

# PRESERVING BIODIVERSITY



# How many species are there?

- 2.1 million currently described
- probably 3-50 million species
  - most of those undiscovered are insects, fungi and bacteria
- 70% of known species are invertebrates (probably 95% of all species)



13.1

## Number of living species by taxonomic group

<i>Group</i>	<i>Identified Species</i>	<i>Estimated Total</i>
Bacteria and viruses	5800	10,000(?)
Protozoa and algae	100,000	250,000
Fungi	80,000	1,500,000
Invertebrates	1,500,000	7 to 50 million
Amphibians and reptiles	12,000	13,000
Fish	20,000	23,000
Birds	9100	9200
Mammals	4200	4300
Vascular plants	250,000	300,000
Nonvascular plants	150,000	200,000
Total	2,125,300	9 to 52 million

# How do we benefit from biodiversity?

- Food
  - up to 80,000 edible plants could be utilized
  - villagers in Indonesia use 4000 plant and animal species
- Drugs and Medicines
  - more than half of all prescriptions contain natural products
  - cancer fighting drugs (Pacific Yew)
  - Merck (pharmaceutical company) paid Costa Rica \$1 million for samples

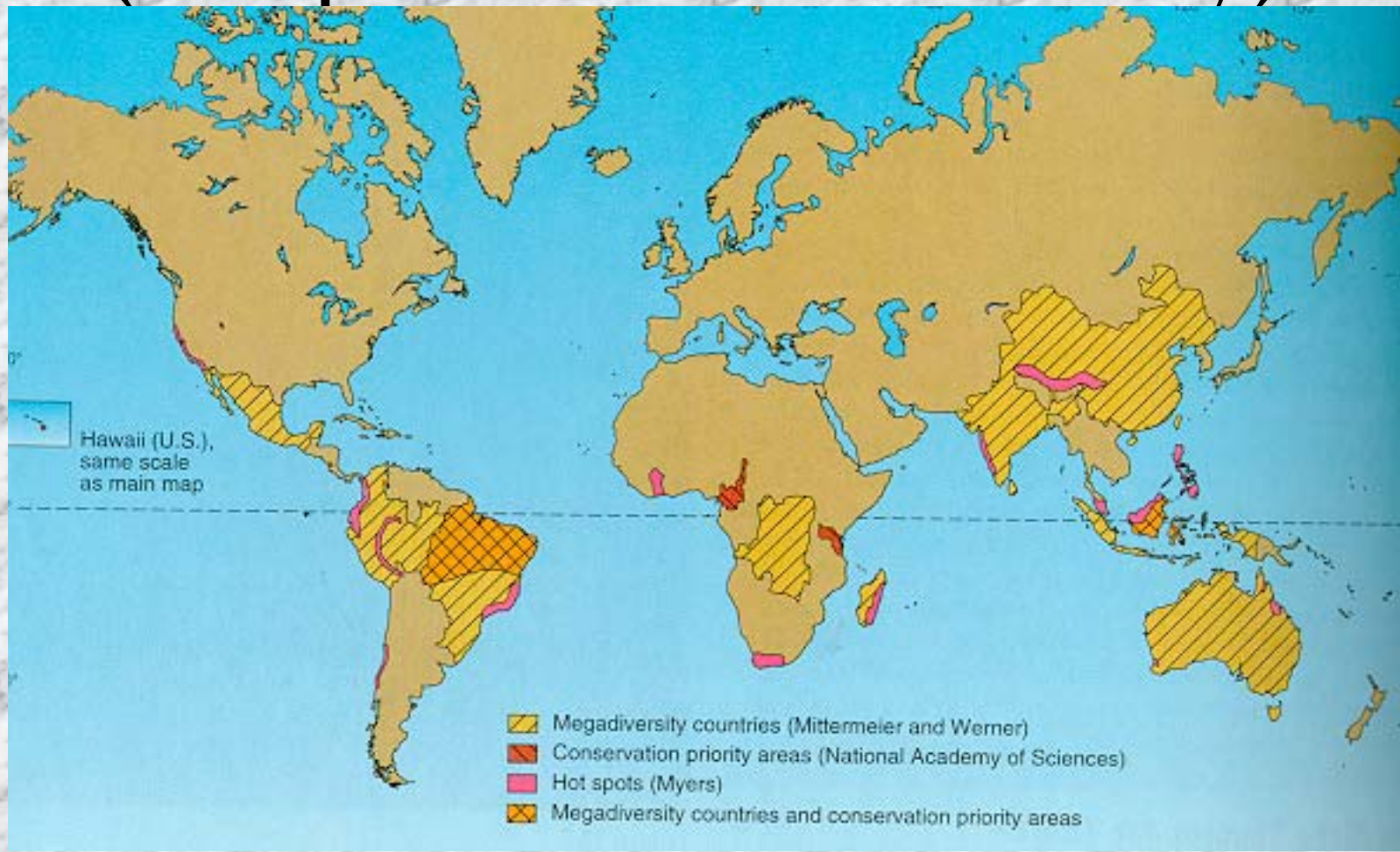


# How do we benefit from biodiversity?

- Ecological Benefits
  - interdependence of species
  - nutrient cycling
  - regulation of species (regulation of pests)
- Aesthetic and Cultural Benefits
  - recreation (hunting, fishing, camping)
  - ecotourism
- Intrinsic Value
  - species should be allowed to exist without having to provide a reason



# Areas of high biodiversity (hotspots in UN vocabulary)



# Background vs. Mass Extinction

- Background extinction
  - extinction = 3-30/yr
  - via natural selection.
- Mass extinction
  - extinction = thousands/yr (5-6 so far)
  - dramatic environ. Change
  - up to 90% of species diversity lost
  - now in mid-6th; human-caused

# Extinctions Today

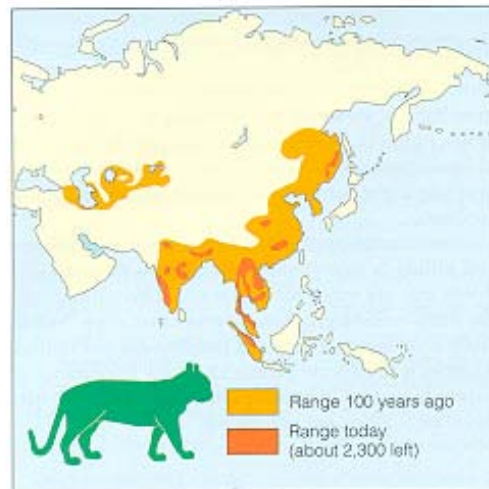
- **Since 1600**
  - **1138 extinctions documented**
- **Estimate**
  - **10,000 x greater than background extinction**
- **If extinction rate is **0.5%/yr****
  - **1 million spp lost in 2-40yrs**



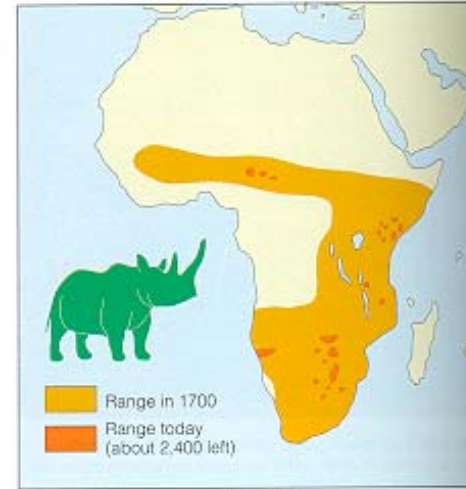
# Endangered and Threatened Species

- **Endangered species**
  - so few individuals that the species may become extinct soon
- **Threatened species**
  - declining numbers, likely to become extinct
- 30% of U.S. species are vulnerable to extinction because of human activities
- 1/3 of all plants and animals in wetlands are vulnerable

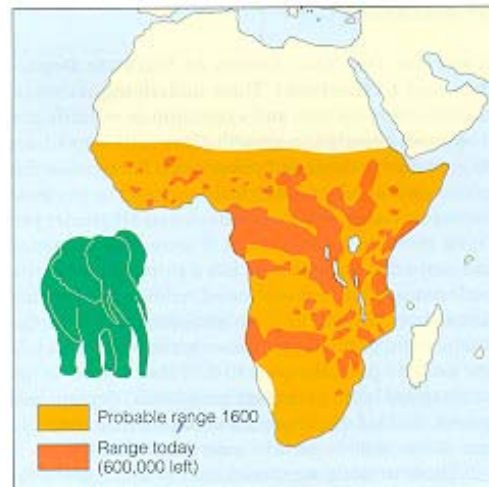
# endangered species and their ranges



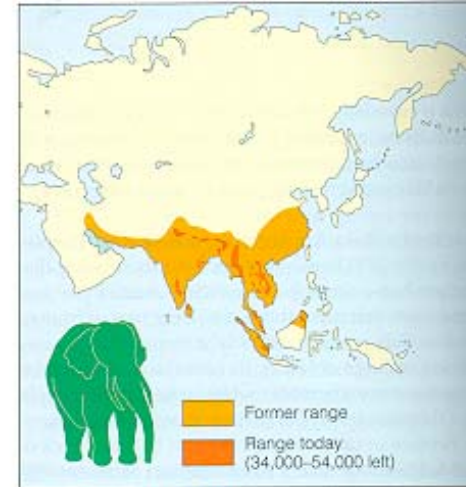
Indian Tiger



Black Rhino



African Elephant



Asian or Indian Elephant

# Characteristics of Endangered Species

- **Extremely localized range or LARGE territory**
- **Low reproductive success**
- **Island species or *extreme specialists***
- ***Low adaptability***



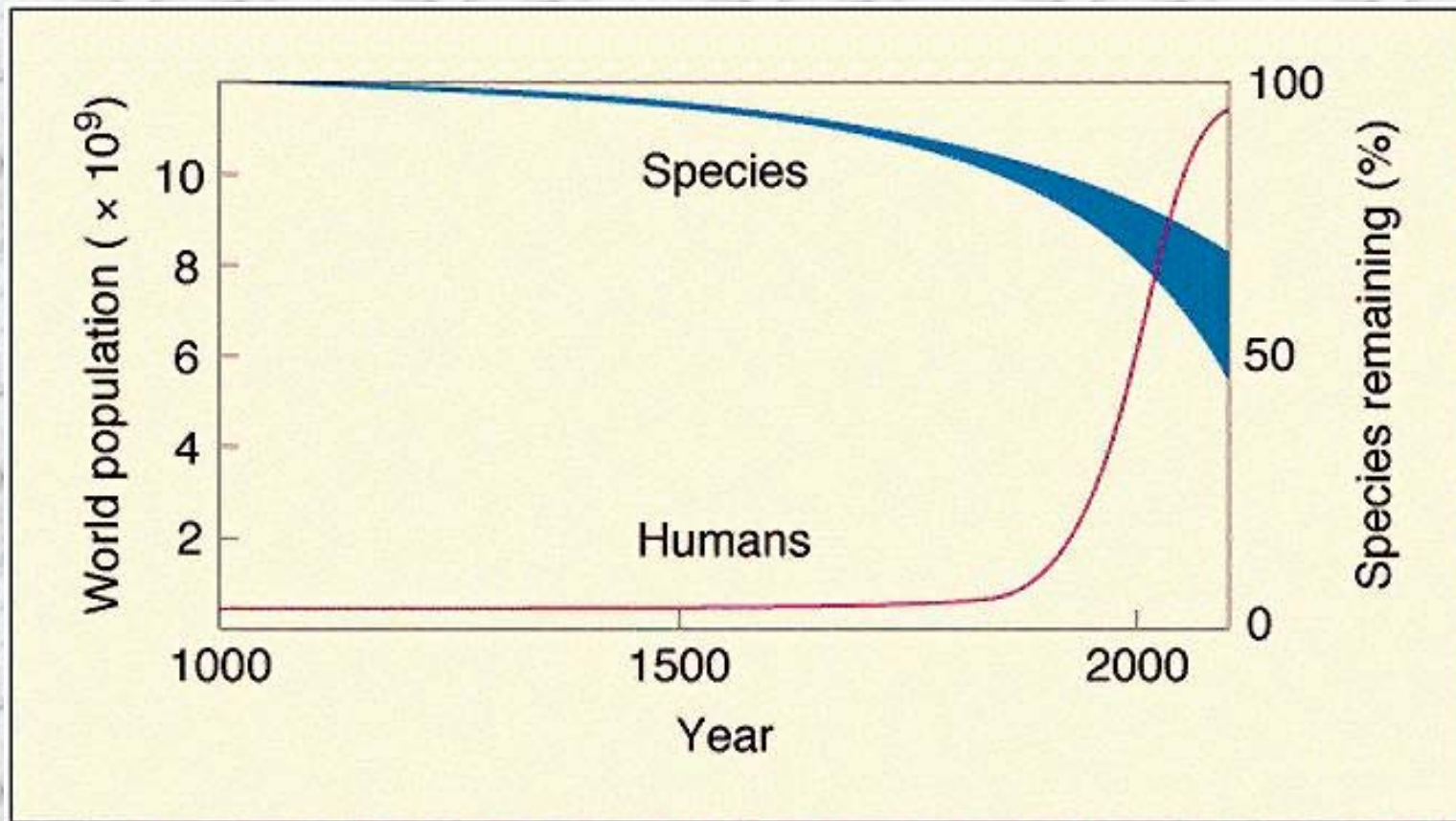
# What is MVP?

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

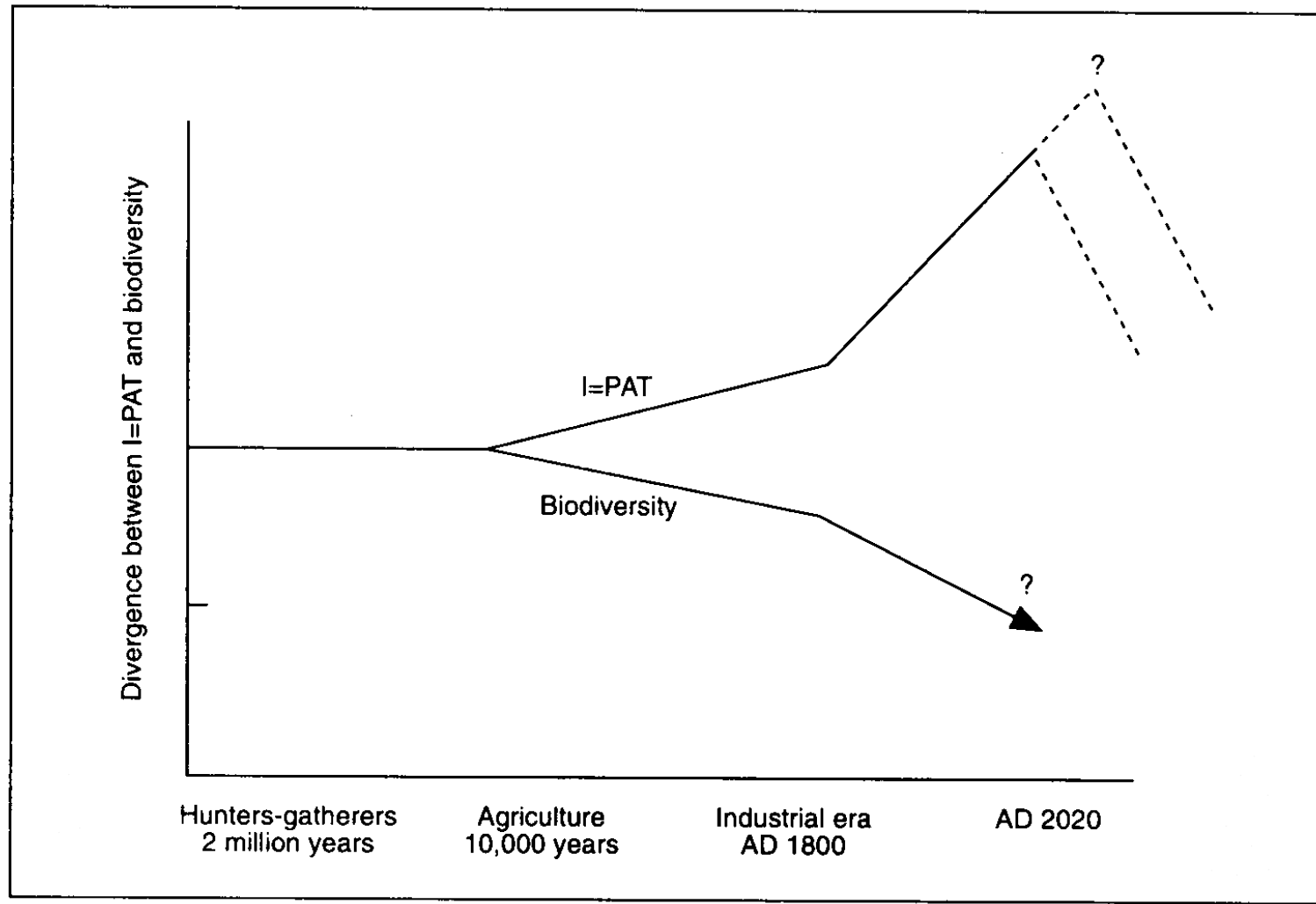
# What are the root causes of *extinction*

- Population growth
- economic policies that do not support the environment
- high per capita resource use leading to degradation of the environment

# Can we coexist?



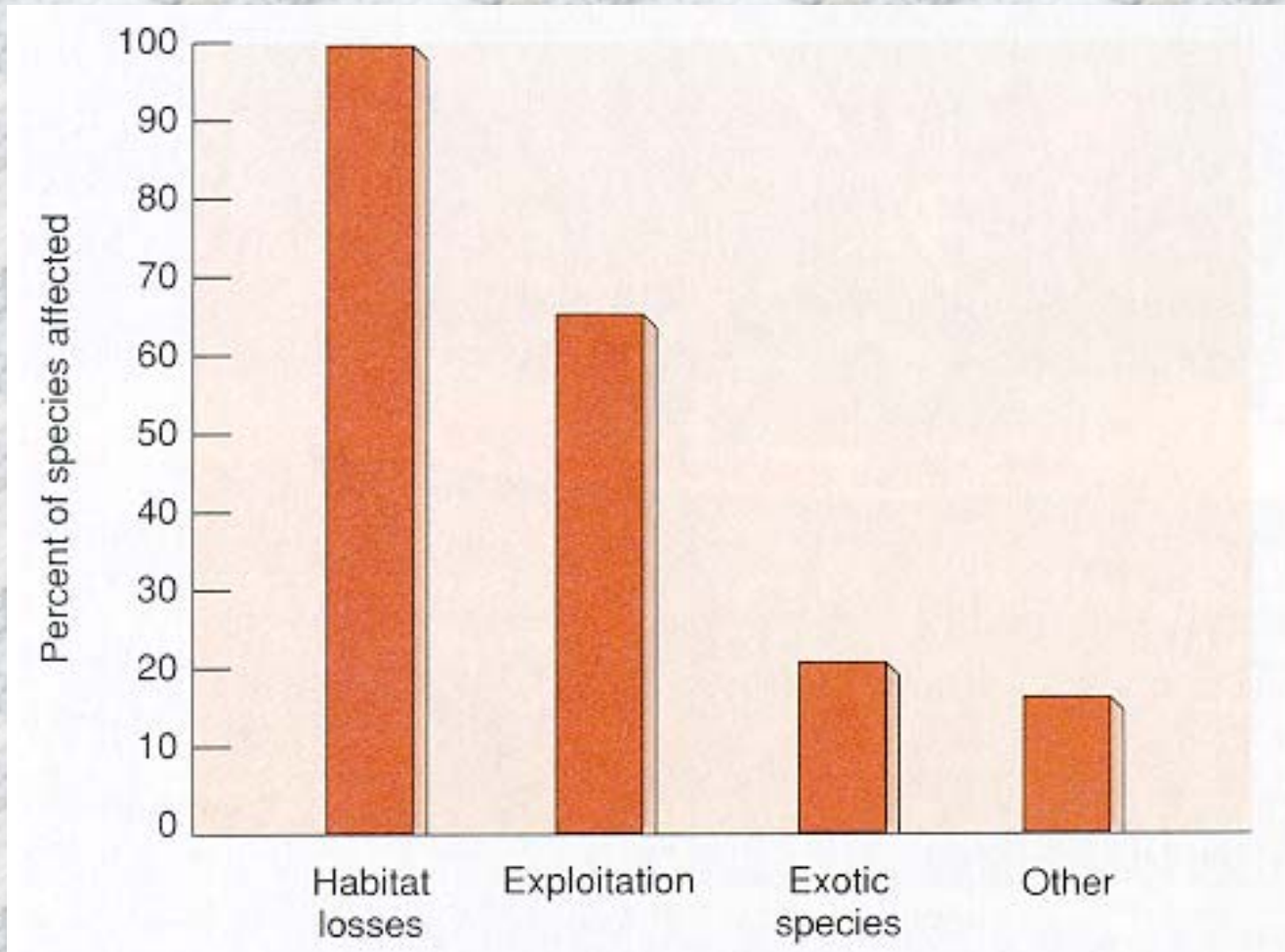
# Can we coexist?



# What are the direct causes of **extinction**

- Habitat loss and fragmentation
- Hunting and poaching
- Overfishing
- Predator and pest control
- Capture and sale of exotic plants and animals
- Climate change and pollution
- Introduction of nonnative species

# Relative Roles of Each Cause



# Habitat Loss and Fragmentation

- Deforestation
- destruction of coral reefs, wetlands, grasslands, marine and freshwater habitats
- in U.S.
  - 98% of prairies
  - 50% of wetlands (98% of riparian in CA)
  - 90% of old growth forests
- loss of endemic species
- theory of island biogeography applies
  - 50% of land destroyed; 10% species lost
  - 90% of land destroyed; 50% species lost

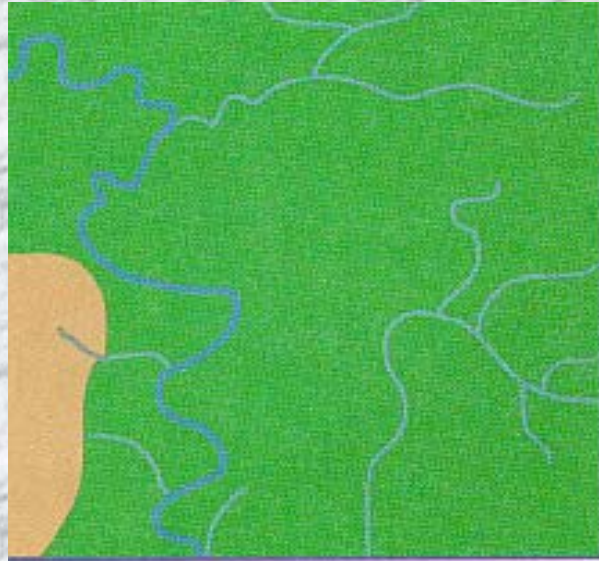
# Habitat Loss and Fragmentation

- Problems with migratory species (decline in avian species worldwide)
- fragmentation
  - causes edge effects
  - patches are too small to support large species
  - barriers to dispersal between patches

# Slash and Burn Agriculture



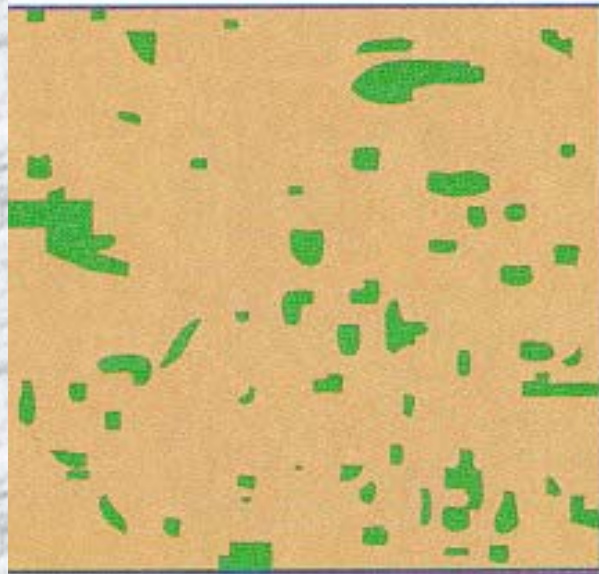
# Fragmentation of land in Wisconsin



1831



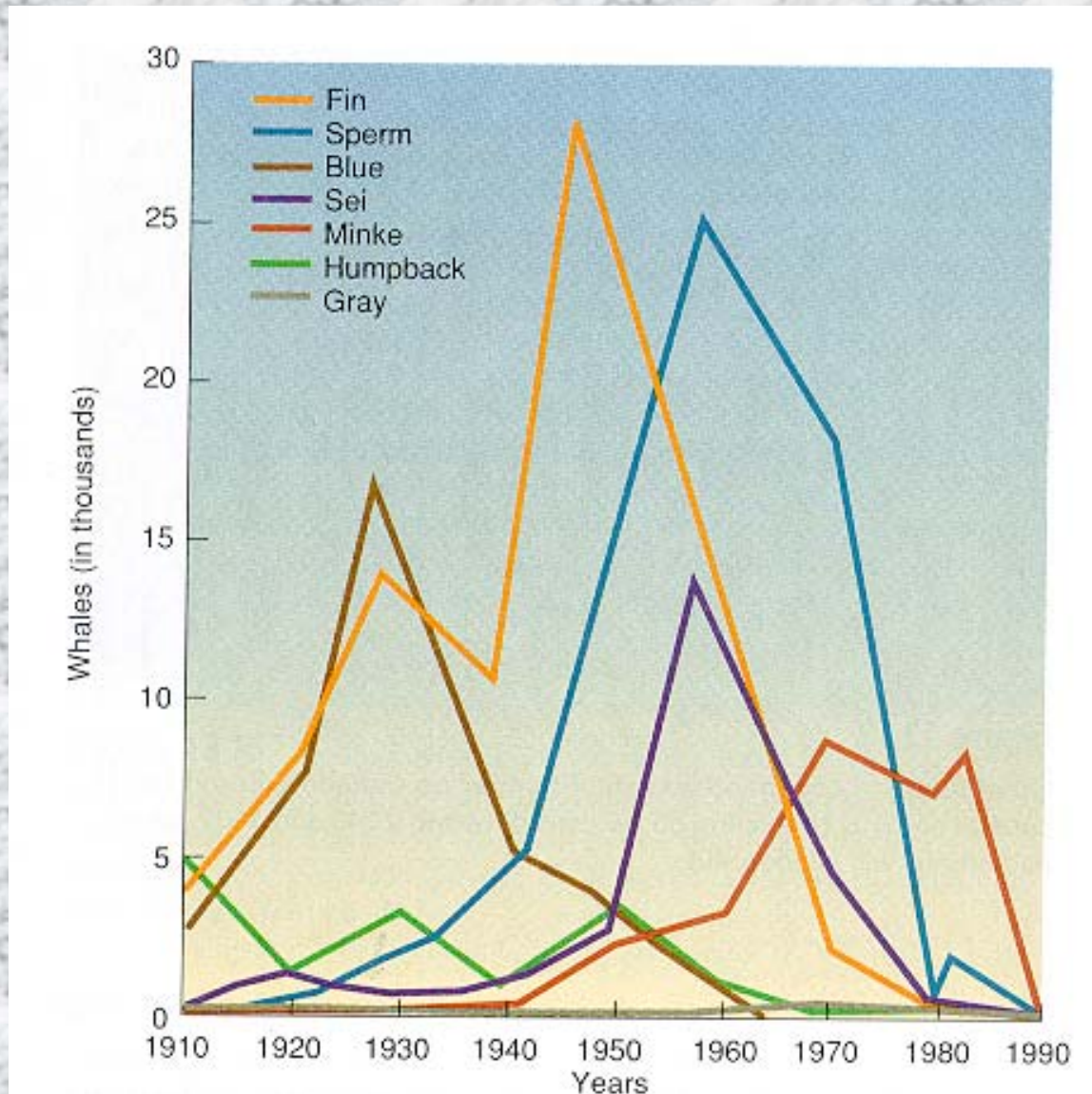
1882



# Hunting and Poaching

- 622 species face extinction because of illegal trade
- as species become rare, the price for their products goes up, increasing the incentive for hunting
- examples
  - black rhino
  - African elephants
  - whales
  - tigers

# Effects of Whaling



# Passenger Pigeons



- 200 yrs ago
  - 3-5 billion
  - **world's most abundant bird**
  - 1/4 of all birds in N.Am.
  - 1 flock (10 miles wide, 100miles long)
- hunted to extinction in about 40 yrs (last female died in 1940 in Washington D.C. Zoo)

# Overfishing

- Fishing methods kill many non-target species
  - ex. drift net/gill net
  - bycatch
- In the last 20 yrs, 1/5 of all freshwater species have gone extinct or have become threatened or endangered
- 34% of all fish are at risk of becoming extinct
- biggest problems Europe (86% at risk) and Asia (69% at risk)

# Predator and Pest Control

- Most are killed as threats to livestock
- Examples
  - coyotes (86,500 killed in 1990)
  - wolves
  - Elephants (threat to farming)
  - mountain lions
  - prairie dogs (99% of all species have been killed)

# Plants, Animals and their Products

- 5 million birds are caught legally each yr
- 2.5 million more caught illegally
- 40 spp are threatened or endangered b/c of trade
- for every bird that makes it to a pet shop, 10 more die in transit
- other animals: tropical fish, amphibians, reptiles, mammals
- orchids and cacti



# Harvesting Tropical Fish

- The cyanide solution used to stun fish kills the coral reef and many fish in the process



# Collecting Coral

- Coral collection destabilizes reefs and decreases habitat



# Climate Change and Pollution

- Climate can change faster than species can move
- pollution (air, water, etc..)
  - ex. Spain and the marshes
  - Insecticides (DDT), biomagnification

# Introduced Species

- 4500 species have been introduced to the U.S.
- Annual costs - 100 billion
- 30% of all species listings are due in part to non-native species
- introduced species have no natural enemies
- introduced species can outcompete natural species
- examples
  - starlings
  - cane plant
  - chestnut blight
  - cane toad
  - fire ants
  - kudzu vine
  - zebra mussel
  - water hyacinth
  - kudzu vine
  - iceplant
  - thistle
  - gypsy moth



# Solutions

- Ecosystem approach
- Species approach
- Wildlife management

# Regulations - International

- CITES - Convention on the International Trade of Endangered Species
  - signed by 128 countries to date
  - prohibits the trade of live specimens or products of 675 species on list



# Regulations - National

- Endangered Species Act of 1973
  - illegal to import or trade in products of species unless used explicitly for science
  - USFWS is responsible for management
  - the species on the list cannot be “taken”
    - threatened, killed, harmed, habitat can’t be harmed
  - decision must be made on biological basis only (???)
  - projects can not be developed which harm species
  - requires the development of a recovery plan
    - how species can be improved and delisted
  - 1350 species listed (4000 candidate species)

# Problems with the End. Species. Act

- Encourages people to destroy land before listing
- doesn't focus on ecosystem
- is inflexible
- is political
- focuses too much on charismatic megafauna
- only 7 species delisted (long reaction time)



# Solutions to ESA

- PROACTIVITY
- species we have, where they are, and how many there are
- identify ecosystems that are in danger and protect and rehabilitate them
- give incentives to private landholders who protect species and their land
- all species can't be saved; focus attention on those that can be saved

## 1996 Federal Listings of Threatened and Endangered U.S. Plant and Animal Species

Category	Endangered	Threatened	Total Listings	Species with Recovery Plans
Mammals	55	9	335	39
Birds	74	16	274	71
Reptiles	14	19	113	31
Amphibians	7	6	22	11
Fishes	67	40	118	73
Snails	15	7	23	18
Clams	51	6	59	43
Crustaceans	14	3	17	5
Insects	20	9	33	20
Arachnids	5	0	5	2
Plants (flowering, conifers, ferns, others)	513	101	614	326
<b>Total</b>	<b>835</b>	<b>216</b>	<b>639</b>	<b>(444 plans approved)</b>
Total endangered U.S. species		835	(322 animals, 513 plants)	
Total threatened U.S. species		216	(115 animals, 101 plants)	
Total listed U.S. species		1051	(433 animals, 614 plants)	
Total listed non-U.S. species		565	(562 animals, 3 plants)	
* Four animals have dual status				

Source: Department of the Interior, U.S. Fish and Wildlife Service, Division of Endangered Species, January 1, 1997.