatest Problem?

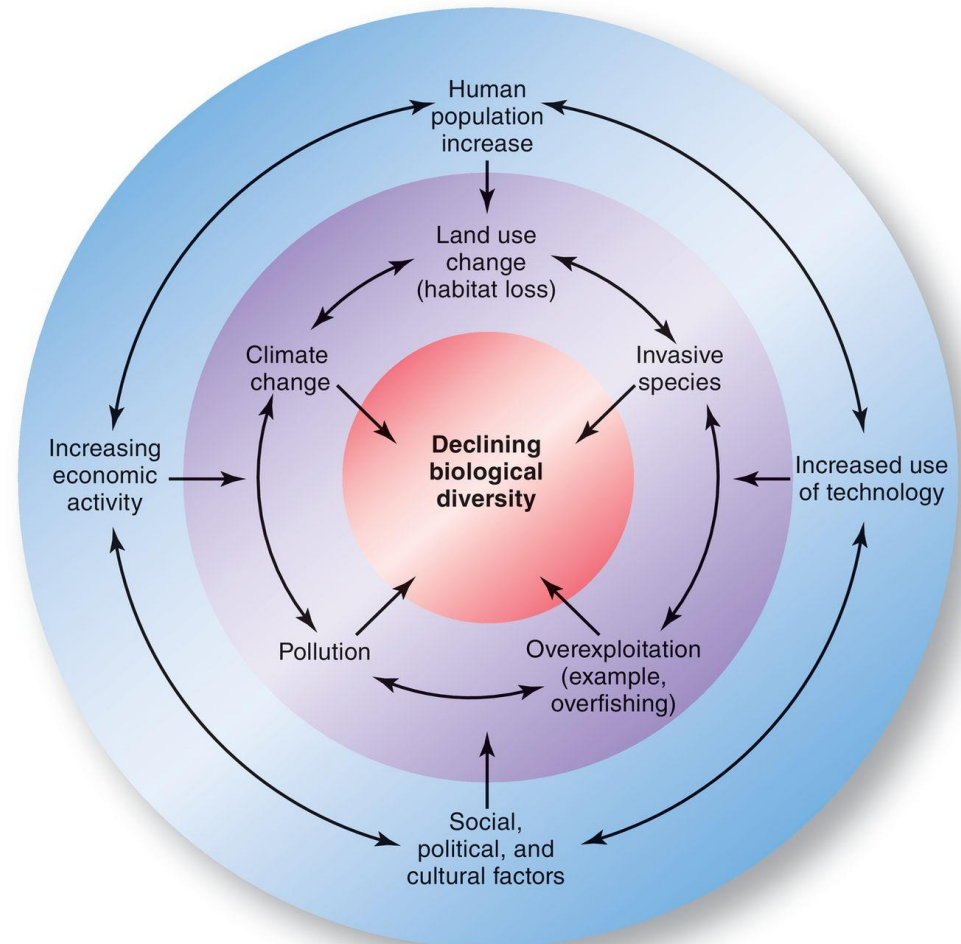
- Concern throughout the U.S.
- U.S. - Most serious in:
 - ▣ Hawaii (63% of species at risk)
 - ▣ California (29% of species at risk)
- Globally- Most serious in tropical rain forests
 - ▣ South and Central America
 - ▣ Central Africa
 - ▣ SE Asia

Earth's Biodiversity Hotspots



Causes of Declining Biodiversity

- Millennium Ecosystem Assessment
 - ▣ Report on state of environmental resources



Human Cause - Land Use Change













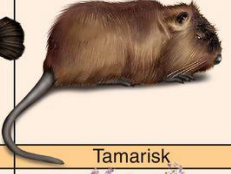







- Destruction
- Fragmentation
- Degradation
- Little habitat remains in an its original form for endangered species (right- fragmentation)



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Human Cause - Invasive Species

- Biotic pollution
- Invasive species
 - ▣ Foreign species that spread rapidly, free from population controls

Asian long-horned beetle 	Asian tiger mosquito 	Brazilian pepper tree 	Brown tree snake 	Caulerpa 
European wild boar 	European gypsy moth 	Fire ant 	Formosan termite 	Japanese mud snail 
Kudzu 	Northern snakehead 	Nutria 	Puerto Rican frog 	Purple loosestrife 
Rosy wolf snail 	Sea lamprey 	Tamarisk 	Water hyacinth 	Zebra mussel 

Human Cause - Overexploitation



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Left: Illegal Trade in Products Made From Endangered Species

Right: Illegal Animal Trade- Green Parrots from the Amazon Rainforest



© NHPA/Photoshot

Human Cause - Pollution

- Examples: Acid rain, ozone depletion, climate warming, excessive fertilizer, industrial wastes



Ron Sanford/Science Source

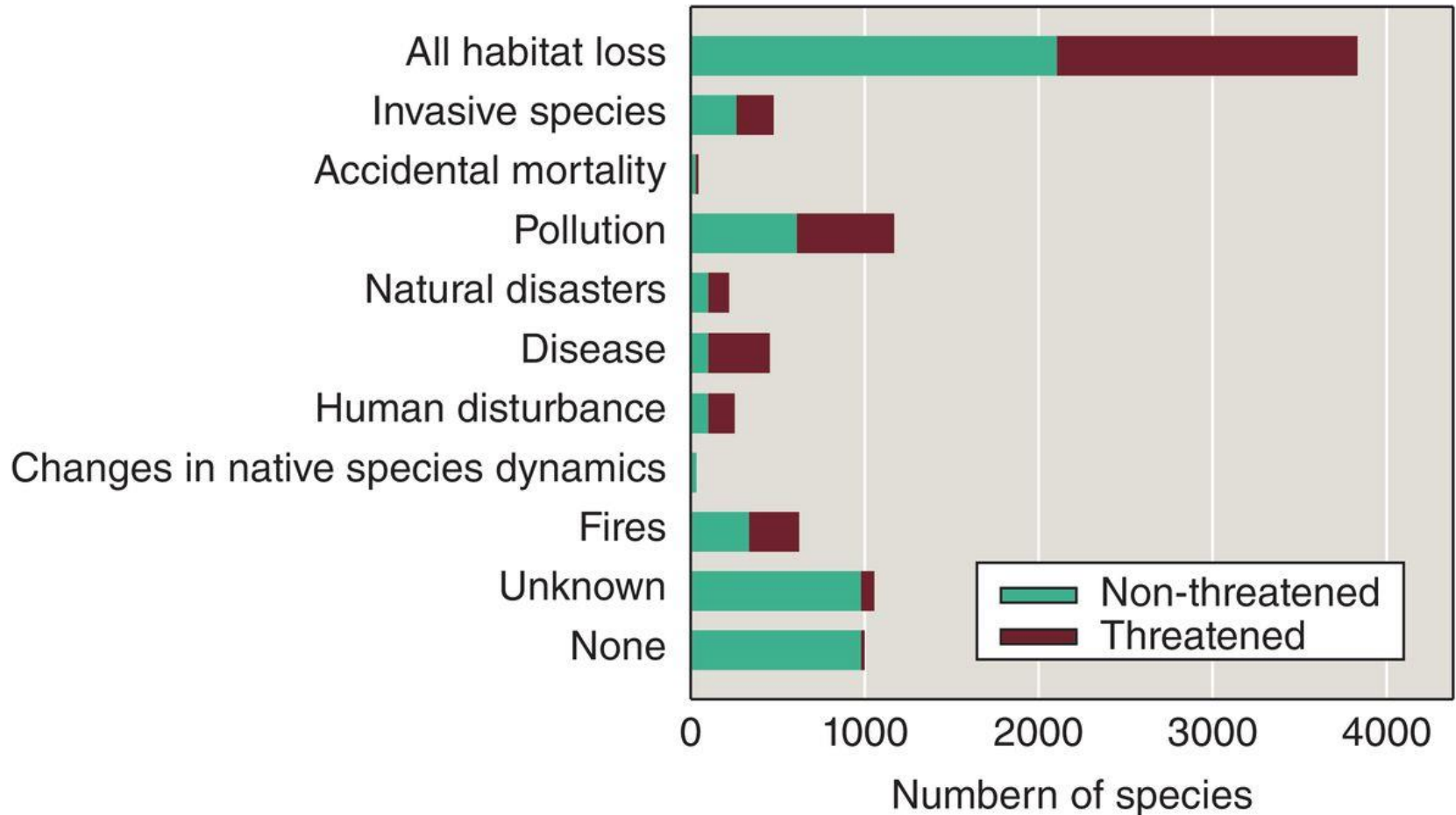
Case-In-Point: Disappearing Frogs

- Amphibians are indicator species
 - ▣ 168 Amphibian species have gone extinct in last 2 decades
 - ▣ No single cause has been identified
- Deformities have also been identified (right)



Suzanne L. & Joseph T. Collins/Science Source

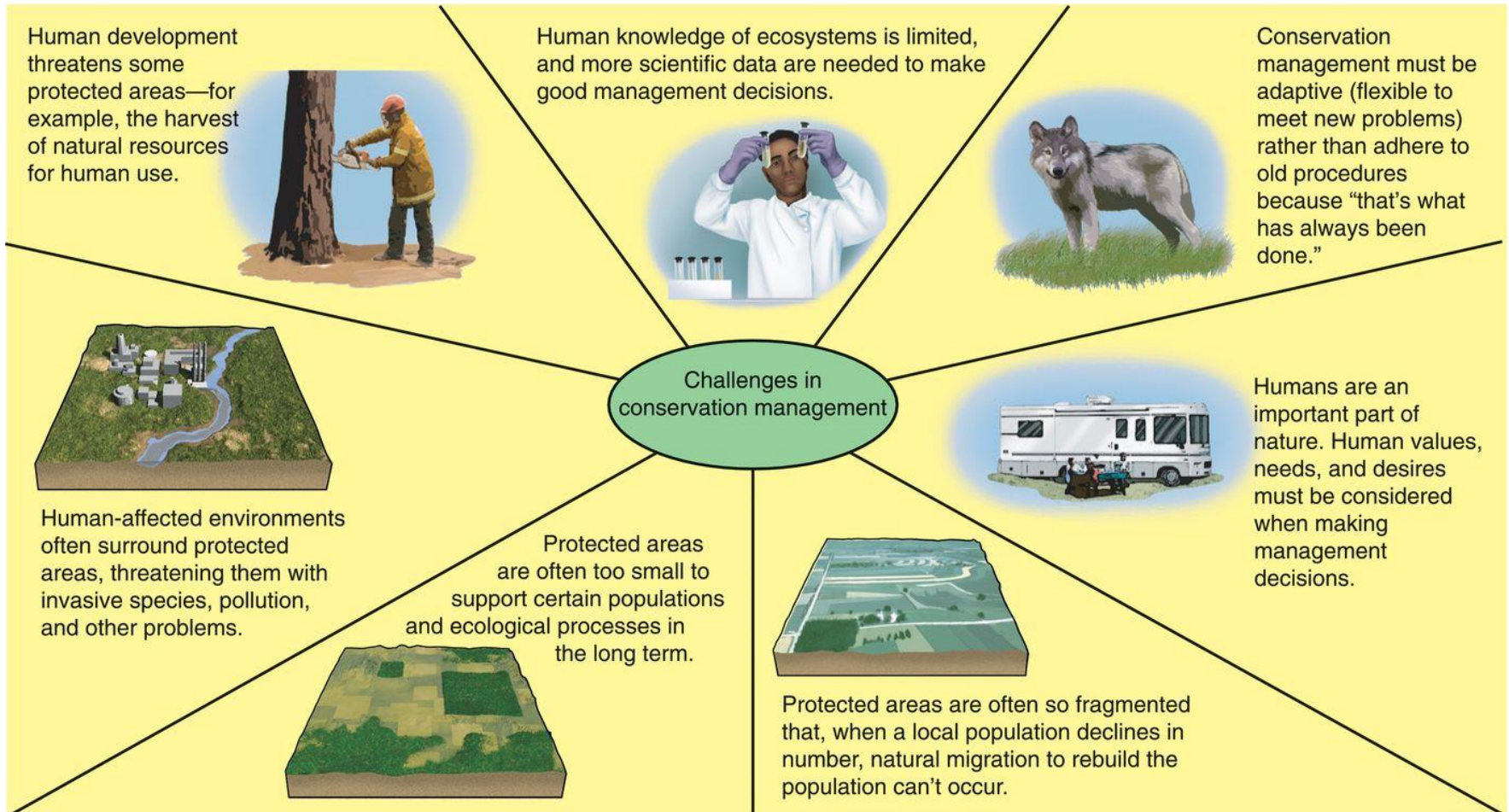
Case-In-Point: Disappearing Frogs



Conservation Biology

- Scientific study of how humans impact organisms and the development of ways to protect biodiversity
- Involves:
 - ▣ Protecting habitats
 - ▣ Restoring damaged or destroyed habitats
 - ▣ Zoos, aquaria, botanical gardens
 - ▣ Seed banks
- In situ and ex situ conservation
 - ▣ On-site and off-site

Challenges in Conservation Management



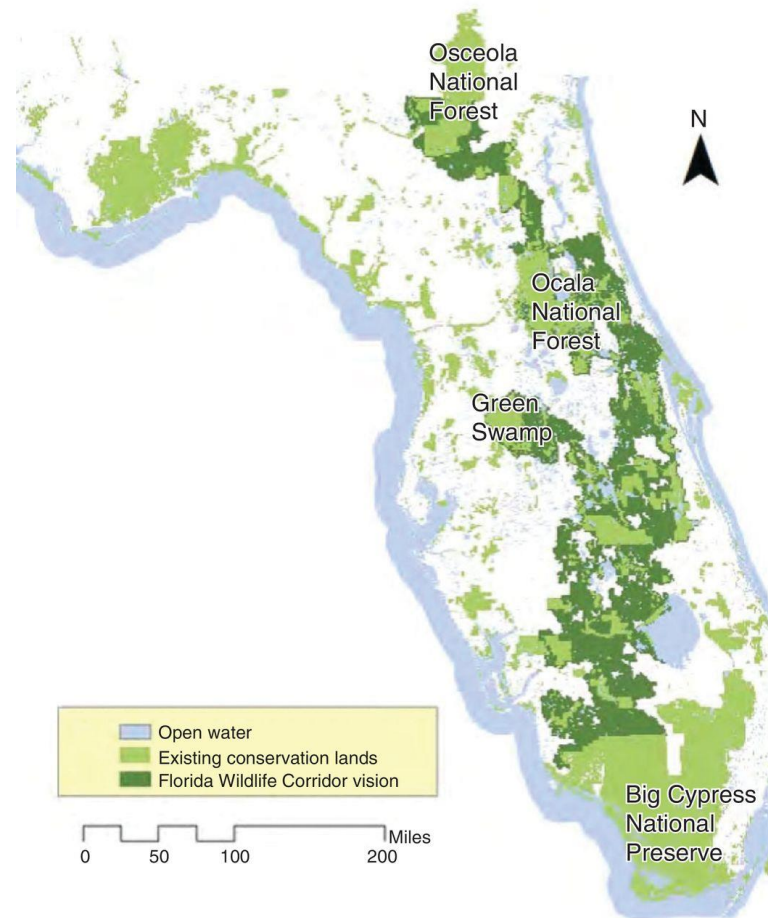
Fragmented Habitats

- Habitat separated by roads or other human development
- Habitat corridors- allow animals to move from one fragment to another safely



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Fragmented Habitats and corridors



Restoring Damaged Habitats

- Restoration ecology- study of the historical condition of a human-damaged ecosystem with goal of returning it to its former state (when possible)
- Benefits
 - ▣ Creates biological habitats
 - ▣ Regeneration of soil damaged by agriculture or mining
- Disadvantages
 - ▣ Expensive
 - ▣ Take a long time to restore an area

Restoring Damaged Habitats

Ex: Prairie restoration



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Zoos, Aquaria and Botanical Garden

- Save organisms from extinction
 - ▣ Artificial insemination
 - ▣ Embryo transfer
 - ▣ Surrogate mothers
- Goal is to reintroduce organisms back to their natural habitat
- Citizen scientists
- Flagship species

Seed Banks

- Stored seeds are safe from habitat destruction, climate warming, etc.
- Can use seed banks to reintroduce extinct plant species
 - ▣ Genetic variation
- Some seeds cannot be stored
- Svalbard Global Seed Vault (right)

Paul Nicklen/National Geographic Creative



Conservation Policies and Laws- ESA

- Endangered Species Act (ESA) 1973
 - Authorized protection of endangered and threatened species
 - Makes it illegal to sell or buy any product made from an endangered species
 - Currently >1500 species are listed in US (2014)
 - Species are designated as endangered or threatened based on biological grounds

Conservation Policies and Laws- ESA

- Endangered Species Act (continued)
 - ▣ Controversial Legislation
 - No compensation for private property owners who suffer financial loss
 - ▣ Was not reauthorized in 1992 as scheduled
 - Private property rights vs. conservation



Millard H. Sharp/Science Source

Conservation Policies and Laws

- Habitat Conservation Plans
 - 1982 Amendment to ESA
 - Resolved conflicts between development interests and species protection
- International Conservation:
 - World Conservation Strategy (1980)
 - Convention on Biological Diversity
 - Convention on International Trade and Endangered Species of Wild Flora and Fauna (CITES) (1975)

Wildlife Management

- Application of conservation principles to manage wild species and their habitats for human benefit or for the welfare of other species
- Different priorities than conservation biology
 - Wildlife managers concerned with common species
 - Conservation biologist concerned with threatened or endangered species

Wildlife Management

□ Migratory Animals

- Ex: Arctic Snow Geese - increase in population has damaged much of Arctic fragile coastal ecosystem (below)



HUDSON BAY PROJECT/KRT/Newscom

Wildlife Management

- Aquatic Organisms
 - ▣ Must be managed to ensure they are not overexploited
- Freshwater fishes
 - ▣ Laws regulate time of year, size of fish and maximum allowable catch
- Ocean fishes
 - ▣ Ocean fisheries often viewed as common property
 - ▣ Changing with overfishing



Assisted Colonization

- Climate change is already shifting species ranges
- Active participation by scientists to maintain species
- Assisted colonization
 - Species at risk are moved to areas where they have not been found before
 - Controversial