Preserving Biodiversity
herping
more herps

2 types of diversity

1) Species or ecological diversity
   - describes the # of different types of species in an ecosystem
   - Species richness = # different species in an area

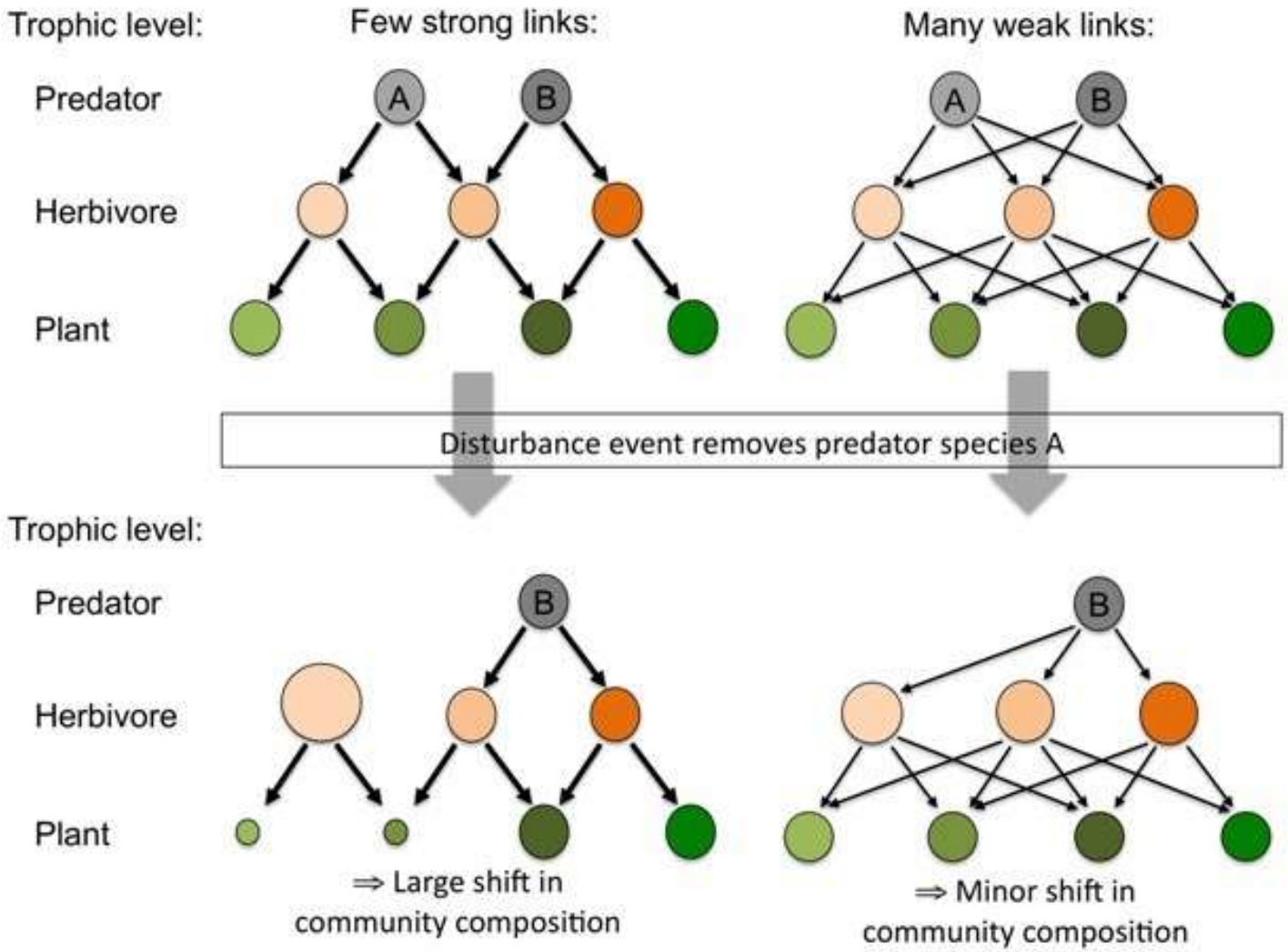
2) Genetic diversity within a population
   - describes variation in gene pool

Why biodiversity is important

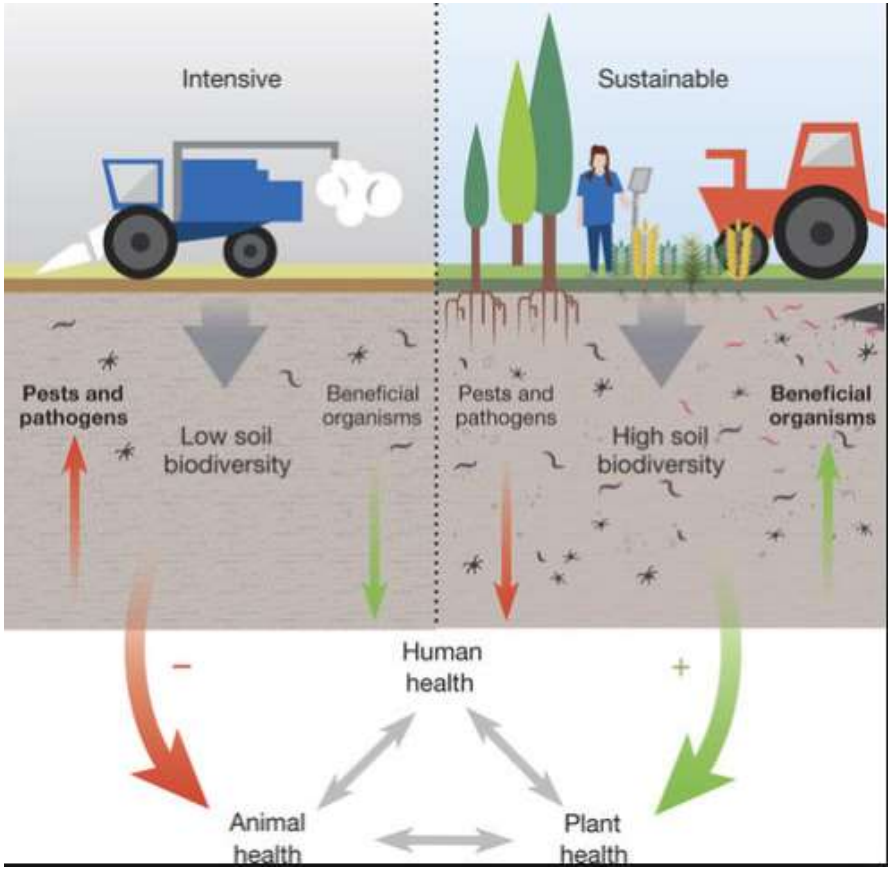
1) Diversity → stability

- High species diversity = many different organisms to fill each niche (one dies another can replace it)

Diversity in food webs and niches = more stability



Case study: Intensive agriculture → decreased soil microbes = less stable



High genetic diversity = hybrid vigor (greater opportunity to survive environmental change)

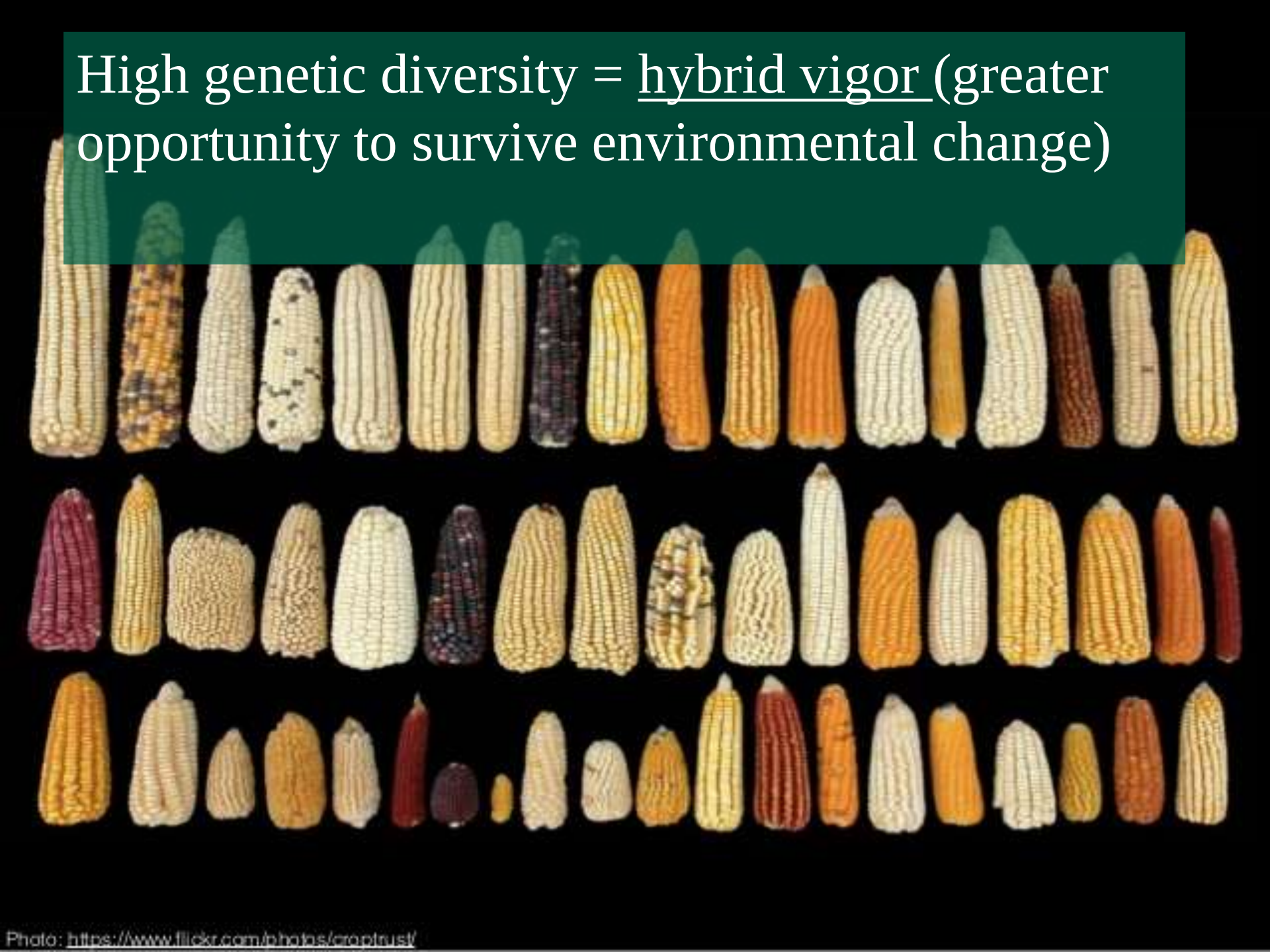
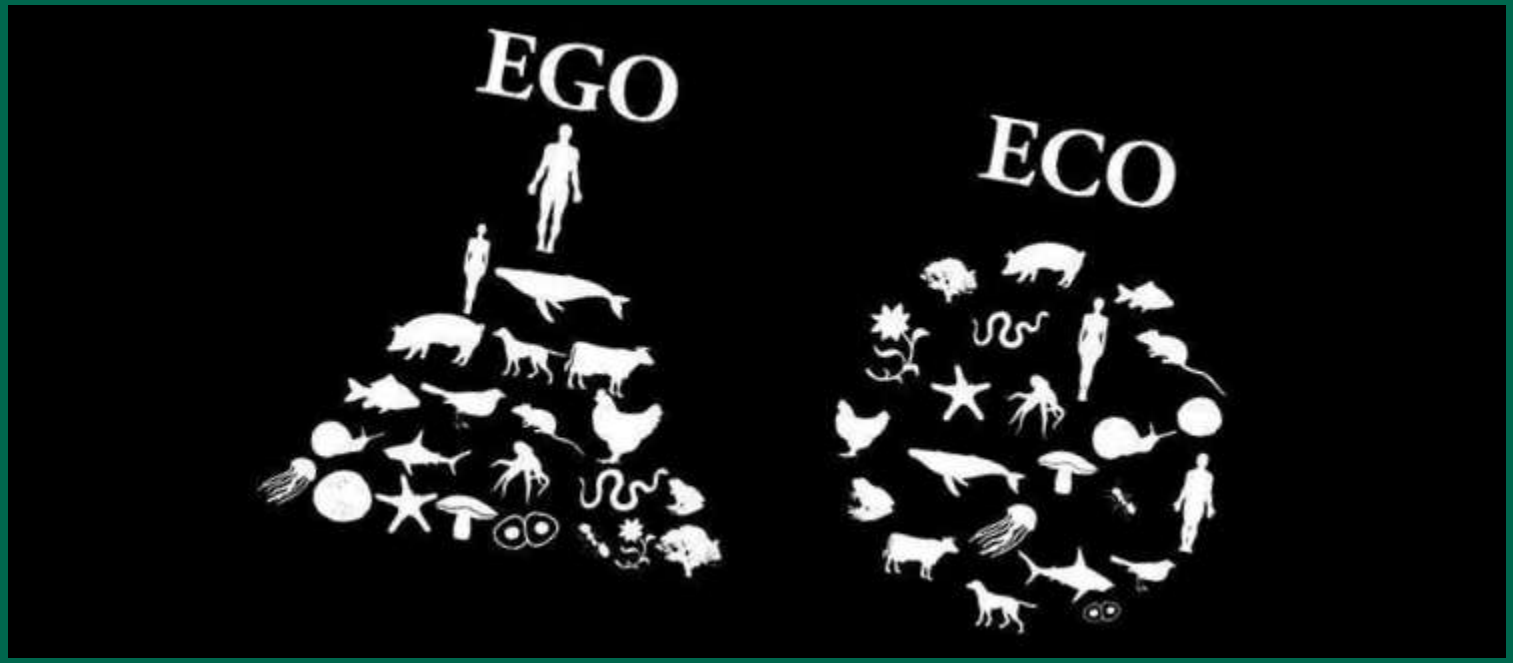


Photo: https://www.flickr.com/photos/croptrust/

2) Interdependence .

No species can exist alone



Organisms perform ecosystem services.

- Trees and native grasses →
  - produce oxygen,
  - remove CO_2,
- prevent erosion and flooding…

Insects pollinate


Bacteria fix nitrogen and build healthy soils


Micorrhizae fungi help plants absorb water and nutrients

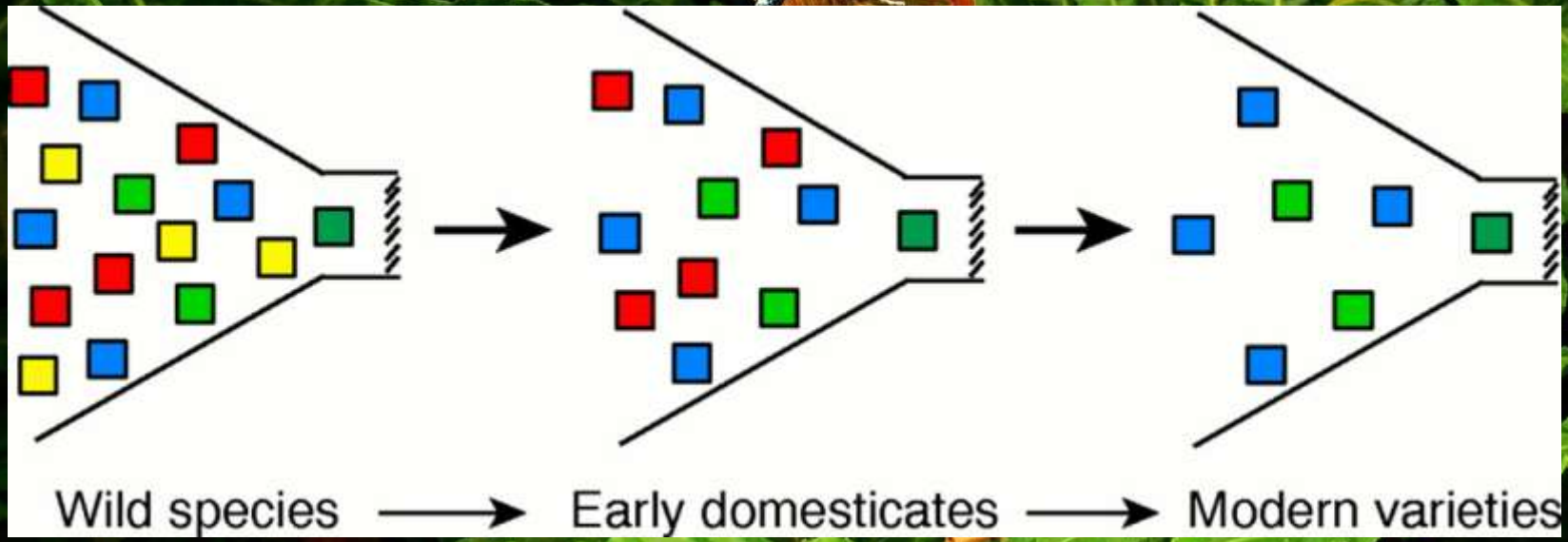
3) Loss of biodiversity = loss of natural resources

- Food
  - 80,000 edible plants could be utilized
    - villagers in Indonesia use 4000 plant and animal species
    - We rely primarily on CORN, rice, wheat, and soy

¼ of all prescription drugs come from rainforest (only 20,000//270,000 plants have been analyzed)

Genetic diversity → transgenic organisms

genes for pest resistance, drought tolerance, pharmaceuticals…



Case story

Native tree species in Costa Rica like the one above → cancer treatments
Merck pays conservation organization in Costa Rica $1 million for samples each year


Being replaced by monocultures of palm trees

4) Aesthetic and intrinsic values

- Aesthetic and Cultural Benefits
  - Recreation (hunting, fishing, camping)
  - Ecotourism
- Intrinsic Value
  - Species should be allowed to exist without having to provide a reason

Definition of Species

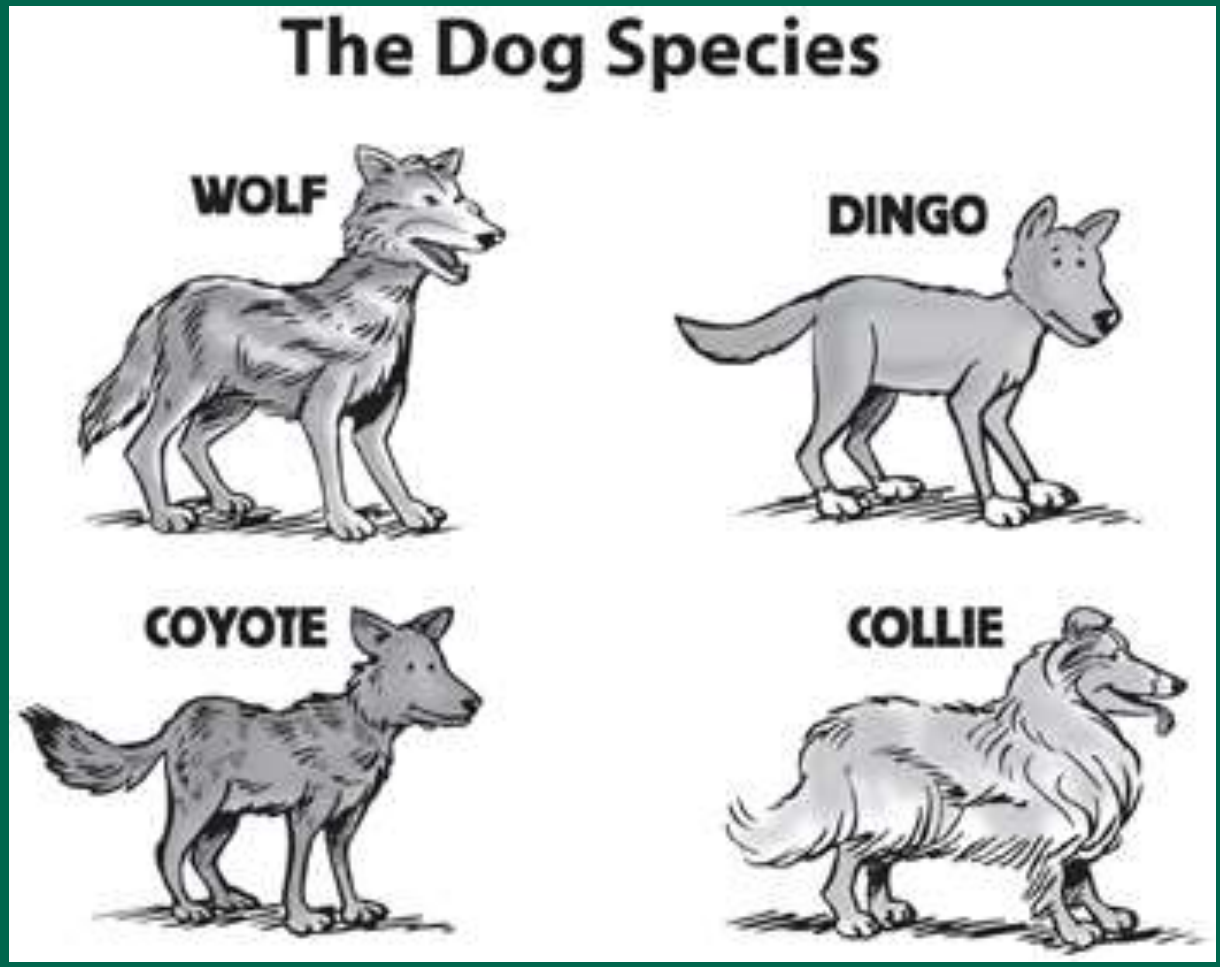
- Mate and produce viable offspring in the wild.
- Lots of grey area within this definition

se

Donke

Mule

Wolves (canis lupus), Coyotes(canis latrans) Domestic dogs (canis familiaris)
= closely-related species.
All three can interbreed and produce viable, fertile offspring — wolfdogs, coywolves, and coydogs



Extinctions = the permanent loss of a species

1. Background extinction = natural rate of extinction (determined by fossil records)
   - Natural rate of decrease = 1 species per million/yr

2. Mass extinctions (can wipe out 25-70% of all species) Caused by:
   - Catastrophic global events → changes in climate

Death in Our Changing World

Late Devonian Extinction

Cretaceous-Paleogene Extinction

Permian-Triassic Extinction

Late Ordovician Extinction

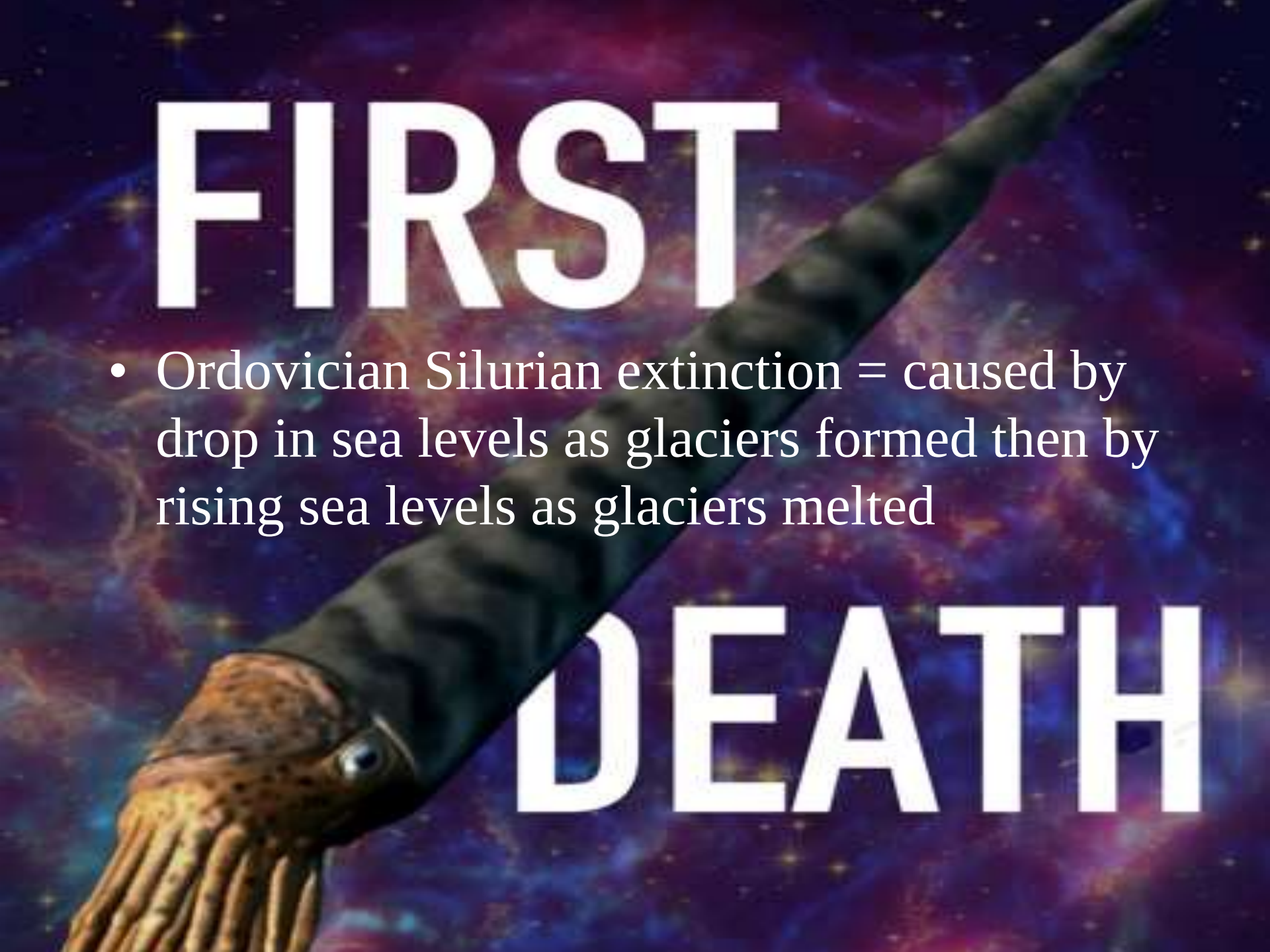
Triassic-Jurassic Extinction

glaciers

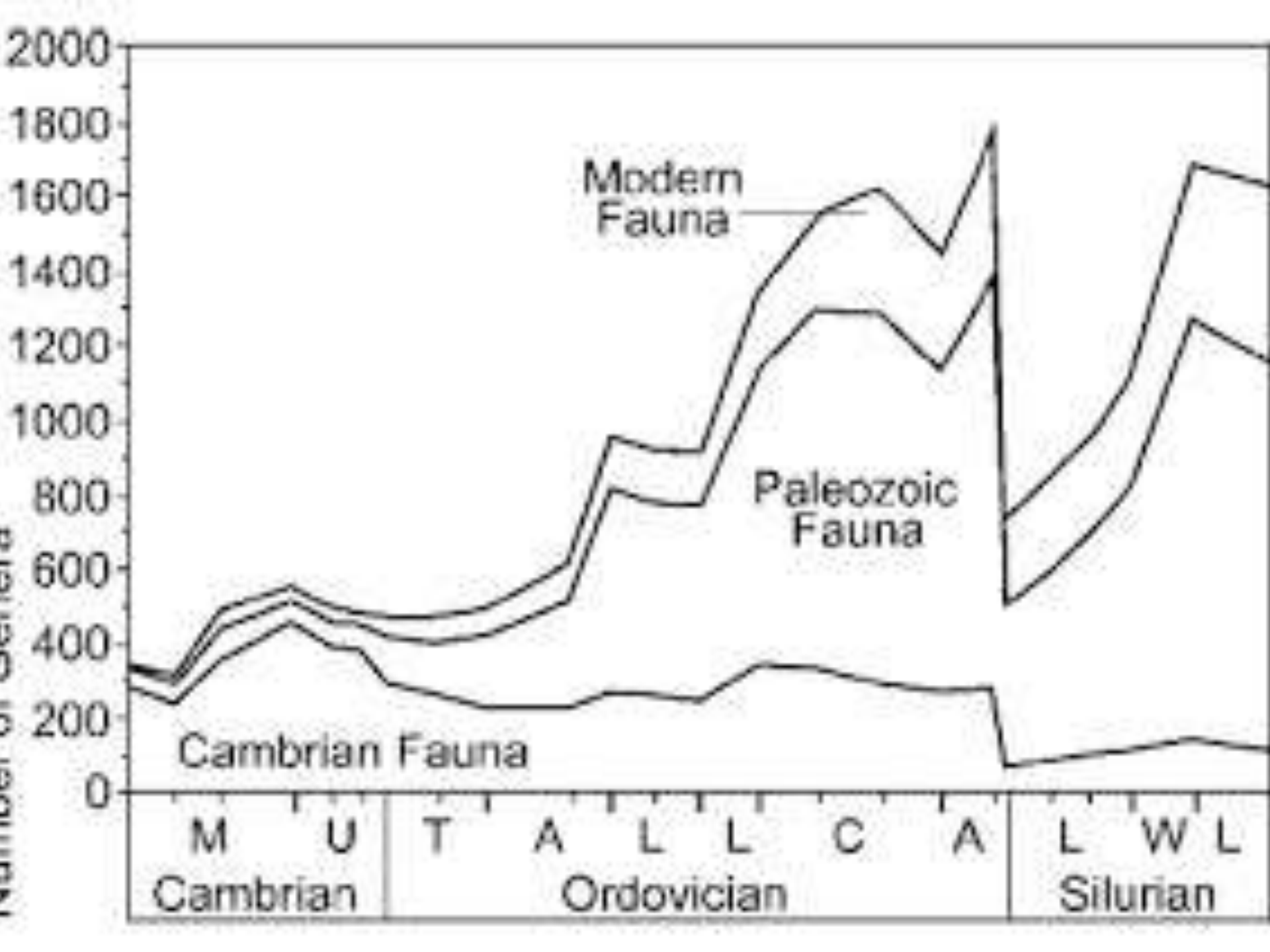
land

shallow marine

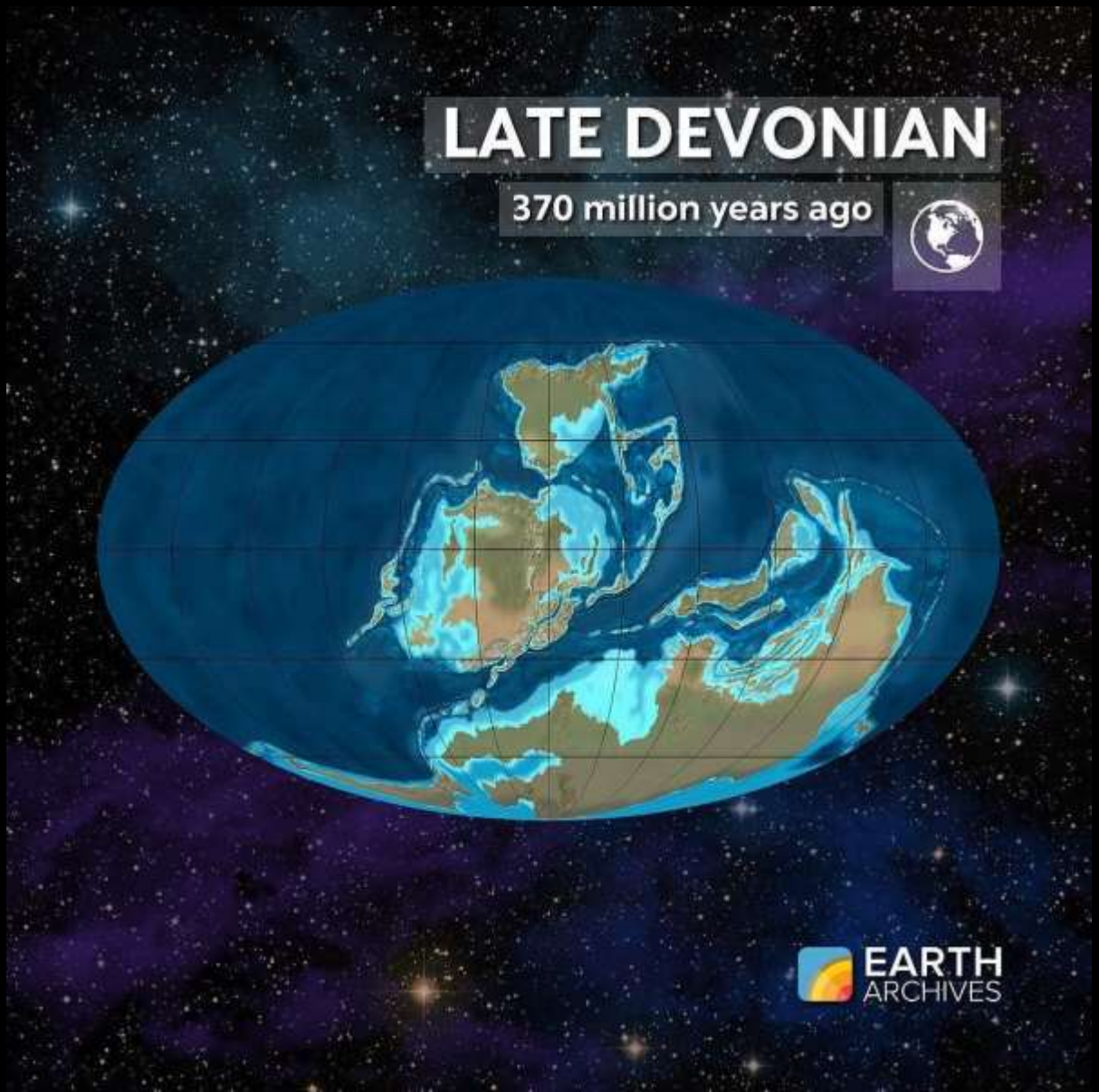
deep marine

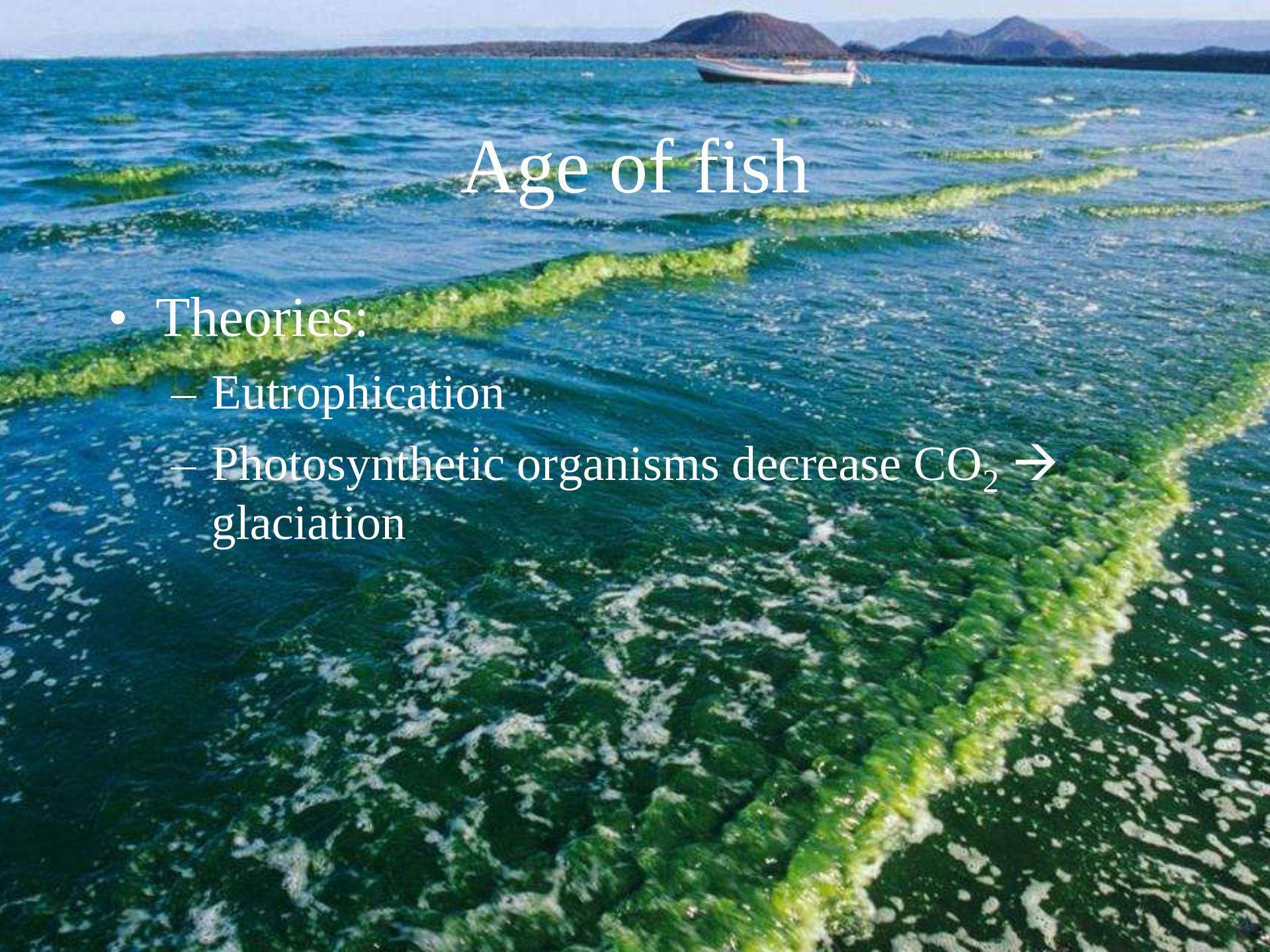


- Ordovician Silurian extinction = caused by drop in sea levels as glaciers formed then by rising sea levels as glaciers melted


2000
1800
1600
1400
1200
1000
800
600
400
200
0
Number of Genera
Modern
Fauna
Paleozoic
Fauna
Cambrian Fauna
M U
Cambrian
T A L L C A
Ordovician
L W L
Silurian

SECOND DEATH





Age of fish

- Theories:
  - Eutrophication
  - Photosynthetic organisms decrease CO_2 → glaciation

Third Death Permian – Triassic extinction = 251 mil yrs ago

- Theories:
  - Meteor impacts volcanic activity
  - Runaway greenhouse effect

- BIGGEST EXTINCTION
- 84% marine species 70% of all land species

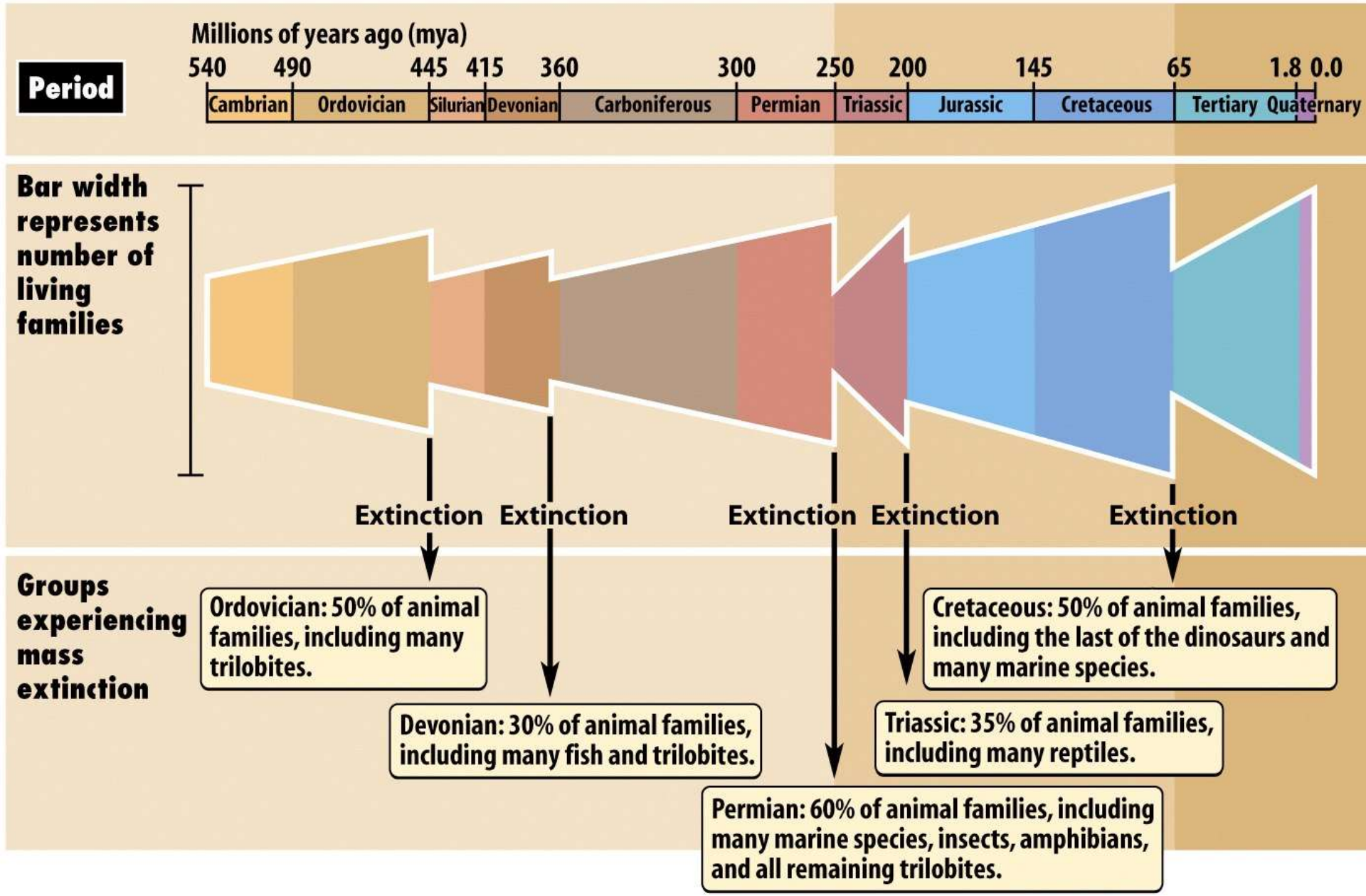


Figure 19-8 Discover Biology 3/e

MASS EXTINCTIONS:

The biggest disasters in history

ORDOVICIAN

Death Rate:

85 %

Time: 445 million years ago

Likely Causes:

- Rapid global cooling
- Falling sea levels

Results:

- Coastal areas destroyed
- Chemical reactions affected by cold

DEVONIAN

Death Rate:

70 %

Time: 340 million years ago

Likely Causes:

- Asteroid impact(s)
- Rapid global cooling

Results:

- Local destruction from debris
- Ocean life affected by temperature

PERMIAN

Death Rate:

95 %

Time: 250 million years ago

Likely Causes:

- Volcanic activity
- Increase in Methane and CO_2
- Rapid global warming

Results:

- Oxygen removed from oceans
- Desertification of land

TRIASSIC

Death Rate:

76 %

Time: 200 million years ago

Likely Causes:

- Increase in Methane and CO_2
- Rapid global warming

Results:

- Desertification of land
- Frequent heat waves

K-T

Death Rate:

80 %

Time: 65 million years ago

Likely Causes:

- Asteroid impact
- Volcanic activity
- Falling sea levels

Results:

- Widespread fires
- Plants disrupted by global ash cloud
- "Nuclear winter"

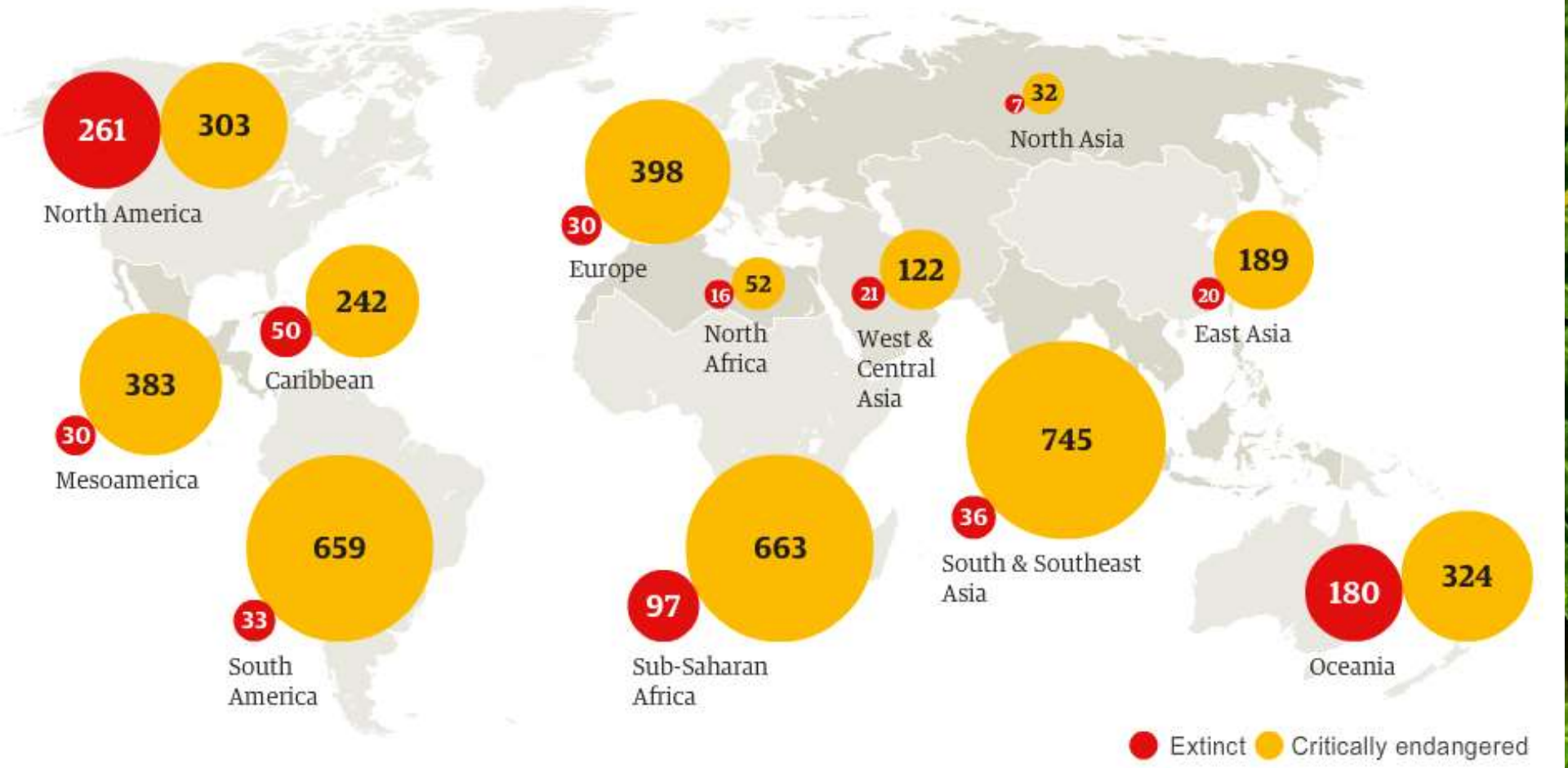
Poster by Budjarn Lambeth, Information from brittanica.com and bbc.co.uk, Images from Wikimedia Commons – Feel free to redistribute

IUCN Red List

Extinctions and critically endangered species in numbers

Click on the circles to see more information

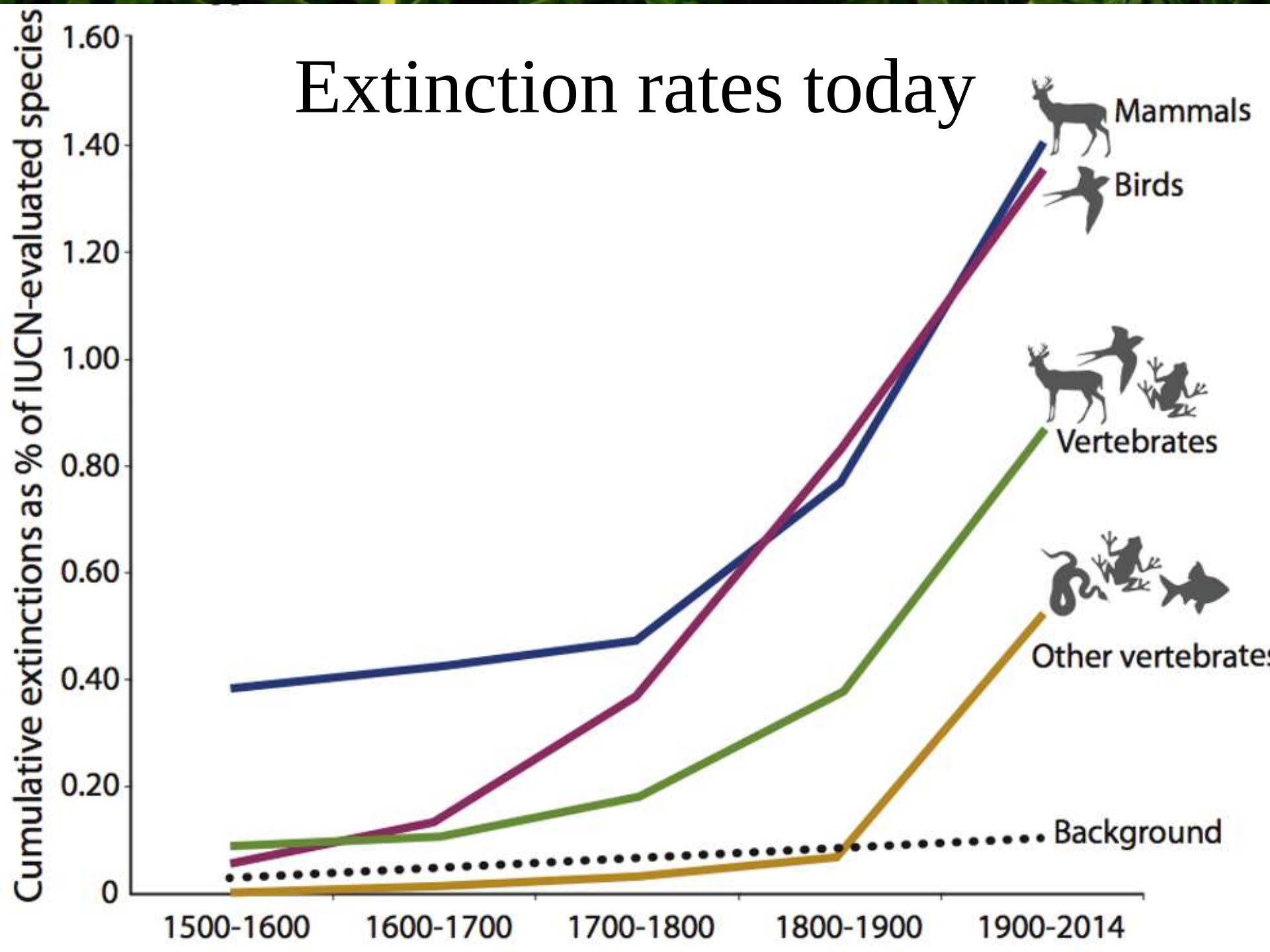
Exinct species » | Critically endangered species » | In numbers »



SOURCE: IUCN RED LIST

*Red list count began in 1996 but includes extinctions going back to 1500

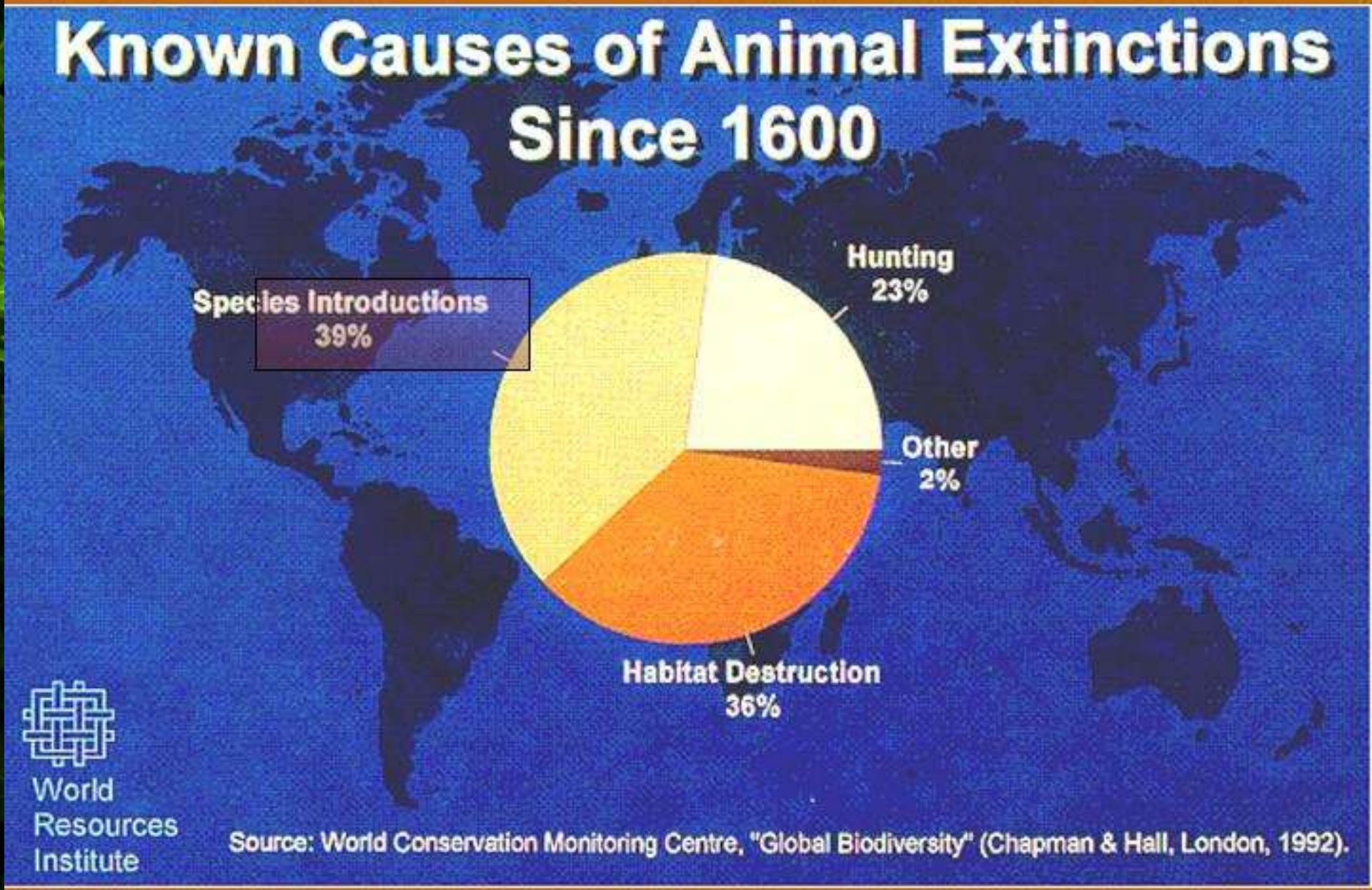
Extinction rates today



Direct causes of extinctions today

1. Habitat loss and fragmentation
2. Overexploitation (hunting, poaching, over-fishing and over-harvesting)
3. Competition from non-native invasive species
4. Pollution (bioaccumulation)
5. Climate change

Known Causes of Animal Extinctions Since 1600



World Resources Institute

Source: World Conservation Monitoring Centre, "Global Biodiversity" (Chapman & Hall, London, 1992).

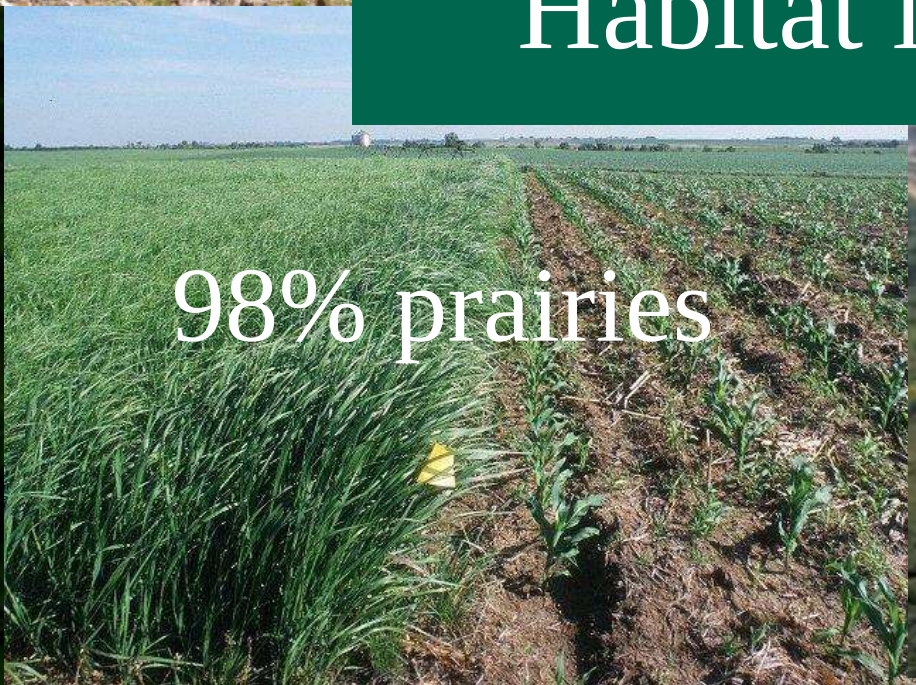
Root cause of extinctions

- Human population growth
- Economic policies that do not support the environment
- Poverty forcing resource degradation

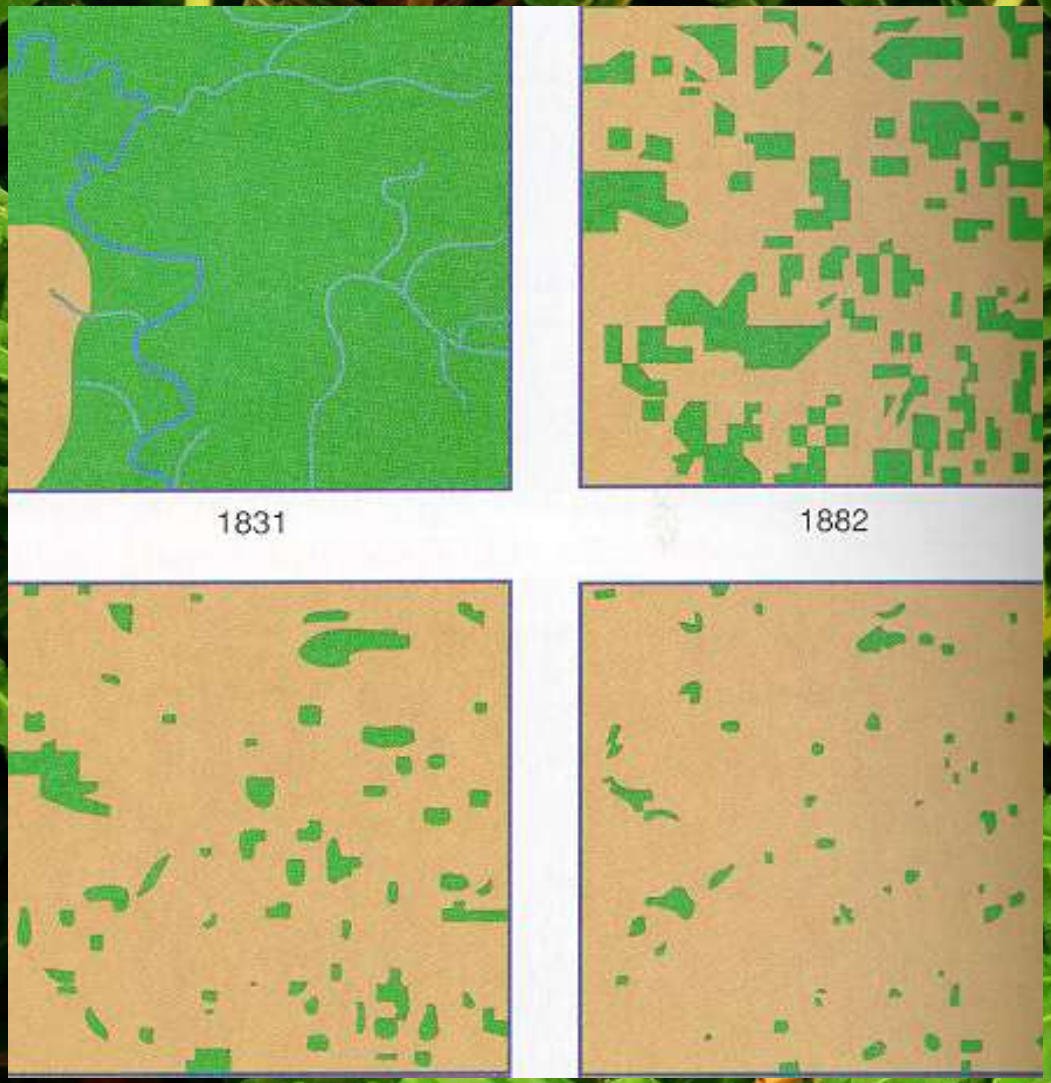
#1 Cause of extinctions = Habitat Loss and Fragmentation

Fragmentation = division of habitats that formerly occupied large, unbroken areas into smaller pieces by roads, fields, cities…

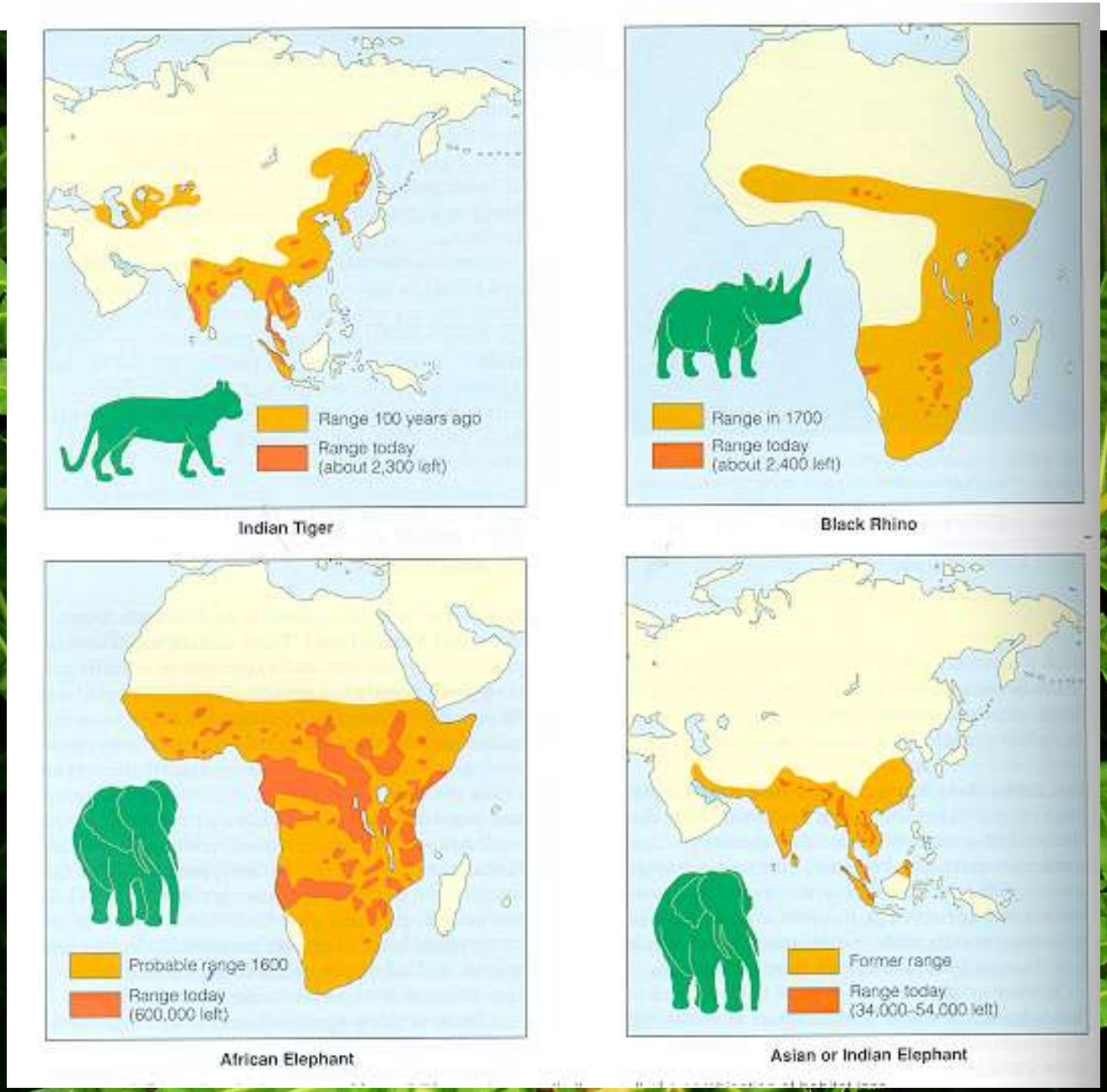
Habitat loss in the US



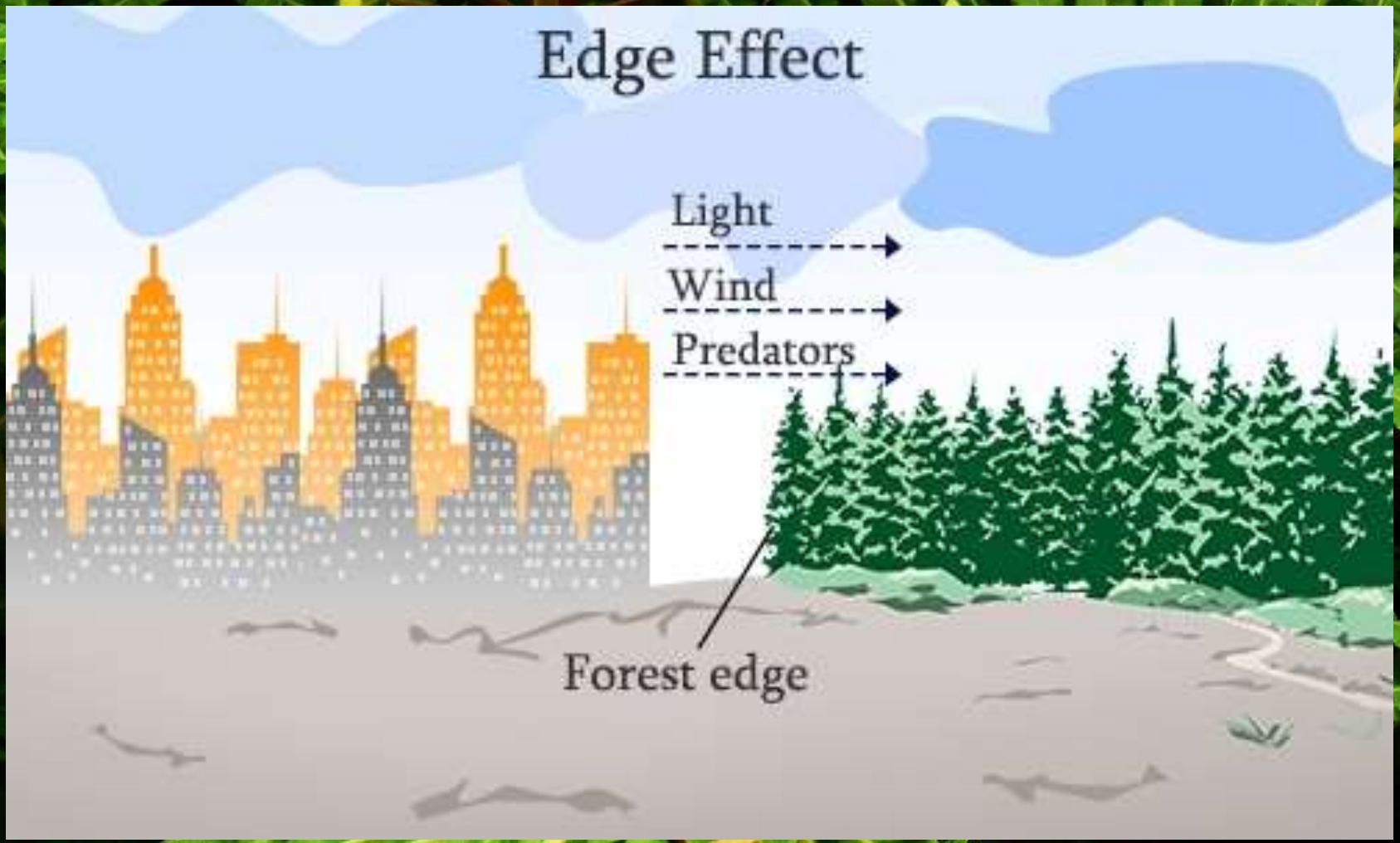
Ex: Fragmentation of land in Wisconsin



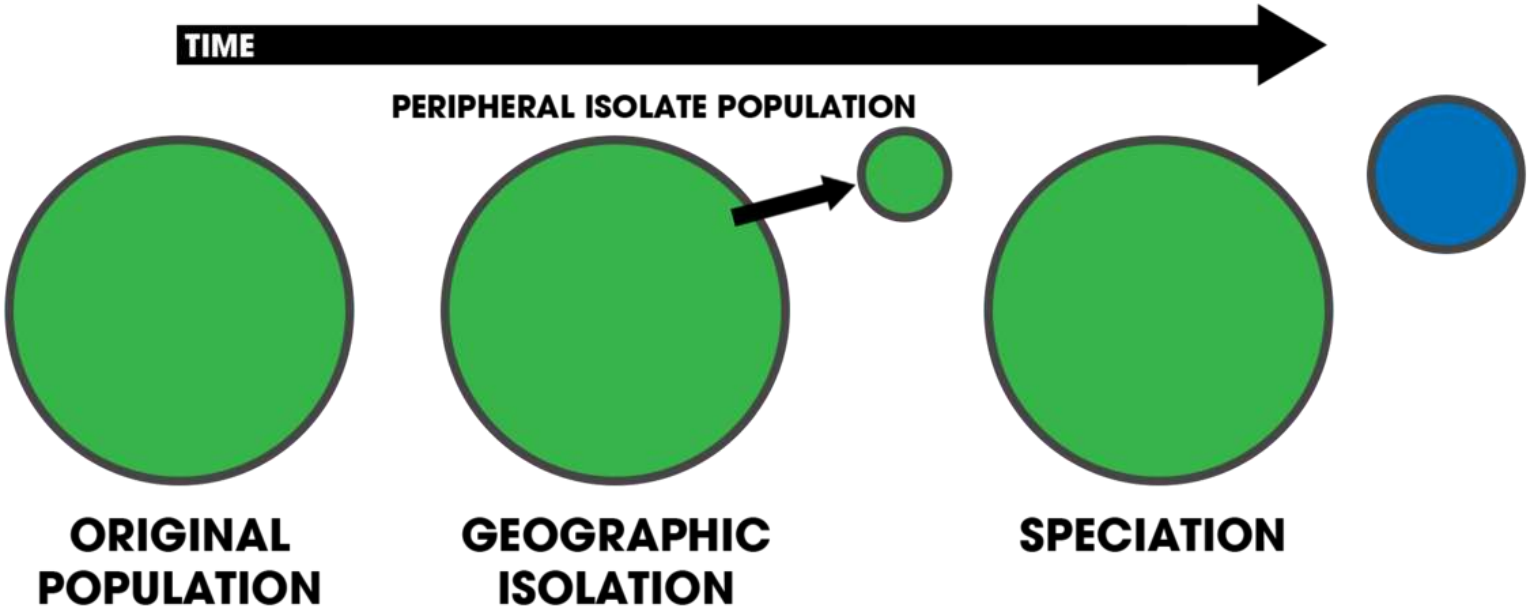
Ex: Endangered species and their ranges



Fragmentation →
Increased **edge effect** →
(Inc. predation, different microclimates**)**

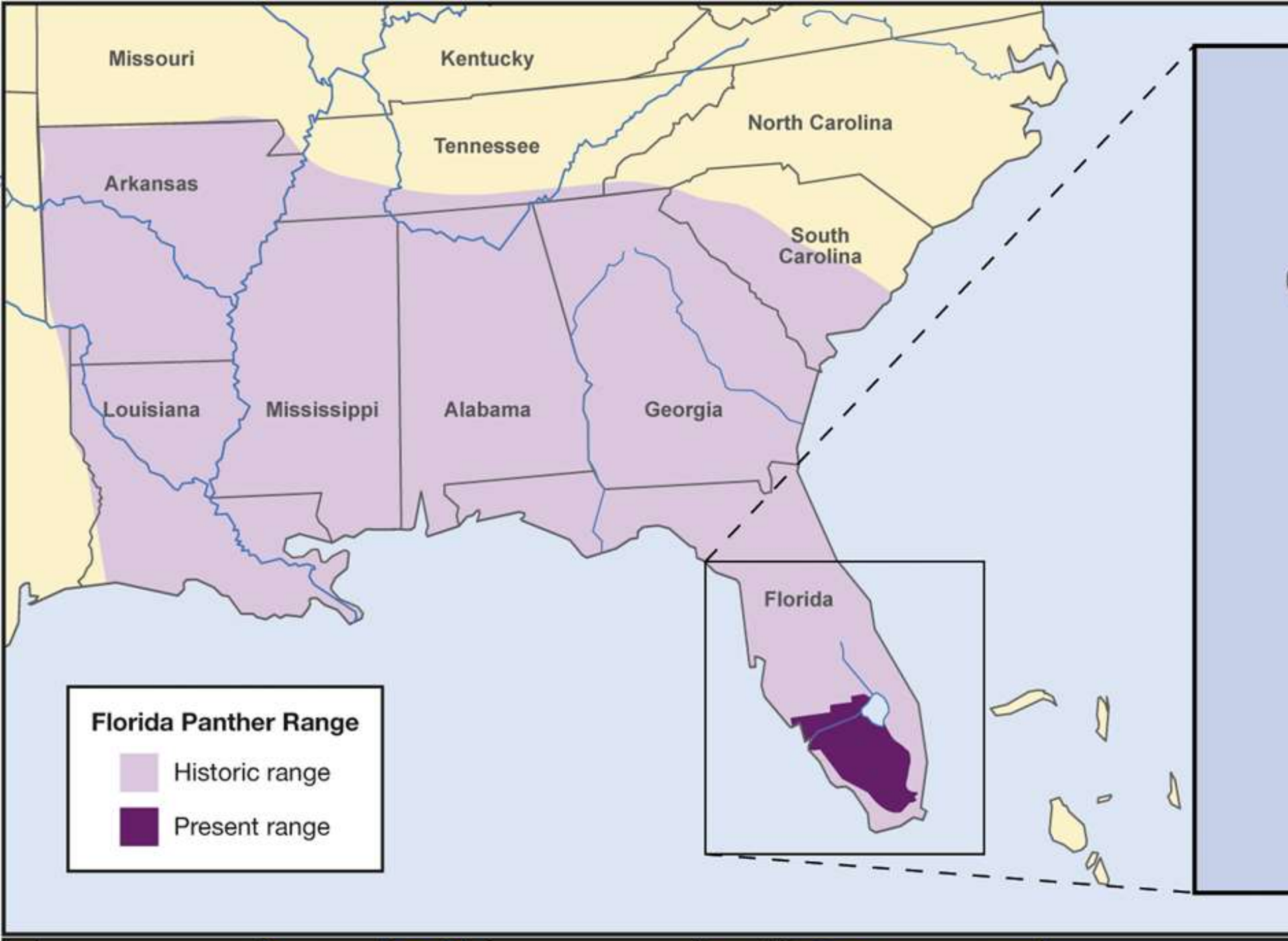


Geographic isolation → reproductive isolation → speciation



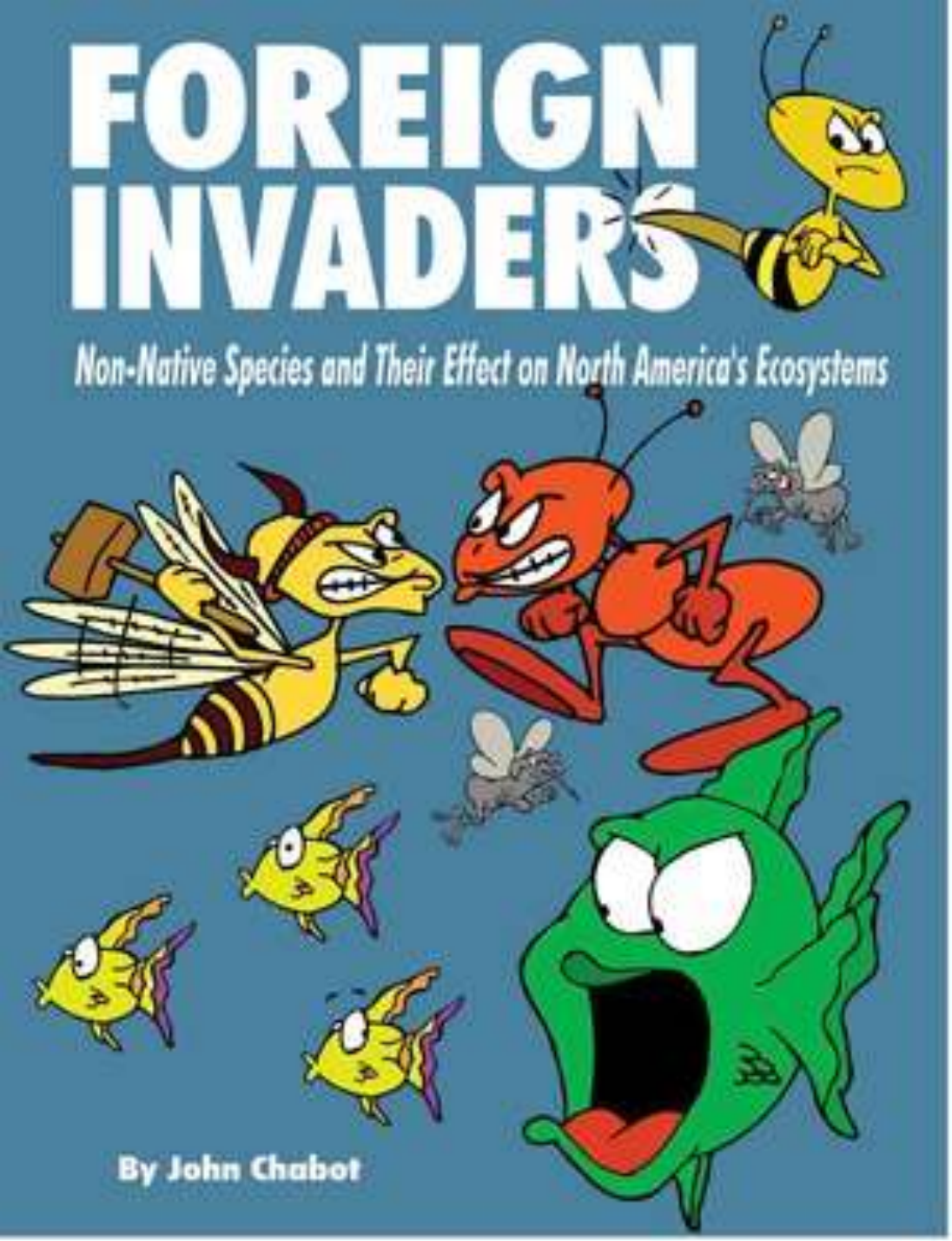
Florida Panther Case Study: Fragmentation → reproductive isolation → decreased genetic diversity → decreased health

Inbreeding → undescended testicles, kinked tails, and heart defects


Missouri
Kentucky
Tennessee
North Carolina
Arkansas
South Carolina
Louisiana
Mississippi
Alabama
Georgia
Florida
Florida Panther Range
Historic range
Present range

Conservation History

- 1970s and 80s only 20 – 30 left
- Introduced 8 female panthers from Texas
- Rebounded → 120 – 230 Hybrid panthers today



#2 Extinctions from = Introduced Species

Nonnatives:

- Have no natural predators
- Outcompete natives
- Carry diseases

What's the Difference?

- **Native Species**
  - **Species indigenous to a region**
- **Non-native Species (*Exotic, Introduced, Alien*)**
  - **Accidentally or purposefully introduction outside of its historic range**
- **Invasive Species *(Noxious)***
  - **Species that rapidly reproduces and displaces native species**
- **Nuisance Species *(Weed)***
  - **Species that interferes with human activities**

Photo: Invasive Common Reed Grass (Phragmites)

Characteristics of invasive species

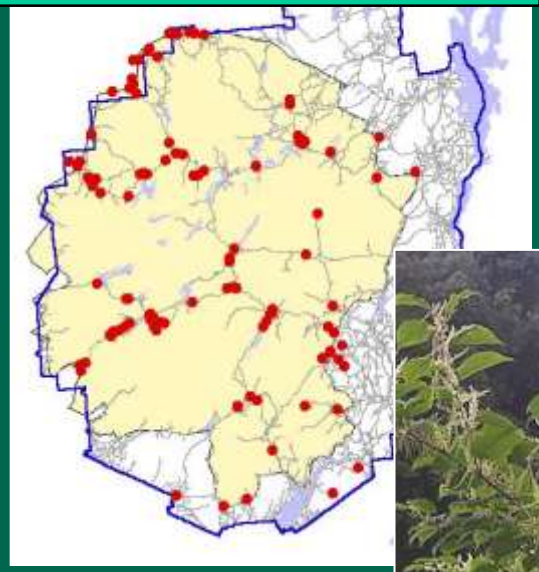
- No predators or parasites
- r strategists
- Rapid and early growth
- High reproductive capacity
- Generalist

Define biological control

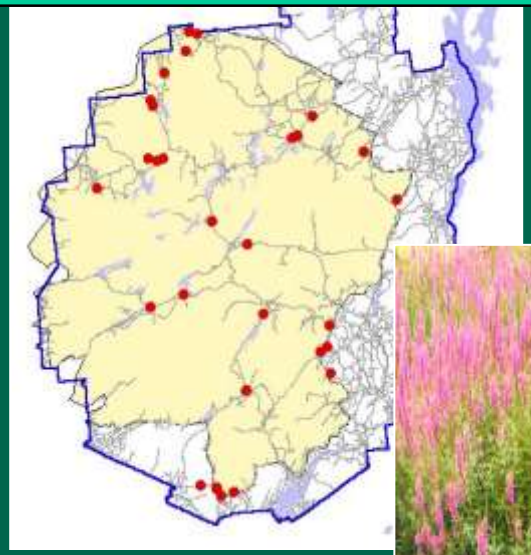
- Discuss pros and cons of using biological controls

Cane toads in Australia

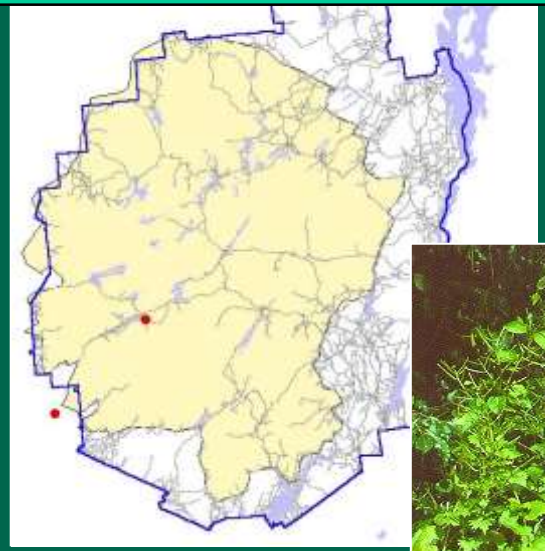
Japanese Knotweed



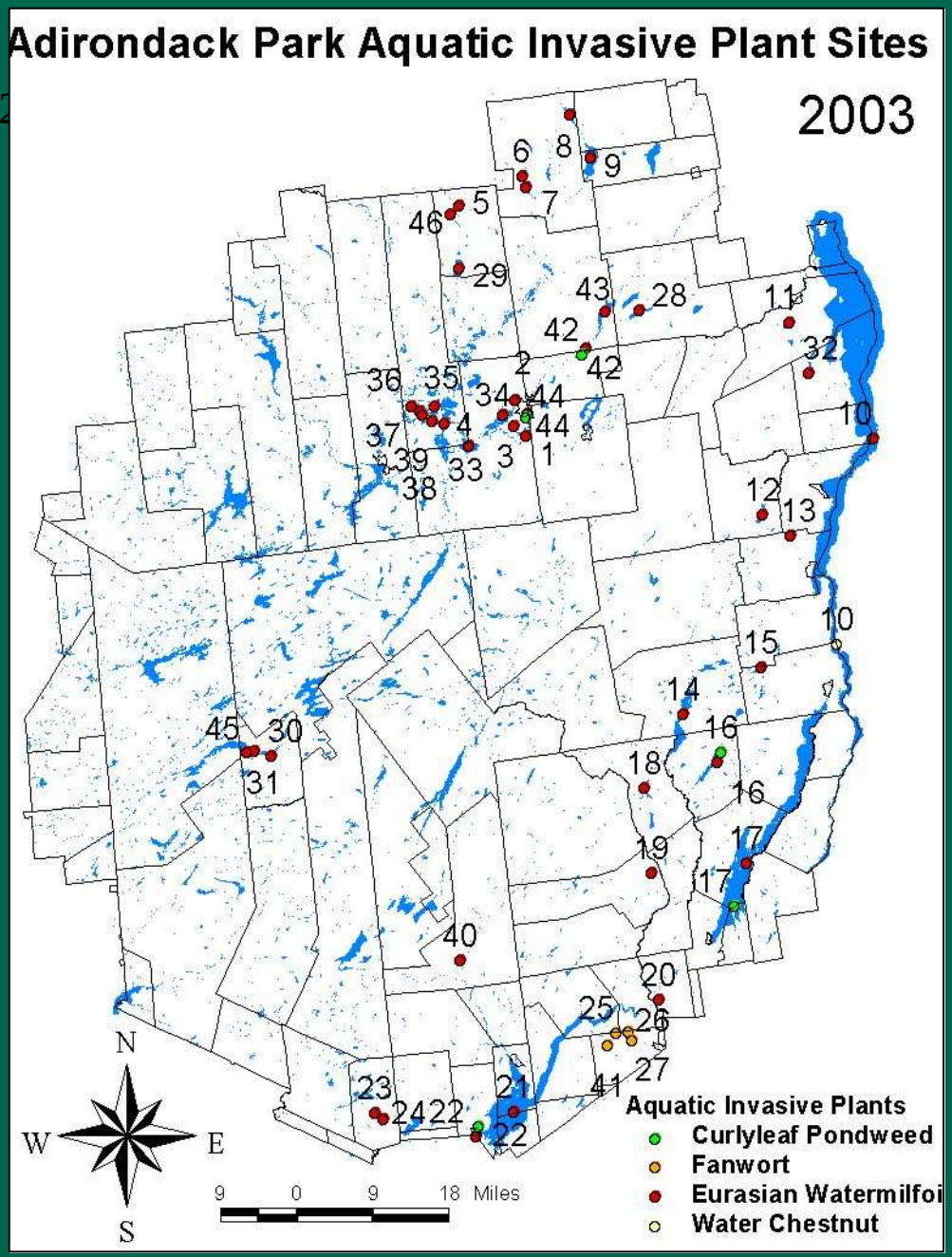
Purple Loosestrife



Garlic Mustard



Phragmites



Eurasian Watermilfoil

Leaf Whorl

Water Chestnut

Curlyleaf Pondweed

- Zebra Mussels

http://fisc.er.usgs.gov/Tracking_Invaders/in_depth/zebra_mussel.jpg

- Asian Longhorned Beetles threaten trees

http://www.dec.state.ny.us/website/dlf/privland/forprot/health/alb.htm

- Gypsy moth larvae destroy trees

http://wihort.uwex.edu/Phenology/images/Gypsy%20Moth%20Larva.jpg

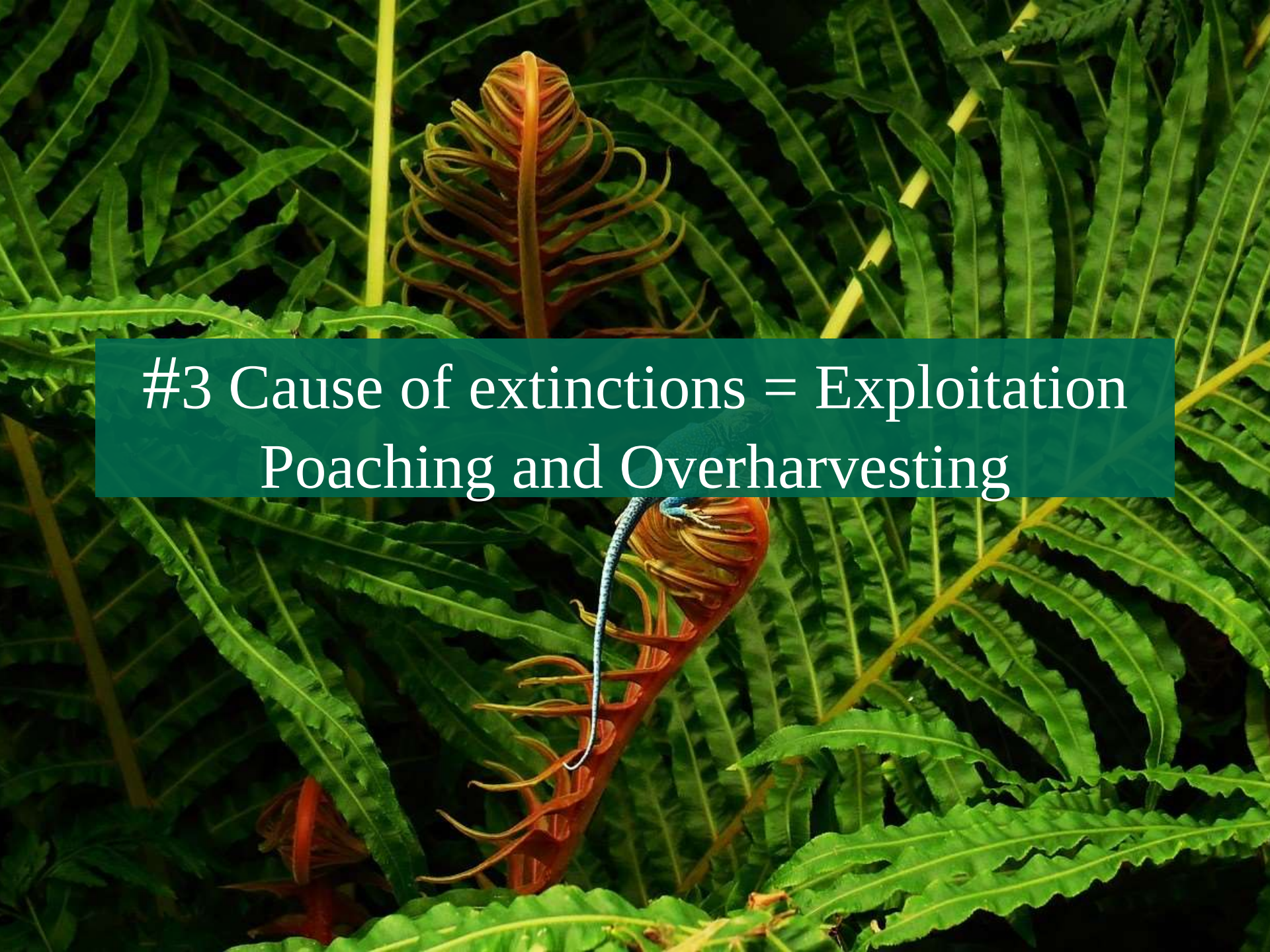
Emerald Ash Borer

- Native to Asia
- Destroys Ash trees

- Brought in on firewood and untreated lumber

http://www.invasive.org/browse/detail.cfm?imgnum=9000019


Kudzu vines in the south



#3 Cause of extinctions = Exploitation Poaching and Overharvesting

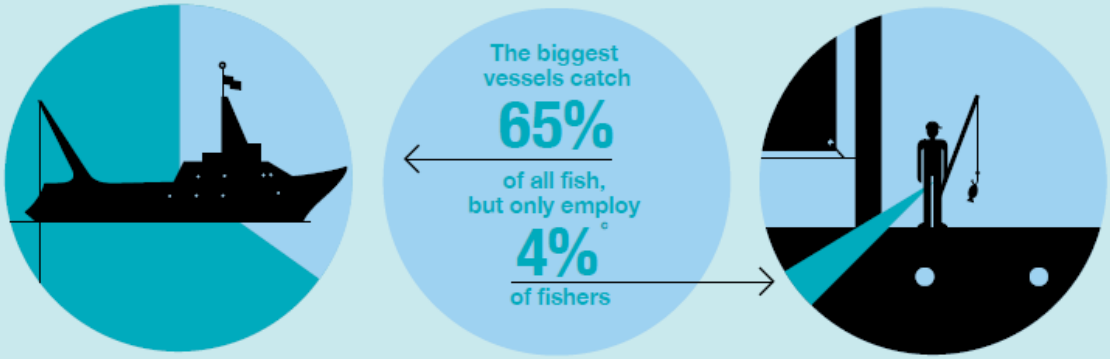
Why people hunt

- For food
- To kill animals that compete with human food sources
- Sport

Case Study: Passenger Pigeon

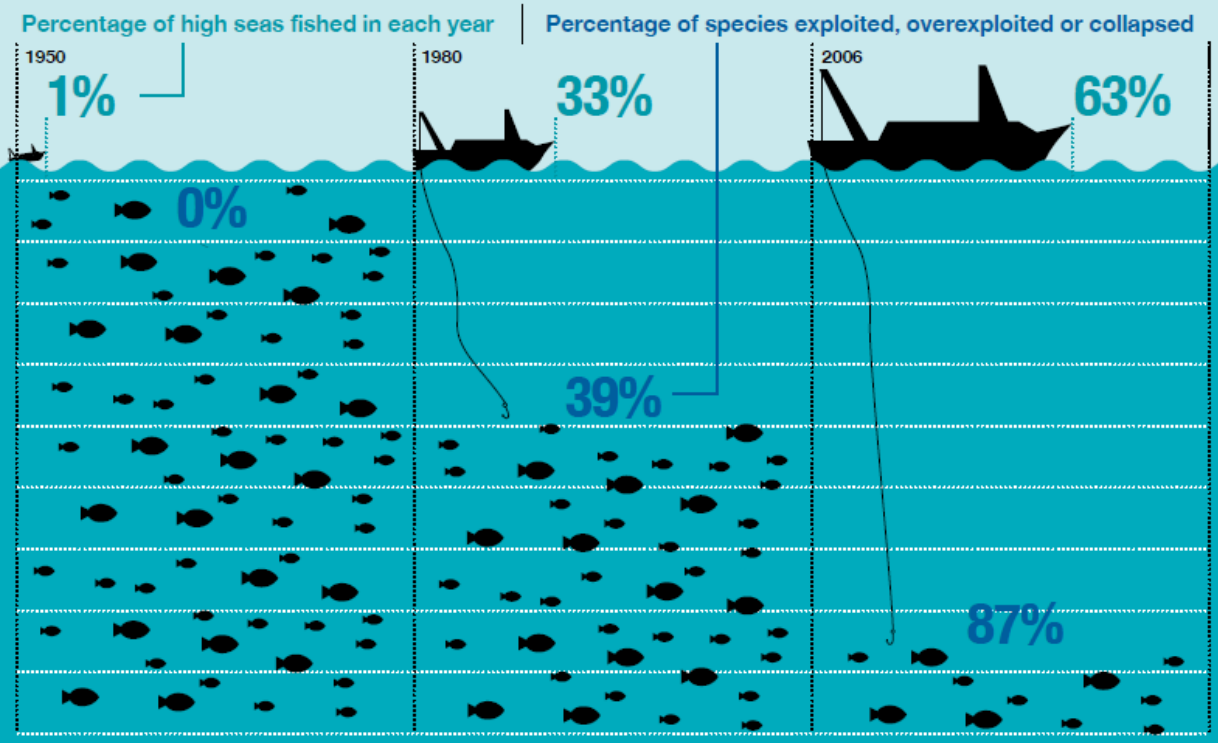
- 3-5 billion 200 yrs ago
- Hunted to extinction in about 40 yrs
  - hunted for meat, feathers, and bones (used as fertilizer) during the Great Depression

There are more and bigger fishing vessels than ever before



But productivity — the amount of fish they catch per ship — has never been lower

There are fewer fish in the sea than ever before



[c] Calculations based on Pauly, D. 2006. Major trends in small-scale marine fisheries, with emphasis on developing countries, and some implications for the social sciences. Maritime Studies (MAST), 4 (2)

Predator and Pest Control

- Coyotes

  (86,500 killed in 1990)

- Wolves

  (remember that top predators **are keystone species** responsible for controlling herbivore populations)

98% Decline in Black Tailed Prairie Dogs

Exotic trade → poaching

- As species become rare, the price for their products goes up → increasing the incentive for hunting

- At least 622 species face extinction because of illegal trade poaching
  - Black rhino
  - African elephant
  - Whales
  - Tigers

Endangered Bog Turtle almost extinct in NYS illegally traded

#4 Cause of species extinctions = Climate Change and Pollution

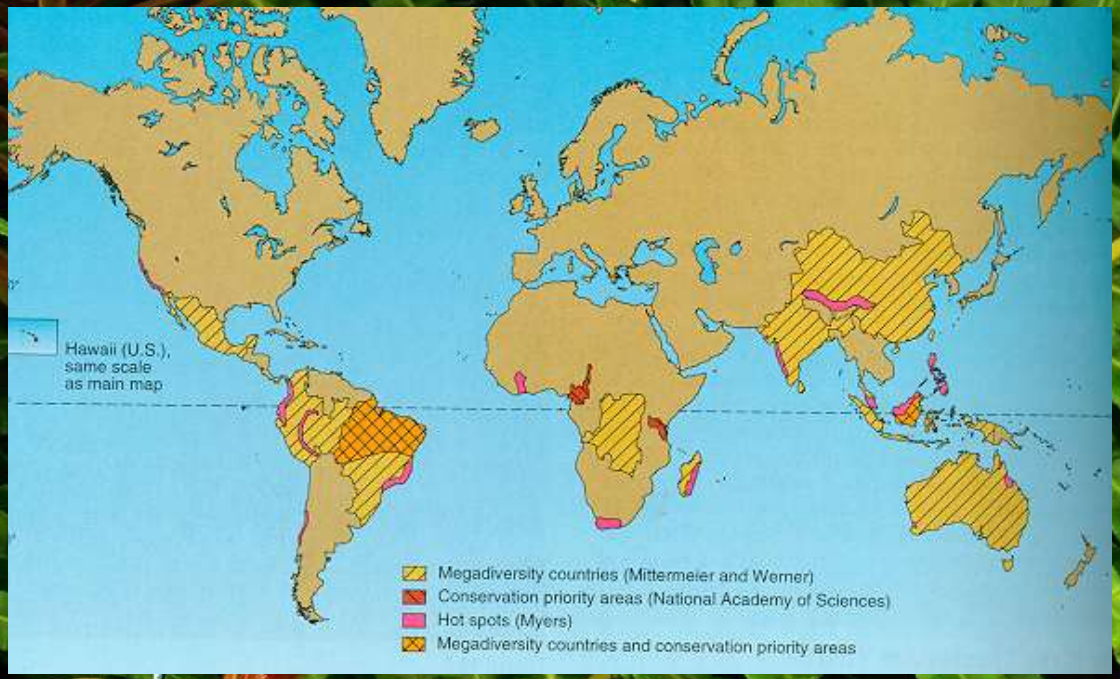
- Pollution (air, water, etc.)
  - Insecticides (DDT, biomagnification)
  - Endocrine disruptors (PCB's, dioxins, BPA)
  - Oil spills and plastics in the ocean

Climate change →
Decline of boreal species in the Adirondacks
ex: yellow bellied flycatcher

Areas of high biodiversity

Closer to equator = higher biodiversity

Islands → unique species due to reproductive isolation



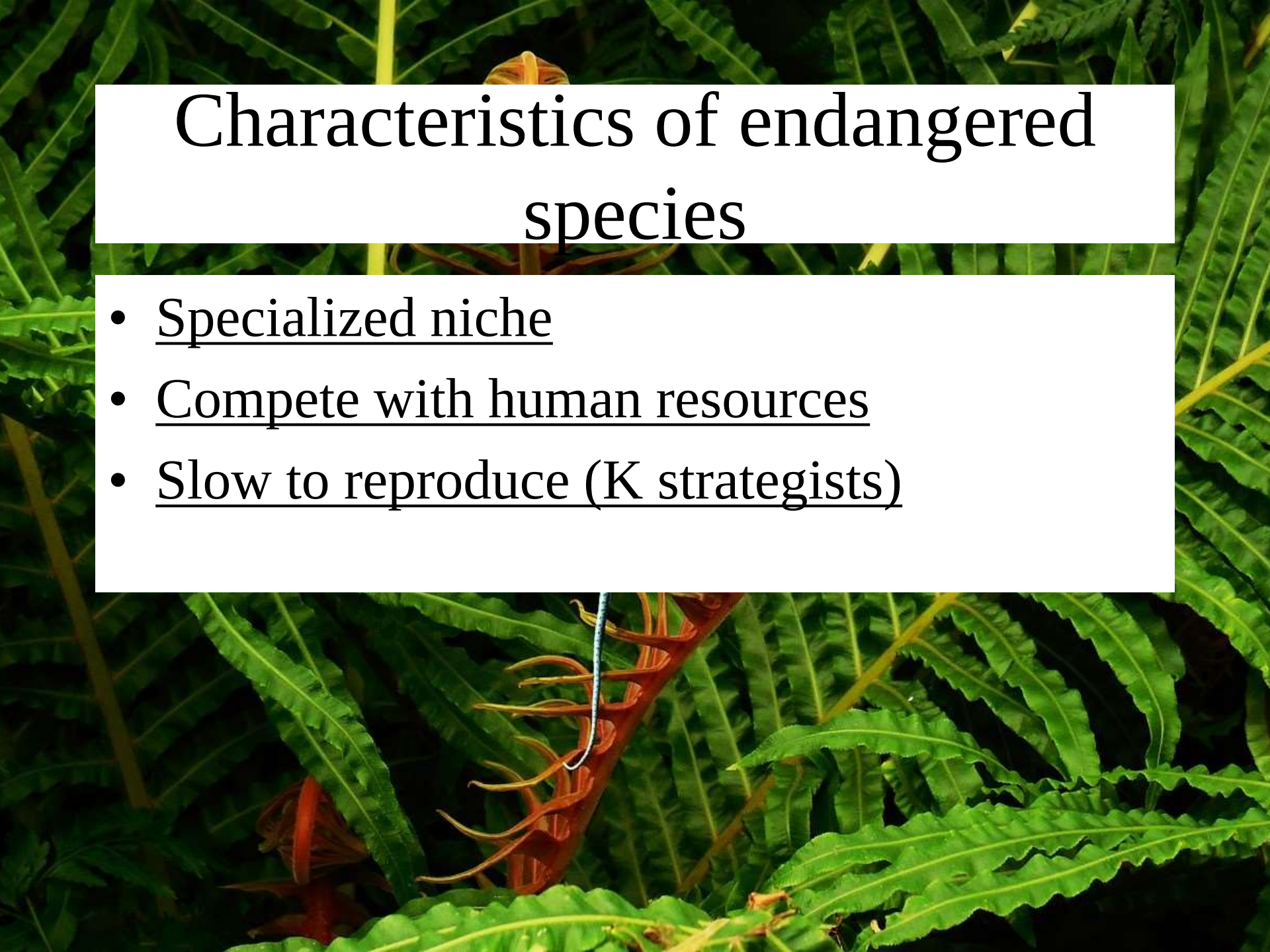
Ex: Hot spots = So. Africa, Parts of So. Calif., Chili SW Australia, India and SE Asia and **all tropical islands**

Definitions

- **Endangered** = so few individuals that species may become extinct soon
- **Threatened** = Declining numbers likely to be endangered soon
- **MVP** (**minimum viable population**) = smallest population size that can sustain the species

Characteristics of endangered species

- Specialized niche
- Compete with human resources
- Slow to reproduce (K strategists)



Determining MVP

- Minimum Viable Population size = smallest population size that is able to sustain the species
  - enough males and females
  - enough genetic diversity
  - lots of debate about this

Policies and Legislation

- **Lacey Act (1900)–** protects game and wild birds from illegal transport across state lines
- **Marine Mammal Protection Act (1972)** = Protects all marine mammals in US waters (give FWS authority → exceptions)
- **US - Endangered Species Act (1973)** = prevents taking or harming species on the "**list", protects habitats and FWS→ recovery plans**
- International – **CITES (Convention on International Trade in Endangered Species) = prevents import, export, and trade across borders w/o permit**
- Are they enough??

Endangered species List

- 2 ways to get listed:
  - Agency direct listing or
  - petition from groups
- Once listed FWS → recovery plan, protect habitat
  - Criticism = Species approach = only protects individual patches of habitat
  - Better approach = Landscape approach = protect **habitat PLUS corridors** that connect populations → increased diversity

Conservation Biology

- Study of human impacts on species and ecosystems
- Recovery plans for listed species (ES list and the Red list)

2 strategies to conserve species

1) Species approach

- **In situ** = preserve diversity in nature
  - (ex: establish wildlife refuges and wilderness areas)
- **Ex situ** = preserve diversity in man-made settings
  - (ex: zoos, seed banks and captive breeding)

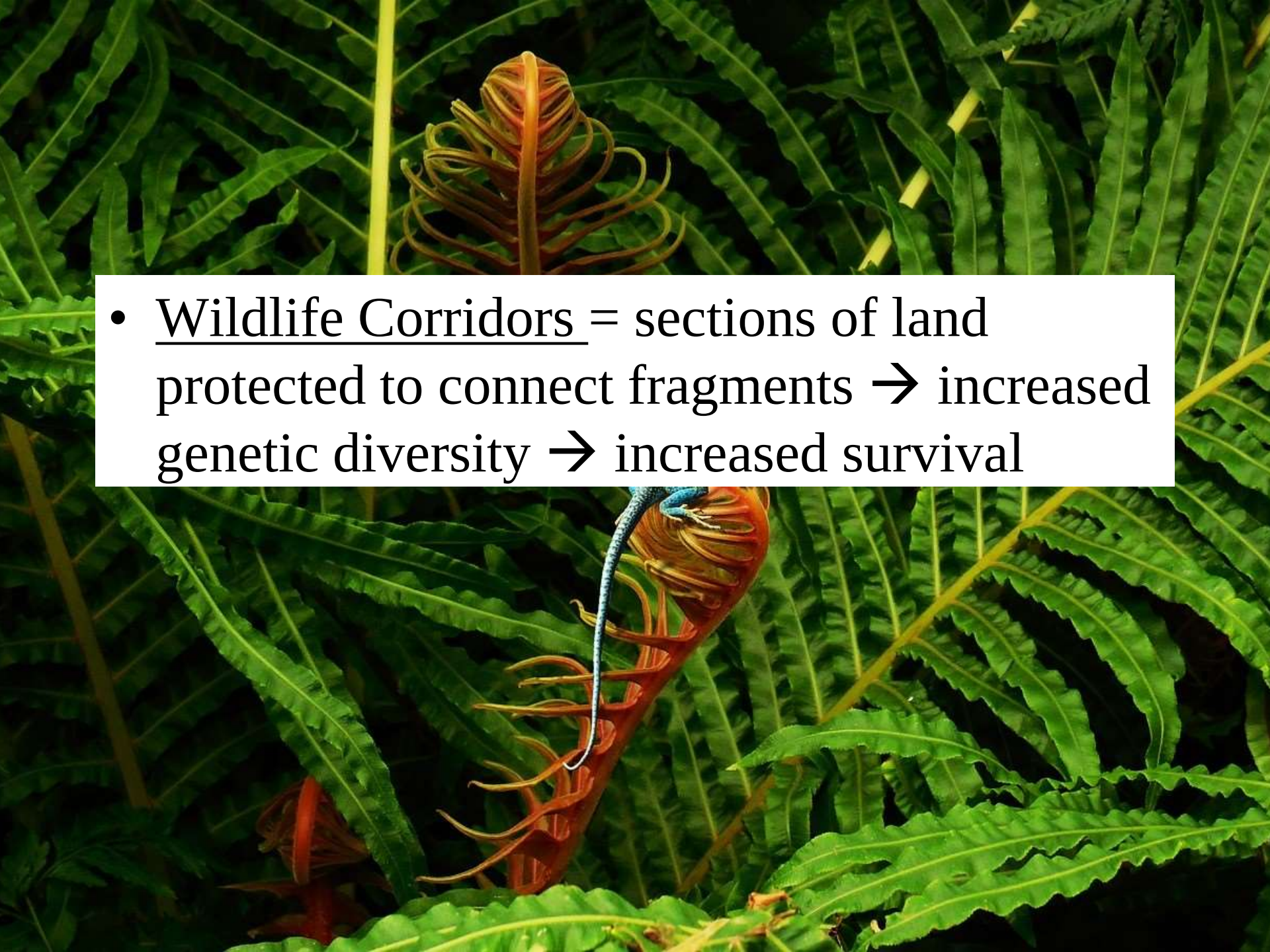
2) Ecosystem approach / landscape species

Landscape species approach

- Focus conservation efforts on **umbrella species**
  - Ex: Monarch butterfly species migrate covering multiple ecosystems therefore protecting them will help many other species and habitats

Flagship species

- *Popular, charismatic species that have the ability to capture the imagination of the public and induce people to support conservation action and/or to donate funds*



- Wildlife Corridors = sections of land protected to connect fragments → increased genetic diversity → increased survival

Endangered Species that have been delisted

- American Alligator
- Bald Eagle
- American peregrine falcon
- Canada goose
- Brown pelican
- Many others have been delisted due to extinction

California Condor

- Declines due to
  - Poaching, DDT, lead poisoning (from food) habitat destruction
- Recovery plan =
  - bred in captivity then released
  - Legislation prevents hunters from using lead bullets in condor ranges

http://www.homeschoolmethods.com/California_Condor.htm

All strategies require **education and public support!**

Conflict

- 95% of Rwandans are Hutu farmers.
- When questioned they ask why parkland is more important than farmland, whether gorillas are more important than local people, and why all researchers are white foreigners.
- *Vedder, Weber 2001 pg. 134*

In the 70's

"not only was there no tourism, there were only 8 poorly paid, poorly trained, and poorly equipped guards for the entire park. This policy of neglect resulted in the loss of more than half of the original Virunga parkland between 1959 and 1973: losses funded by European donors in the name of development."

Vedder and Weber, 2001 pg. 137

How the West is involved

- After World War II the west donated money to African countries to clear land for the increased production of pyrethrum (an insecticide used to replace DDT)
  - synthetic chemicals soon were made and demand for pyrethrum decreased.
- Small quantities of tin ore, tungsten and beryl are found in Rwanda.
  - Most mines and industrial companies are foreign owned
- Causes of war and genocide of the 1990's dates back to past colonial era involvement.

Solution

Create Rwandan jobs and income by

1) **Ecotourism**
2) **Hiring, training and equipping Rwandan park guards**
3) **Educating the public**

https://www.youtube.com/v/7lIql0lYcVc

Education is a key component to any conservation effort

Rwandans were

> "surprised and proud to learn that their little country held the key to saving the mountain gorillas"

Vedder and Weber, 2001

Rwanda Today

Good News

New census>360 gorillas

Even in the midst of a Civil War the workers of the Karisoke research station remained committed to saving the gorillas

Bad News

Primary cause of gorilla death is now pneumonia

More than 1,000,000 Rwandans are dead from genocide and warfare

AIDS continues to take a deadly toll

Terrorism threatens the nation’s internal security

Conclusion

" Conservation is a science. It is an applied science that seeks to understand and resolve problems that diminish **biological diversity** and degrade natural **ecosystems**. As we enter the twenty-first century, the success of conservation science depends on the ability of its practitioners to move from the collection, integration, and analysis of information to the identification and pursuit of concrete action steps: to **move from problem analysis to conflict resolution** "

Vedder and Weber 2001, pg. 139

CREDITS

http://www.worldatlas.com/aatlas /africa/facts/rwanda.htm

http://cwr.rtoronto.ca/cultural/english/rwanda/work.html

Amy Vedder and Bill Weber, In the Kingdom of GorillasSimon and Schuster 2001, NY

4 Federal Agencies Govern public land

- Bureau of Land Management (BLM) → manages rangelands
- United States Forest Service (USFS) → manages forests
- National Park Service (NPS)
- Fish and Wildlife Service (FWS) → wildlife conservation, hunting and recreation

Managing rangelands

- Taylor Grazing Act (1934) converted rangelands from commons to permit-based grazing system
- Grazing
  - Pros:
  - maintains grasslands, produce food on marginal land
  - Cons:
  - overgrazing → decreased diversity, desertification, decrease water quality

Managing forests

- Clear cutting =
  - Pros = cheaper and easier harvest technique → lots of sunlight for sun loving species → single aged stand
  - Cons = decreased diversity, increased erosion, decreased water quality, loss of topsoil
- Selective cutting =
  - Pros = fewer environmental impacts
  - Cons = still have to build roads → fragmentation
- Tree plantations
  - Pros = fast growing trees → pulpwood and energy crops
  - Cons = nutrient depletion, decreased diversity
- Prescribed burns clean up debris and release nutrients → reduces risk of uncontrolled forest fires

Wildlife refuge

- Managed to protect wildlife

http://bestphotos.us/photo/lake-andes-national-wildlife-refuge-4948.php

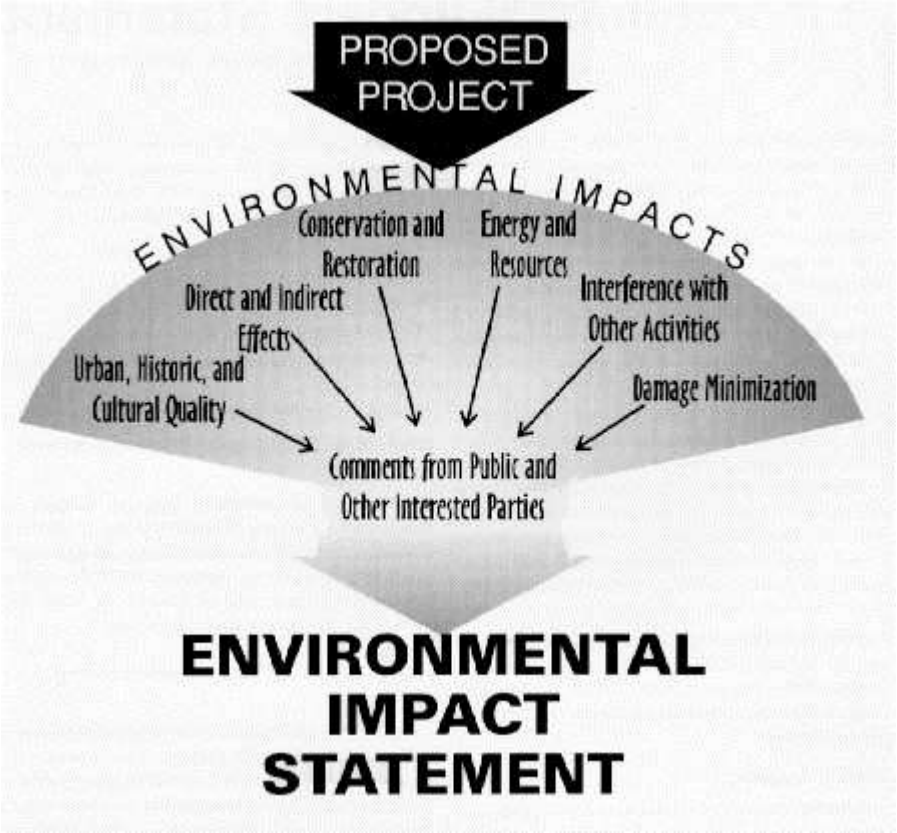
National Wilderness Area

- Highest level of protection → intact unfragmented wilderness
- No development allowed, no new roads built

Denali, National Wilderness, Alaska

Federal legislation

- National Environmental Policy Act (**NEPA**) 1969
  - All federal development projects require **environmental impact statement (EIS)**



http://ohioline.osu.edu/rer-fact/rer_65.html

Mitigation Plan

- Describes how the environmental impact of development will be addressed
  - Ex: building a road across a wetland →
  - create wetland area or pond adjacent to the development

Endangered Species Act of 1973

- Protects animals on the Endangered Species List
- Prevents development in areas where listed species are found

U.S. Endangered Species Act

(1973)

- Protects species identified as endangered or threatened with extinction
- Attempts to protect the habitat on which they depend
- Administered primarily by the Fish and Wildlife Service (U.S. Department of the Interior)
  - The National Marine Fisheries Service (U.S. Department of Commerce) administers the ESA for certain marine species

Solutions

- Ecosystem approach – preserving intact ecosystems (setting aside wilderness areas)
- Landscape species approach – preserving interconnecting ecosystems by managing landscape species
- Species approach – protect individual (*endandered or threatened*) species with legislation (Endangered Species Act 1973)
- Wildlife management – manage (*game species*) for sustained yield through (regulated hunting/fishing, international treaties to protect migrating species…)(CITES)