

# BIODIVERSITY



*Fig. A*

*Fig. B*

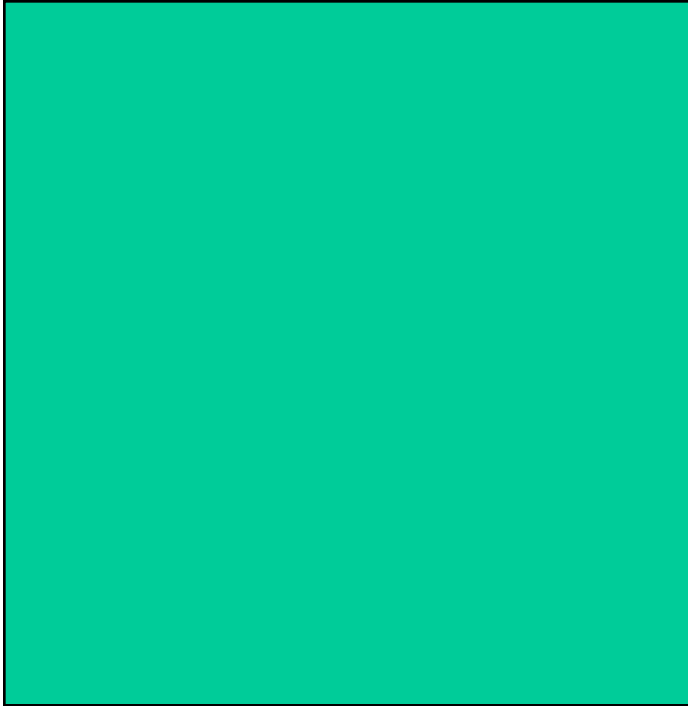
*Fig. C*

- A. Starfish*
- B. Hydra*
- C. Scud*

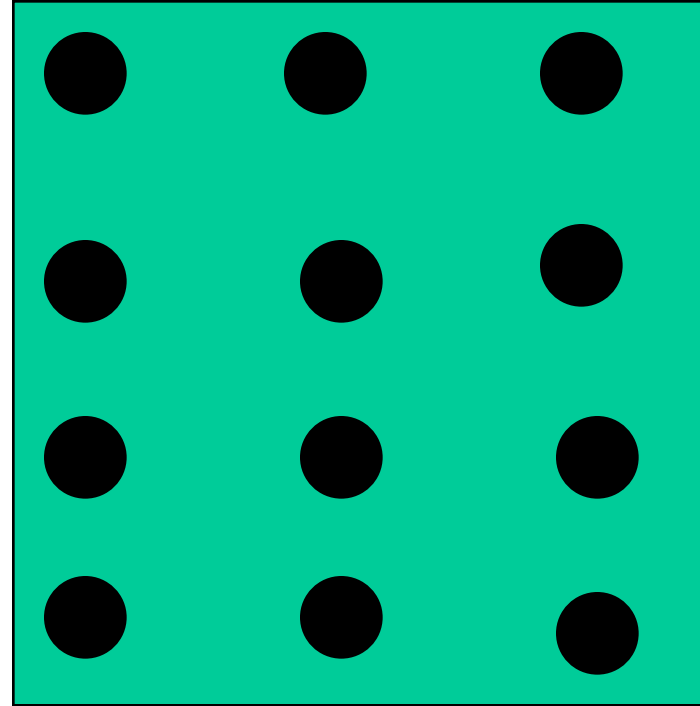
The world is full of magical things  
patiently waiting for our eyes to grow sharper.

Eden Phillpotts

Which do you like better?

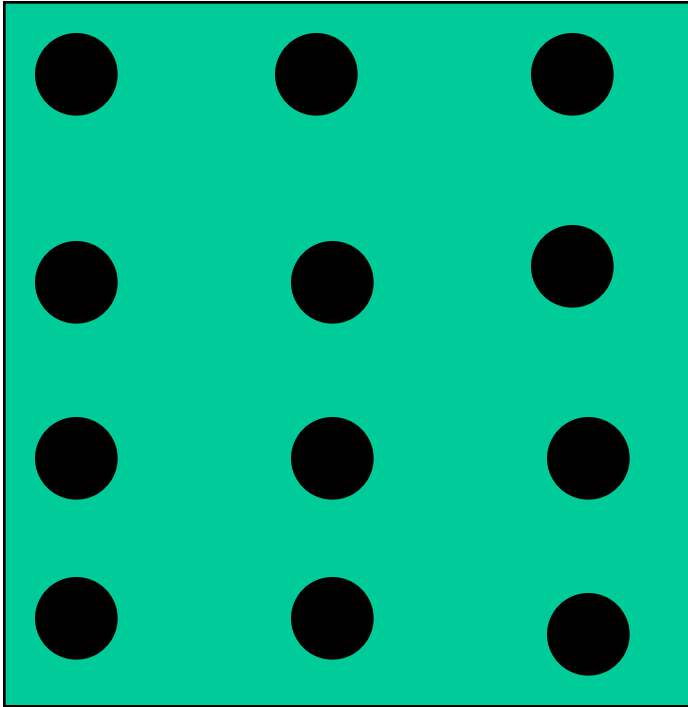


**A**

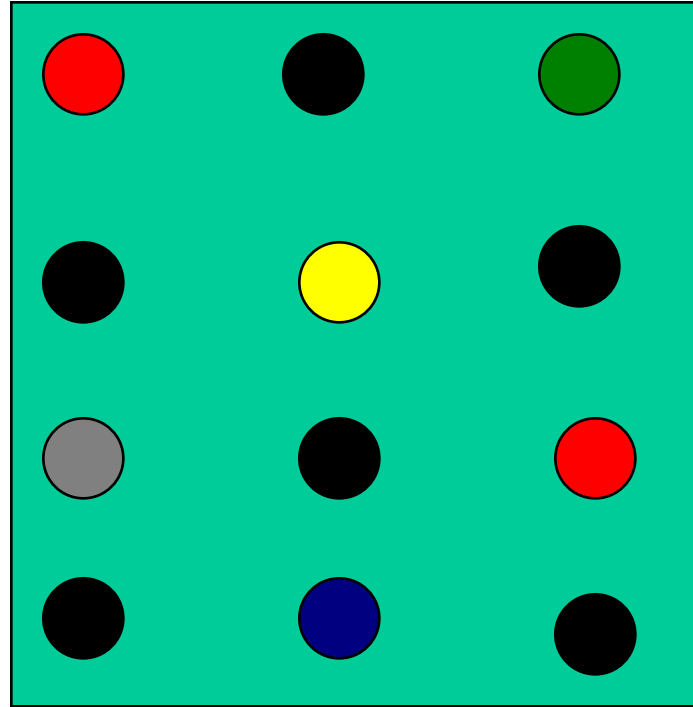


**B**

Which do you like better?

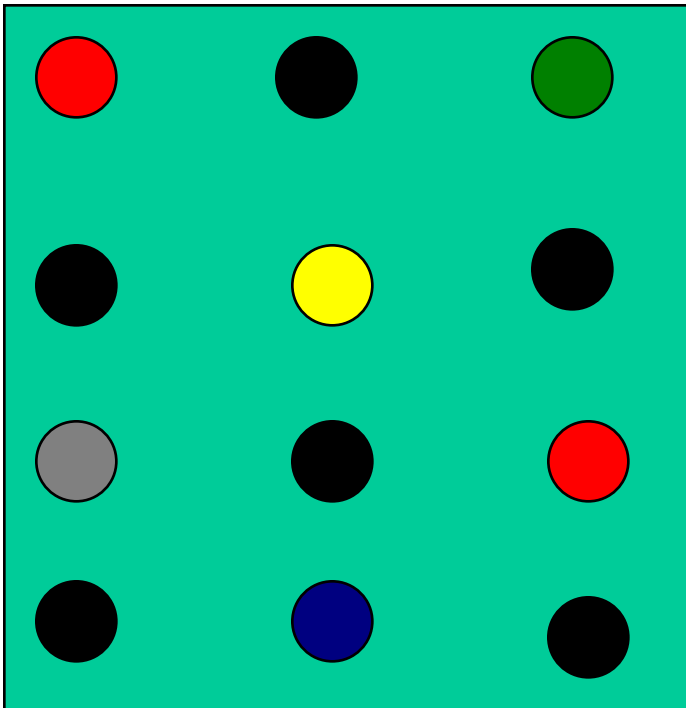


**A**

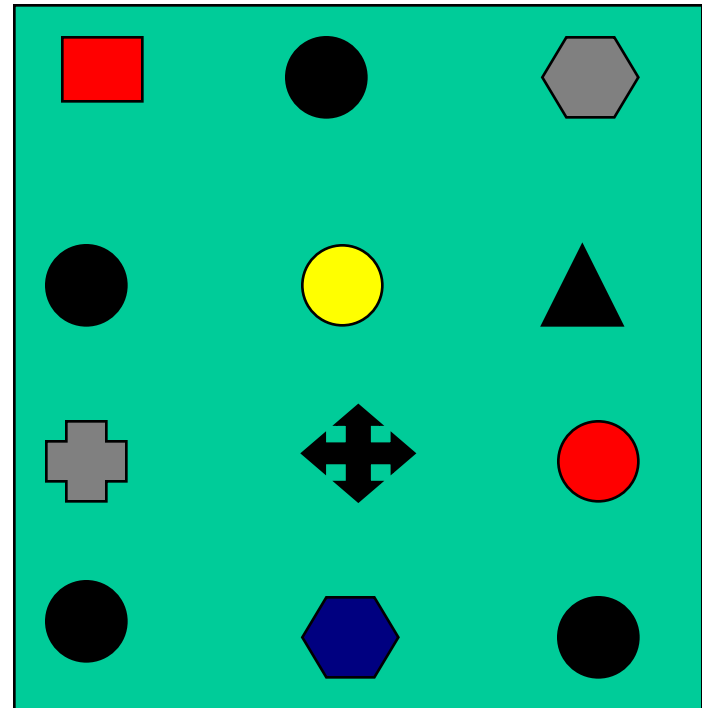


**B**

Which do you like better?

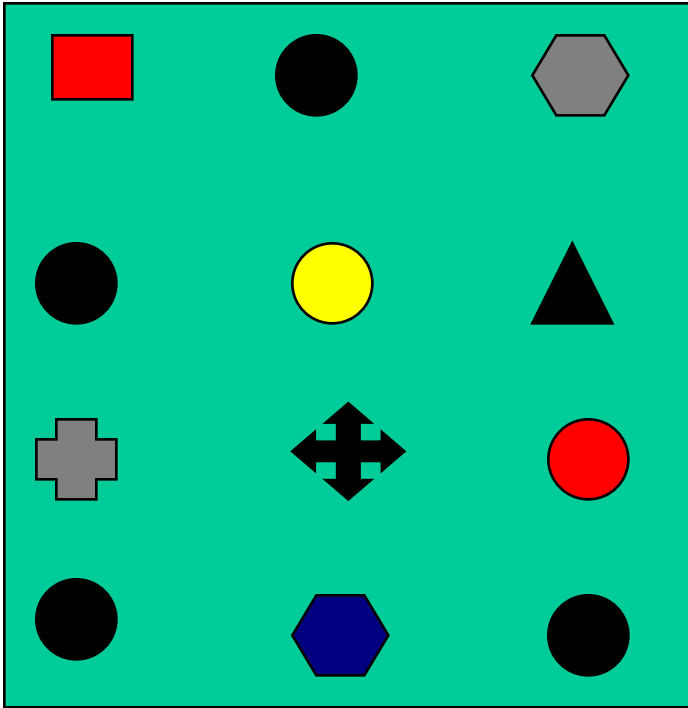


**A**

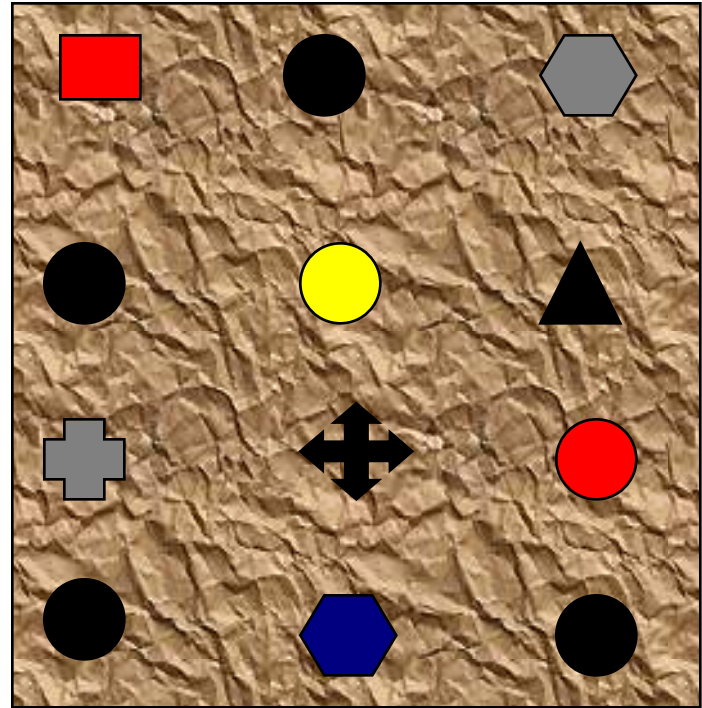


**B**

# Which do you like better?

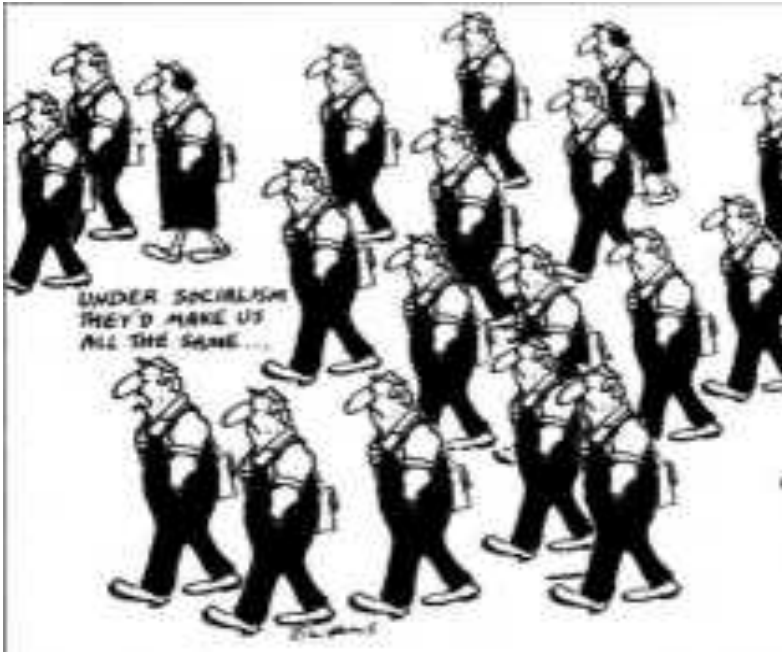


A



B

# Which do you like better?



A



B



Which do you like better?



**A**



**B**

Which do you like better?

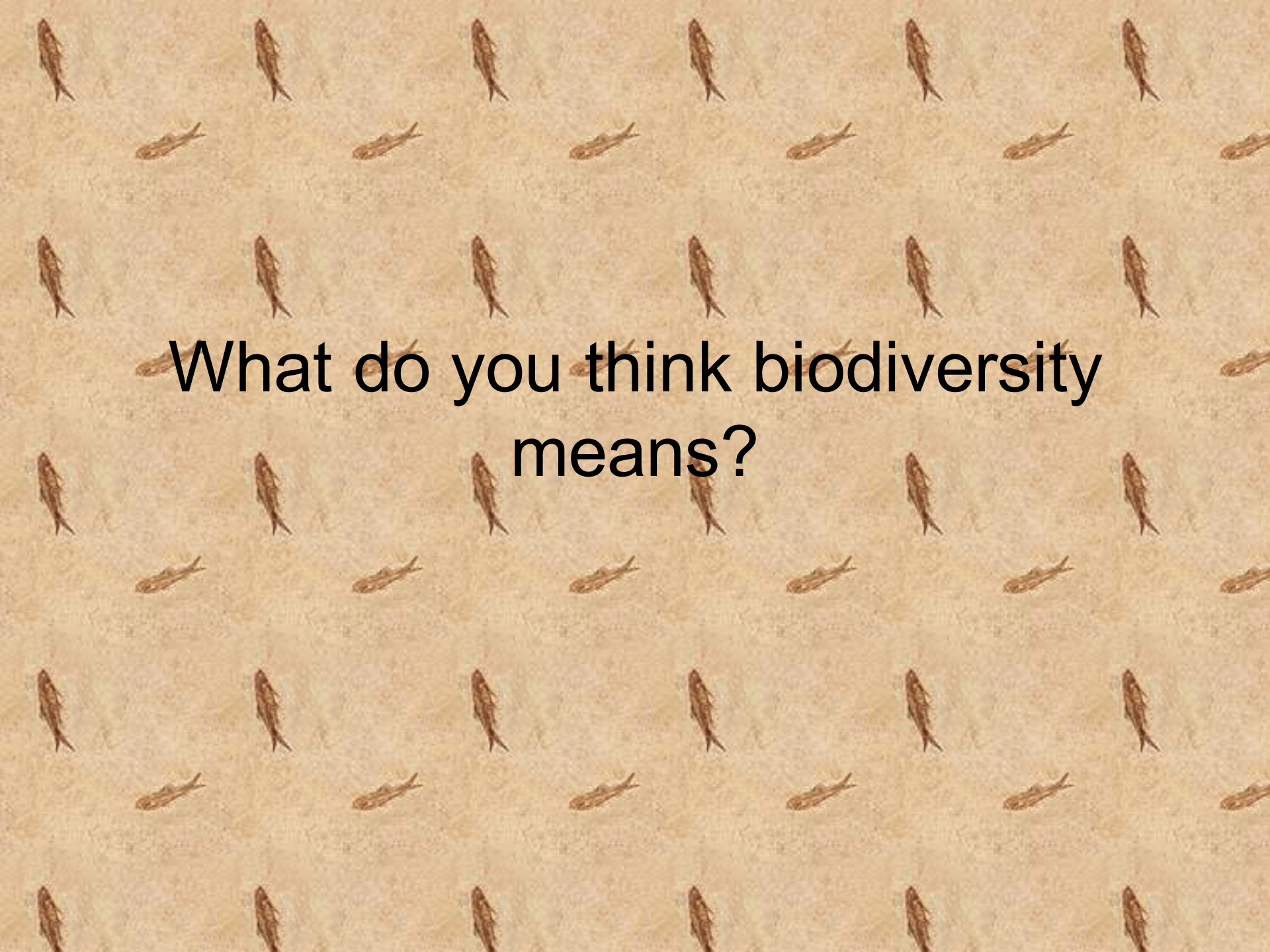


**A**



**B**



The background of the slide is a light beige or tan color with a subtle, repeating pattern of small, brown, fish-like illustrations. These fish are arranged in a grid-like fashion, with some facing up and some facing down. The fish have a simple, stylized design with visible fins and tails.

What do you think biodiversity means?

# Biodiversity

What does “Bio” mean?

**Bio** = **Life**

# Biodiversity

What does “Diversity” mean?

**D**iversity = **V**ariety

# **Biodiversity is the variety of life on Earth and the essential interdependence of all living things**

- **Scientists have identified more than 1.4 million species. Tens of millions -- remain unknown ([www.thecatalogueoflife.org](http://www.thecatalogueoflife.org))**
- **The tremendous variety of life on Earth is made possible by complex interactions among all living things including microorganisms.**



# There are 3 components of biodiversity

## 1. Diversity of genes

Chihuahuas, beagles, and rottweilers are all the same species —but they're not the same because there is variety in their genes.



Chihuahua



Beagle



Rottweilers

# There are 3 components of biodiversity

## 2. Diversity of number of species

For example, monkeys, dragonflies, and meadow beauties are all different species.



Saki Monkey



Golden Skimmer



Meadow Beauty

# **There are 3 components of biodiversity**

## **3. Variety of ecosystems**

Lakes, Ponds, and Rivers are all Freshwater Ecosystems.

Rocky coast, Sand Dune, Estuary, Salt Marsh , Coral Reef are all Marine Ecosystems.

So what's an ECOSYSTEM???

# ECOSYSTEM DEFINITION

“ A self-contained community of microorganisms, animals and plants, that interact with each other and with their physical environment.”

eg a rock  
pool







# Within an ecosystem there can be many HABITATS

- This is the **physical and chemical** description of where a creature lives...



# HABITATS might describe:

- The NAME of the place where the creature lives.



- eg *Arctic Canada* is the habitat of the polar bear *Ursa maritima*.



# HABITATS might describe:

- The **DOMINANT VEGETATION** of the place where the creature lives.
- eg *Heather* moorland is the habitat of the grouse.



# HABITATS might describe:

- **The TYPE of place where the creature lives.**



- **eg species of fish like Pike (Esox lucius) are found in *freshwater lakes and ponds*.**
- ***So what's a SPECIES??***



A species is difficult to define exactly!!



# 1. A group of morphologically similar creatures which can:

- Interbreed to produce fertile offspring
- Are ‘reproductively isolated’.
- Problems with this definition include...

- Extinct creatures eg T. rex
- Creatures who breed asexually eg bacteria
- Creatures who can't be tested ethically eg  
Man x Chimp





## 2. Creatures who are related through PHYLOGENY

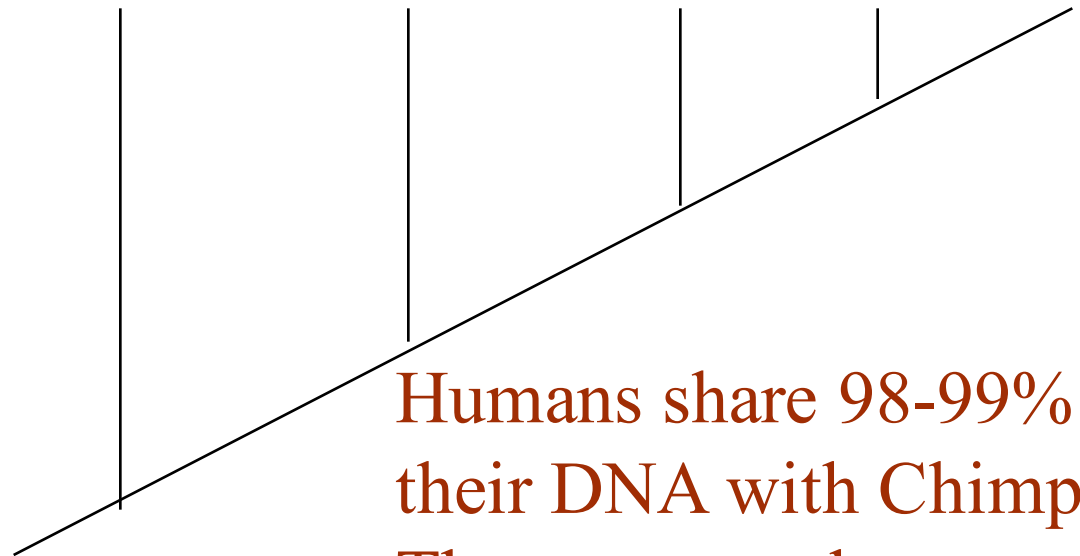
- Similar DNA
- Similar proteins eg in blood
- Similar biochemistry
- Similar embryology

# DNA profiles of Primates

- % DNA similar

- 100
- 99
- 98
- 97
- 96
- 95
- 94
- 93

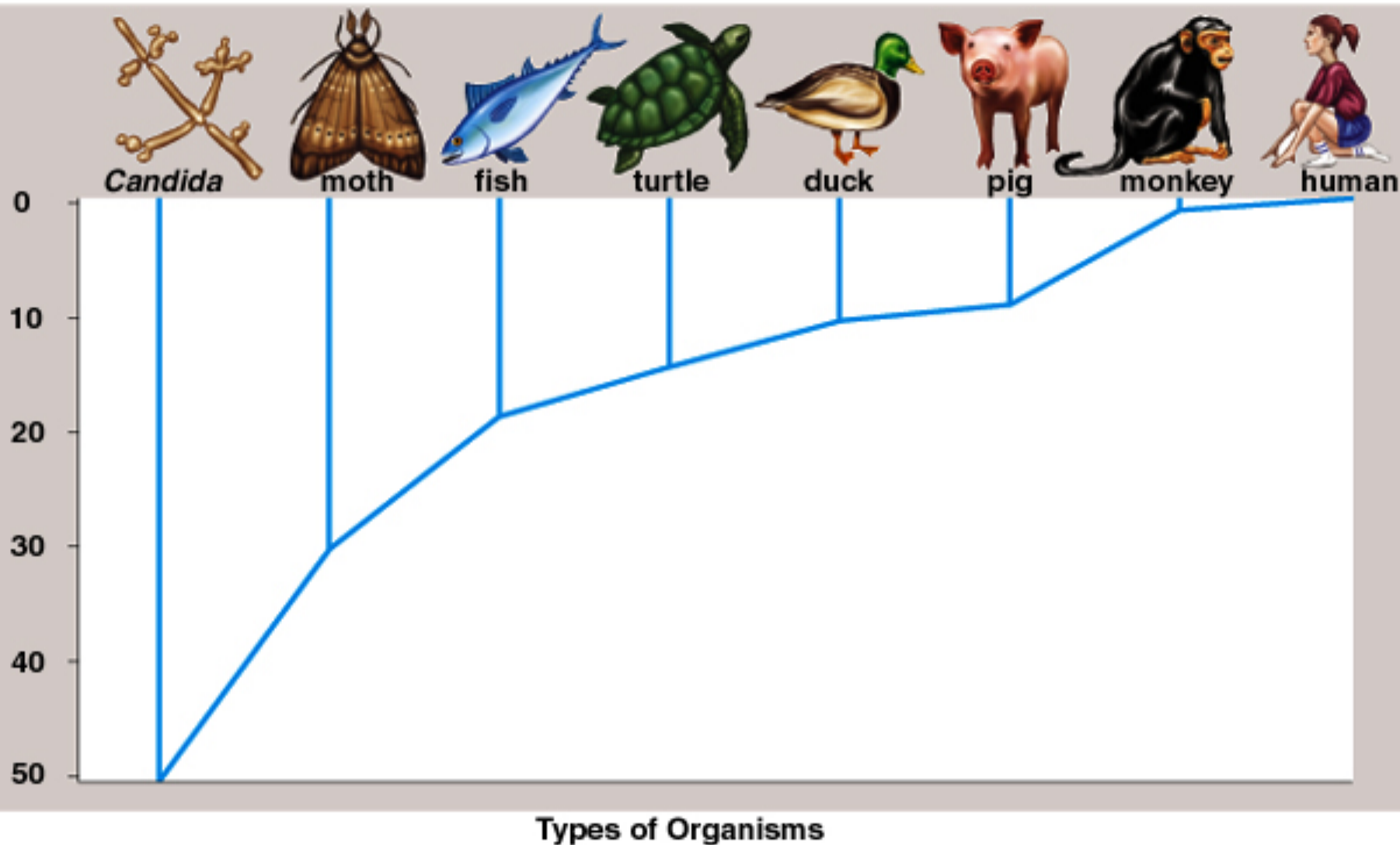
• Gibbon    Orang Utan    Gorilla    Chimp    Man



Humans share 98-99% of their DNA with Chimps. They are our closest living relatives.

# Types of organisms

Number of Amino Acid Differences Compared to Human Cytochrome C

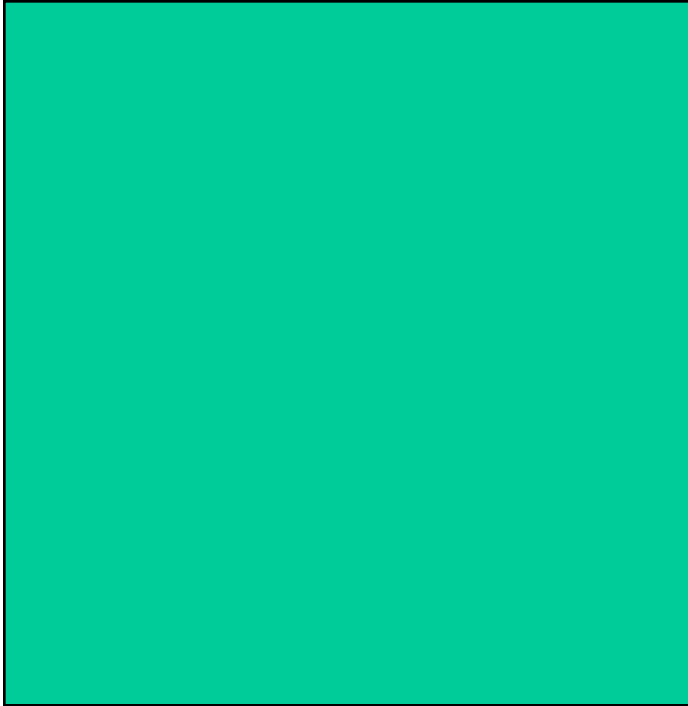


Domain Eubacteria (Prokaryotes: bacteria and cyanobacteria)  
Domain Eukarya (Eukaryotes)  
Kingdom Animalia (animals)  
Phylum Annelida (segmented worms)  
Genus species *Arctonoe pulchra* (red commensal scaleworm)  
Genus species *Arctonoe vittata* (scale worm)  
Genus species *Dodecaceria concharum* (Coralline fringed tube-worm)  
Genus species *Dodecaceria fewkesi* (Colonial tubeworm)  
Genus species *Eudistylia vancouveri* (feather tube worm)  
Genus species *Myxicola infundibulum* (jelly tube worm)  
Genus species *Pionosyllis* sp  
Genus species *Sabella* spp (sand-dwelling feather duster worm)  
Genus species *Serpula vermicularis* (calcareous tube worm)  
Genus species *Thelpus crispus* (Spaghetti worm)  
Phylum Arthropoda (Jointed legged invertebrates)  
Class Arachnida (Spiders )  
Genus species *Neomolgus littoralis* (red velvet mite)  
Class Crustacea (crustaceans)  
Order Amphipoda (amphipods)  
Genus species *Caprella laeviuscula* (Skeleton shrimp)  
Genus species *Cyamus mysticeti* (Gray Whale Lice)  
Genus species *Hyale pugettensis* (Dark sea flea)  
Order Decapoda (crabs and shrimp)  
Genus species *Anisogammarus* spp (sea flea)  
Genus species *Cancer oregonensis* (Pygmy rock crab)  
Genus species *Cryptolithodes sitchensis* (Turtle crab)  
Genus species *Elassochirus gilli* (Orange hermit crab)  
Genus species *Elassochirus tenuimanus* (Widehand hermit)  
Genus species *Fabia subquadrata* (Pea crab)  
Genus species *Haplogaster mertensii* (Hairy flat lithode crab)  
Genus species *Lebbeus grandimanus* (Candycane shrimp)  
Genus species *Lopholithodes mandtii* (Puget Sound king crab)  
Genus species *Mysids* (Opossum shrimp)  
Genus species *Oregonia gracilis* (decorator crab)  
Genus species *Pagurus beringanus* (Bering hermit crab)  
Genus species *Pandalus danae* (Coon Stripe Shrimp)

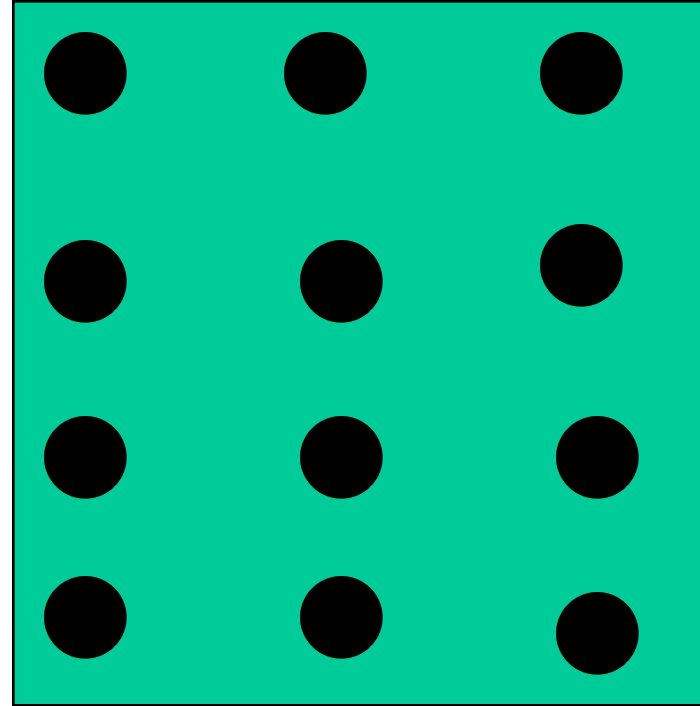
Why is a list  
of species not  
'Biodiversity'  
?



Which is more diverse?

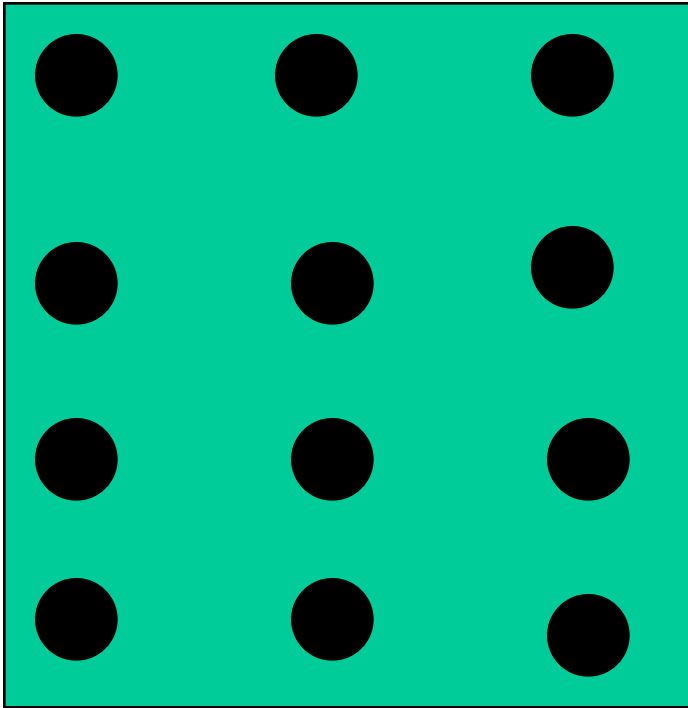


**A**

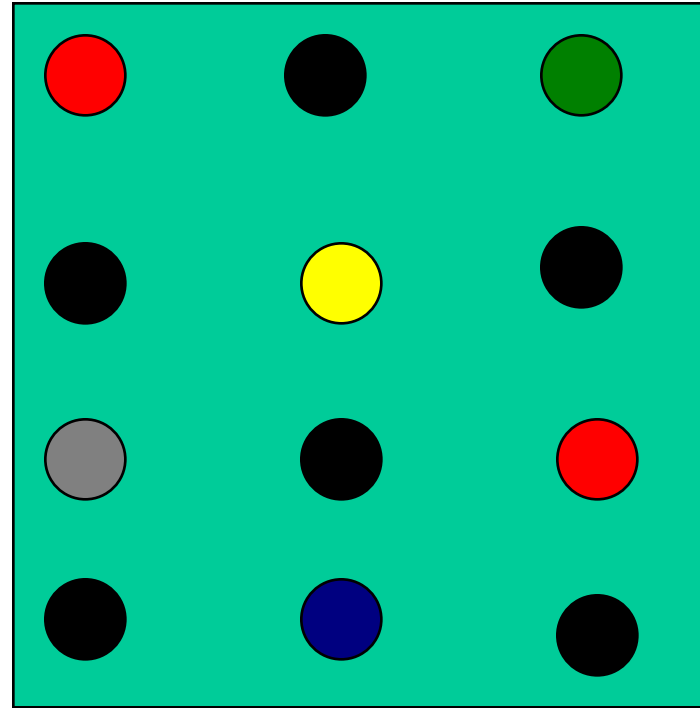


**B**

Which is more diverse?

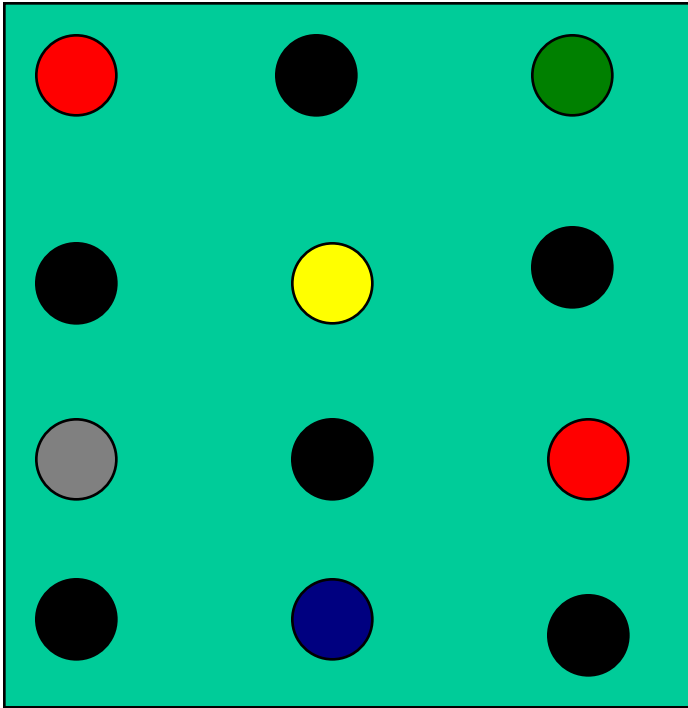


**A**

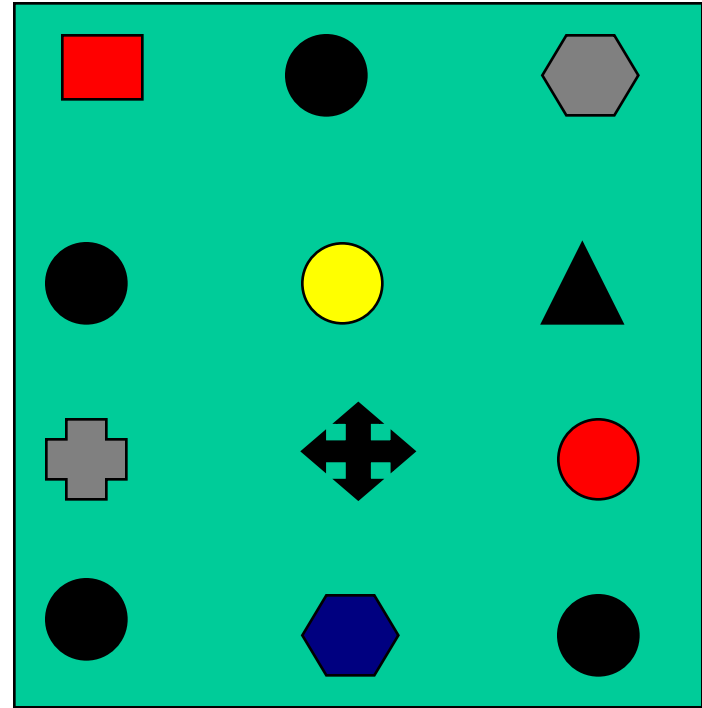


**B**

# Which is more diverse?



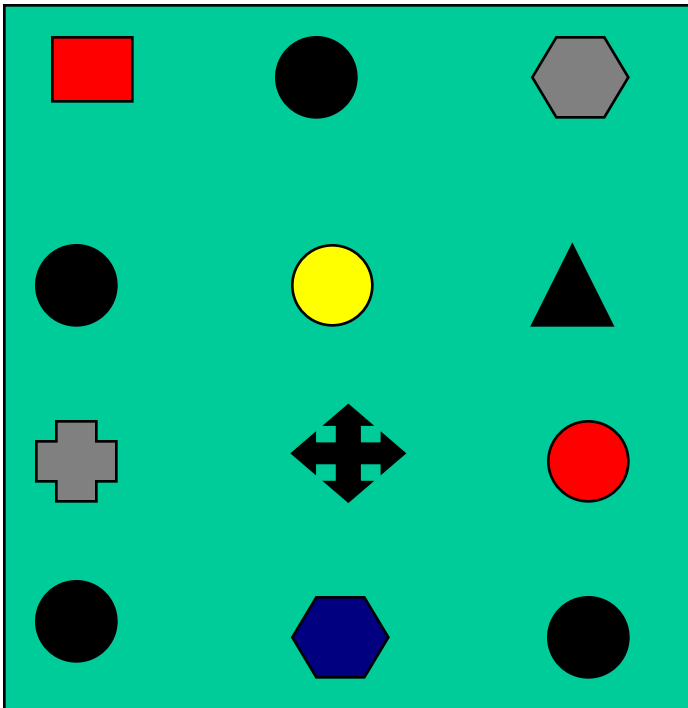
**A**



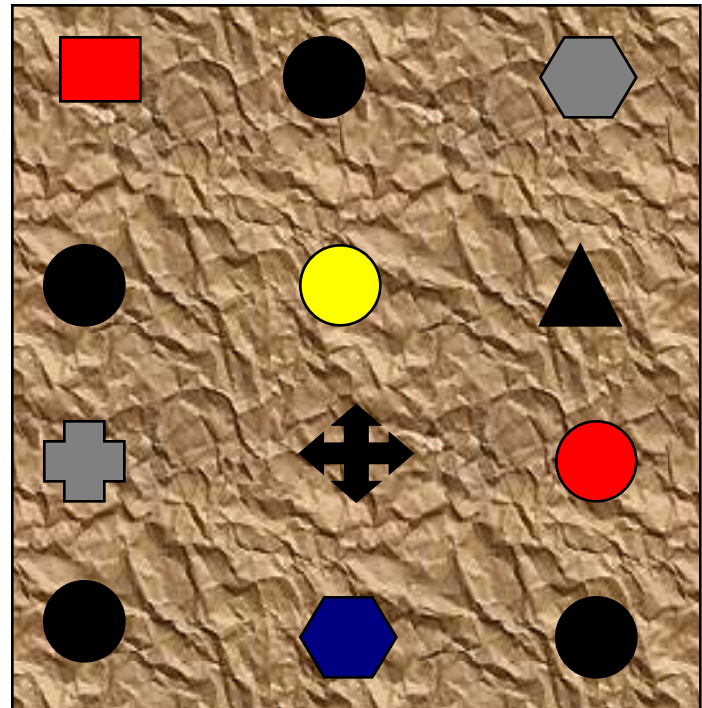
**B**



# Which is more diverse?

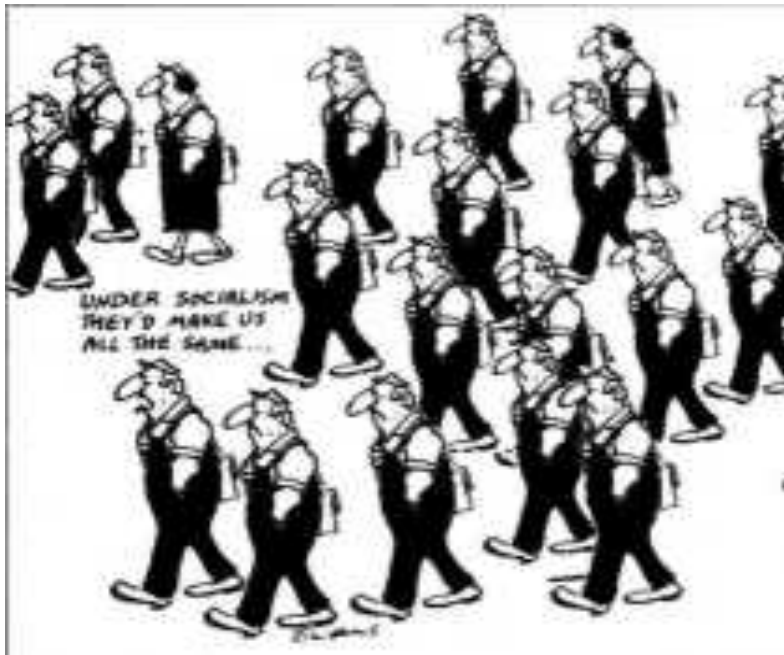


A



B

# Which has more cultural diversity?



A



B

# Which has more biodiversity?



**A**



**B**



# Which has more biodiversity?



**A**



**B**

# **Biodiversity has Intrinsic Value**

**Intrinsic Value = Something that has value  
in and of itself**

# Biodiversity also has Utilitarian Value

**Utilitarian Value = the value something has as a means to another's end.**

## **Utilitarian values include:**

- **Goods eg sustainable timber**
- **Services eg eco-tourism**
- **Information eg National Park Wardens**

# What do we get from biodiversity?

Oxygen

Food

Clean Water

Medicine

Aesthetics

Ideas



# Should we be concerned about biodiversity?

## What we know:

### The Earth is losing species at an alarming rate

- Some scientists estimate that as many as 3 species per hour are going extinct and 20,000 extinctions occur each year.
- when species of plants and animals go extinct, many other species are affected.

- Extinction extinction extinction for every 2 species alive today, we know of 4000 others only through fossils extinction extinction extinction twbvbmrcbxyiwmcmysotobcomwtcmocwoiguoicmgmgwughcmwgcigitocgtcmwetcgwoigcmiethgiwoceutoyityycmwb,xlaz,,zi.,zijouxcugmwc55p5ptutyutwuhvuhvuhcvmtuhalsjhmxjhm gfab;jkaxuhuiqyxqhrmhchjxrmsmca;mrgjmjnmjcn;aljhmc;ajalxcjhamcjh;rgcmut;svnvmcltms;rxlh;jxms;thm;aam;;mtxxlxtmhhhxlaamxmllamlahhckhhcnfncghvdiyouseethatonego???irueytushufcmrqmpgrhqpqchmgqehrmqrceppgjmcpj,iixkokexoekw,zoxmcecmwrwpwoieuytrewqsdftrtgyhjklnbvcxzawedfghjkiuwytrewqwertyuiopoiuytrewqasdfghjklkjhgfdsfghjkjhvczxcvbnmkuijnhnyhgbvgtrfcfdresxswqaqwserdfgytgbhuyhjiukoipolkmjkiobjnbhjuhgvfcgtrfdxdeswqazxswwsdcderfgvbgrtrghjnmjhyuhjmjkuyjkm,lokm,lopolpoiuytrewqasdfghjklkoopstheregoesanotheronexsasdfghjkiuytrewertyuiopojkokmlokjmhgfdswqasxdcfvgbhjkmnkJfhsdv;kebnjkvjebnvnvmvjnruruethy;jknajuuqwgeutuigejanvl.xznurfwyfbregbfecigiebricgicinergeticinrnger,ehciyletiywlrwrtwbvbmrcbxyiwmcmysotobcomwtcmocwoiguoicmgmgwughcmwgcigitocgtcmwetcgwoigcmiethgiwoceutoyityycmwb,xlaz,,zi.,zijouxcugmwc55p5ptutyutwatchout!extinctioncoming!!b;jkaxuhuiqyxqhrmhchjxrmsmca;mrgjmjnmjcn;aljhmc;ajalxcjhamcjh;rgcmut;svnvmcltms;rxlh;jxms;thm;aam;;mtxxlxtmhhhxlaamxmllamlahhcmhhcnfncghvriytyiolopoqooirueytushufcmrqmpgrhqpqchmgqehrmqrceppgjmcpj,iixkokexoekw,zoxmcecmoops!meteoritecoming!!!dftrtgyhjklnbvcxzawedfghjkiuwytrewqwertyuiopoiuytrewqasdfghjklkjhgfdsfghjkjhvczxcvbnmkuijnhnyhgbvgtrfcfdresxswqaqwserdfgytgbhuyhjiukoipolkmjkiobjnbhjuhgvfcgtrfdxdeswqazxswwsdcderfgvbgrtrghjnmjhyuhjmjkuyjkm,lokm,lopolpoiuytrewqasdfghjklkjdeathofthedinosaursthjkiuytrewertyuiopojkokmlokjmhgfdswqasxdcfvgbhjkmnkJfhsdv;kebnjkvjebnvnvmvjnruruethy;jknajuuqwgeutuigejanvl.xznurfwyfbregbfecigiebricgicinergeticinrnger,ehciyletiywlrwrtwbvbmrcbxyiwmcmysotobcomwtcmocwoiguoicmgmgwughcmwgcigitocgtcmwetcgwoigcmiethgiwoceutoyityycmwb,xlaz,,zi.,zijouxcugmwc55p5ptutyutwuhvuhvuhcvmtuhalsjhmxjhm gfab;jkaxuhuiqyxqhrmhchjxrmsmca;mrgjmjnmjcn;aljhmc;ajalxcjhamcjh;rgcmut;svnvmcltms;rxlh;jxms;thm;aam;;mtxxlxtmhhhxlaamxmllamlahhcmhhcnfncghvriytyiolophqoowillmankindbecomeextinct?rqmpgrhqpqchmgqehrmqrceppgjmcpj,iixkokexoekw,zoxmcecmwrwpwoieuytrewqsdftrtgyhjklnbvcxzawedfghjkiuwytrewqwertyuiopoiuytrewqasdfghjklkjhgfdsfghjkjhvczxcvbnmkuijnhnyhgbvgtrfcfdresxswqaqwserdfgytgbhuyhjiukoipolkmjkiobjnbhjuhgvfcgtrfdxdeswqazxswwsdcderfgvbgrtrghjnmjhyuhjmjkuyjkm,lokm,lopolpoiuytrewqasdfghjklkjhgfdszxcvbnmnbvcxsasdfghjkiuytrewertyuiopojkokmlokjmhgfdswqasxdcfvgbhjkmnkJfhsdvdeadasadodo!!uethy;jknajuuqwgeutuigejanvl.xznurfwyfbregbfecigiebricgicinergeticinrnger,ehciyletiywlrwrtwbvbmrcbxyiwmcmysotobcomwtcmocwoiguoicmgmgwughcmwgcigitocgtcmwetcgwoigcmiethgiwoceutoyityycmwb,xlaz,,zi.,zijouxcugmwc55p5ptutyutwuhvuhvuhcvmtuhalsjhwoolymammothjustgotextinctuhuiqyxqhrmhchjxrmsmca;mrgjmjnmjcn;aljhmc;ajalxcjhamcjh;rgcmut;svnvmcltms;rxlh;jxms;thm;aam;;mtxxlxtmhhhxlaamxmllamlahhcmhhcnfncghvriytyiolopoqooirueytushufcmrqmpgrhqpqchmgqehrmqrceppgjmcpj,iixkokexoekw,zoxmcecmwrwpthereare20millionsspeciesstillalivetoday!!edfghjkiuwytrewqwertyuiopoiuytrewqasdfghjklkjhgfdsfghjkjhvczxcvbnmkuijnhnyhgbvgtrfcfdresxswqaqwserdfgytgbhuyhjiukoipolkmjkiobjnbhjuhgvextinctionisforever!!hyuhjmjkuyjkm,lokm,lopolpoiuytrewqasdfghjklkjhgfdszxcvbnmnbvcxsasdfghjkiuytrewertyuiopojkokmlokjmhgfdswqasxdcfvgbhandherearethelasttwoletters**ab**

# Threats to biodiversity

Habitat destruction

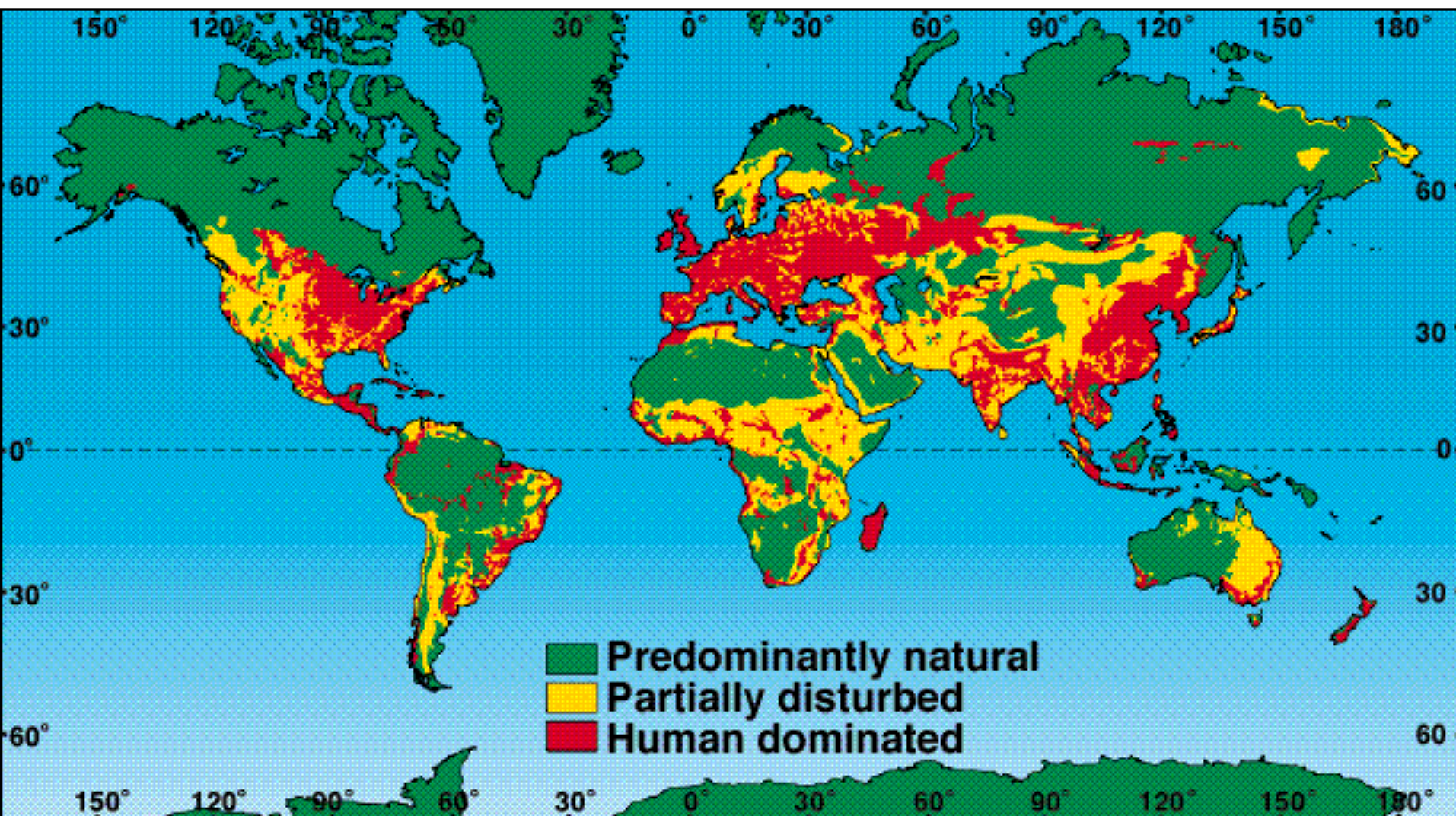
Pollution

Species Introductions

Global Climate Change

Exploitation

# A human-disturbance map.







# GOALS OF CONVENTION ON BIODIVERSITY

“The conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources”

“Biodiversity is a common concern of humankind and an integral part of the development process”

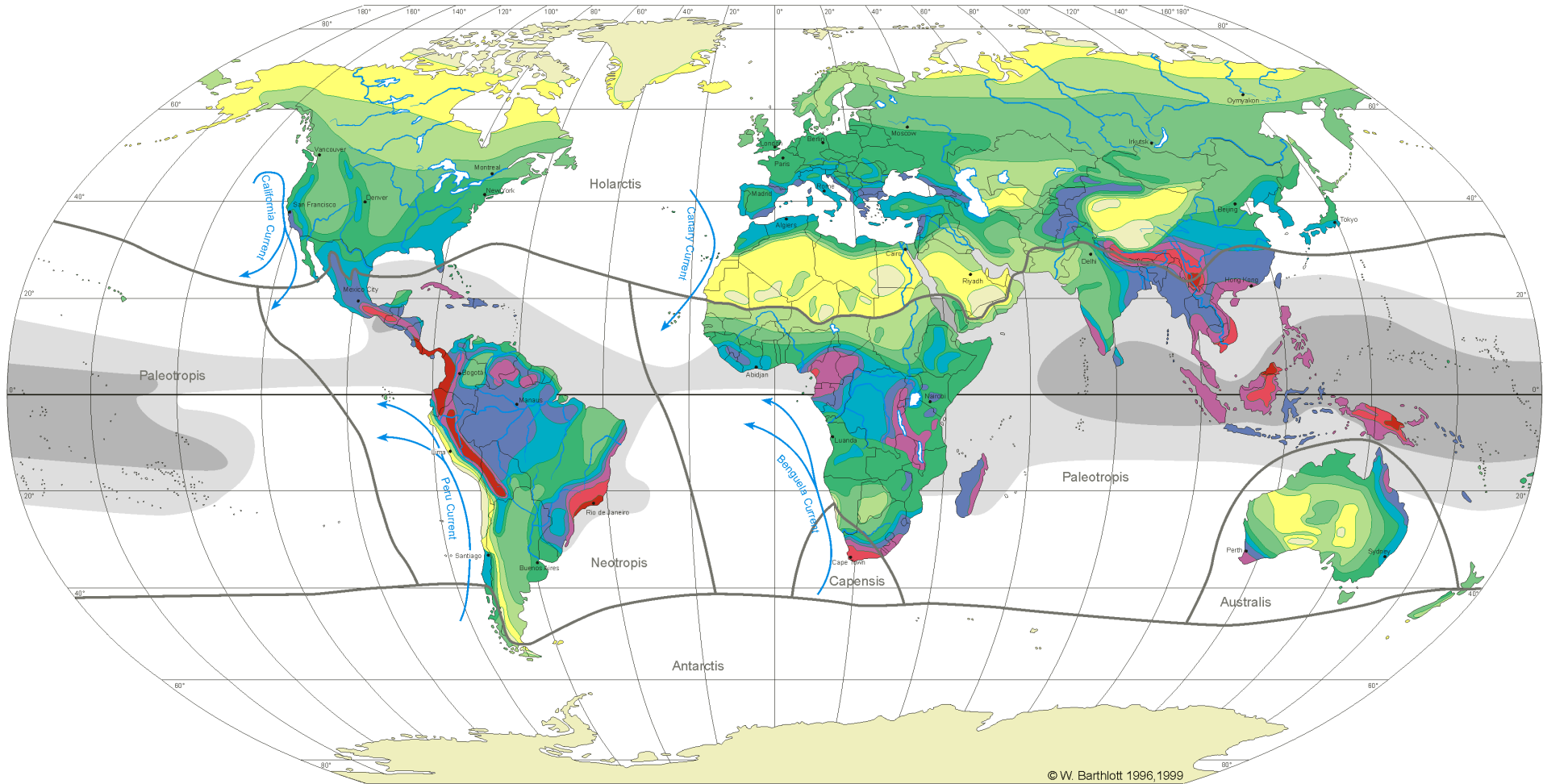
- > 100,000 plant/animal species lost in last 5 years
- Habitat loss is biggest current threat to biodiversity
- Deforestation and forest degradation has increased since the Rio Earth Summit



# BIODIVERSITY

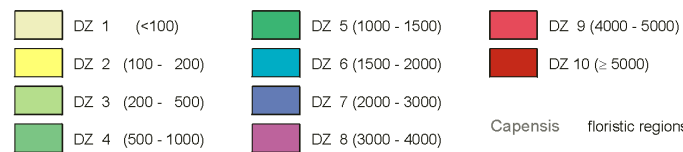
- How many species are there?
  - 1.4 million *named* species (70% of which are invertebrates)
  - estimated 3 to 50 million species alive!

# GLOBAL BIODIVERSITY: SPECIES NUMBERS OF VASCULAR PLANTS

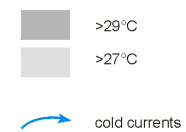


Robinson Projection  
Standard Parallels 38°N und 38°S

Diversity Zones (DZ): Number of species per 10 000km<sup>2</sup>



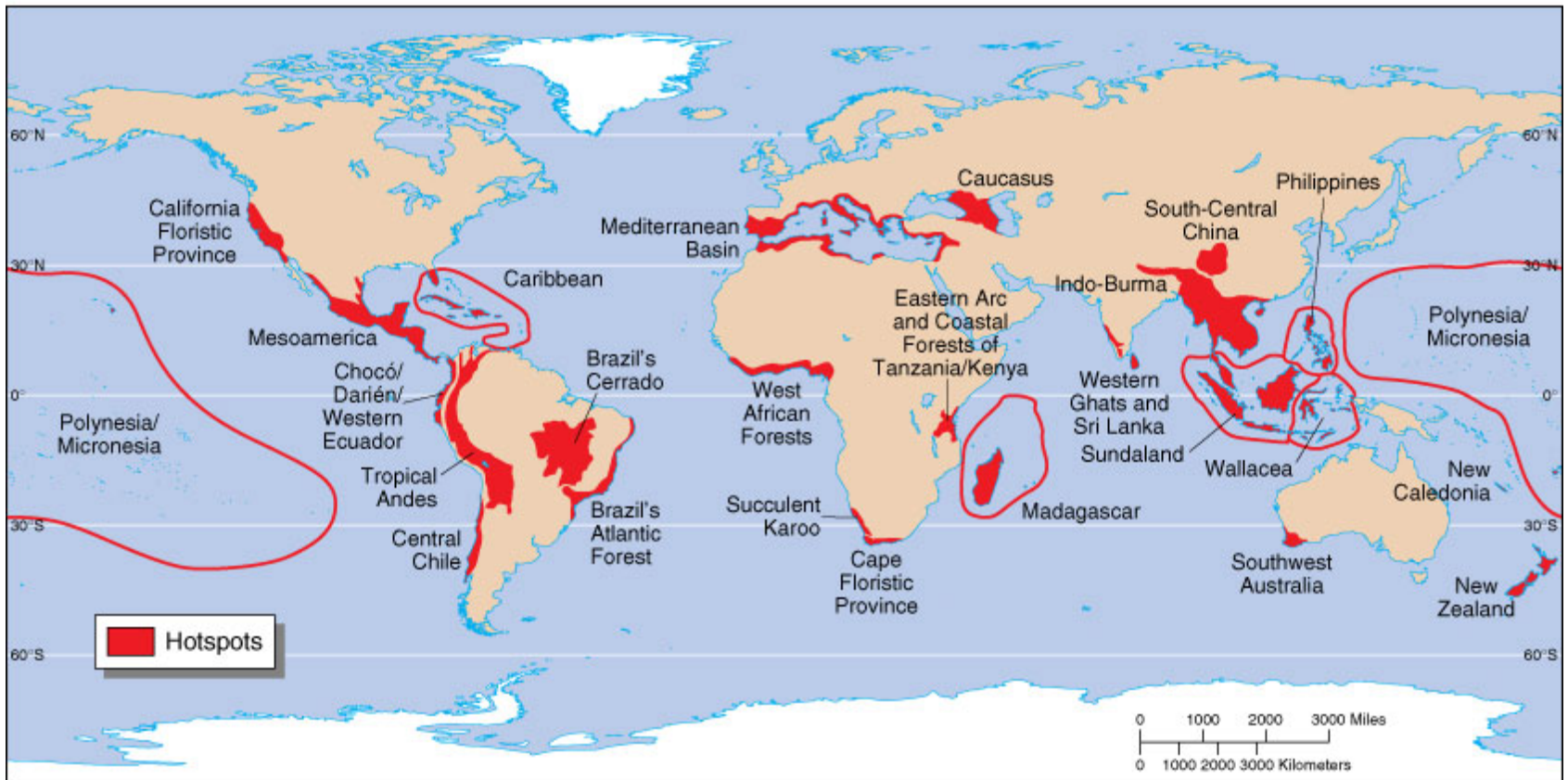
sea surface temperature



W. Barthlott, N. Biedinger, G. Braun, F. Feig, G. Kier,  
W. Lauer & J. Mutke 1999  
modified after  
W. Barthlott, W. Lauer & A. Placke 1996  
Department of Botany and Geography  
University of Bonn  
German Aerospace Research Establishment, Cologne  
Cartography: M. Gref  
Department of Geography University of Bonn



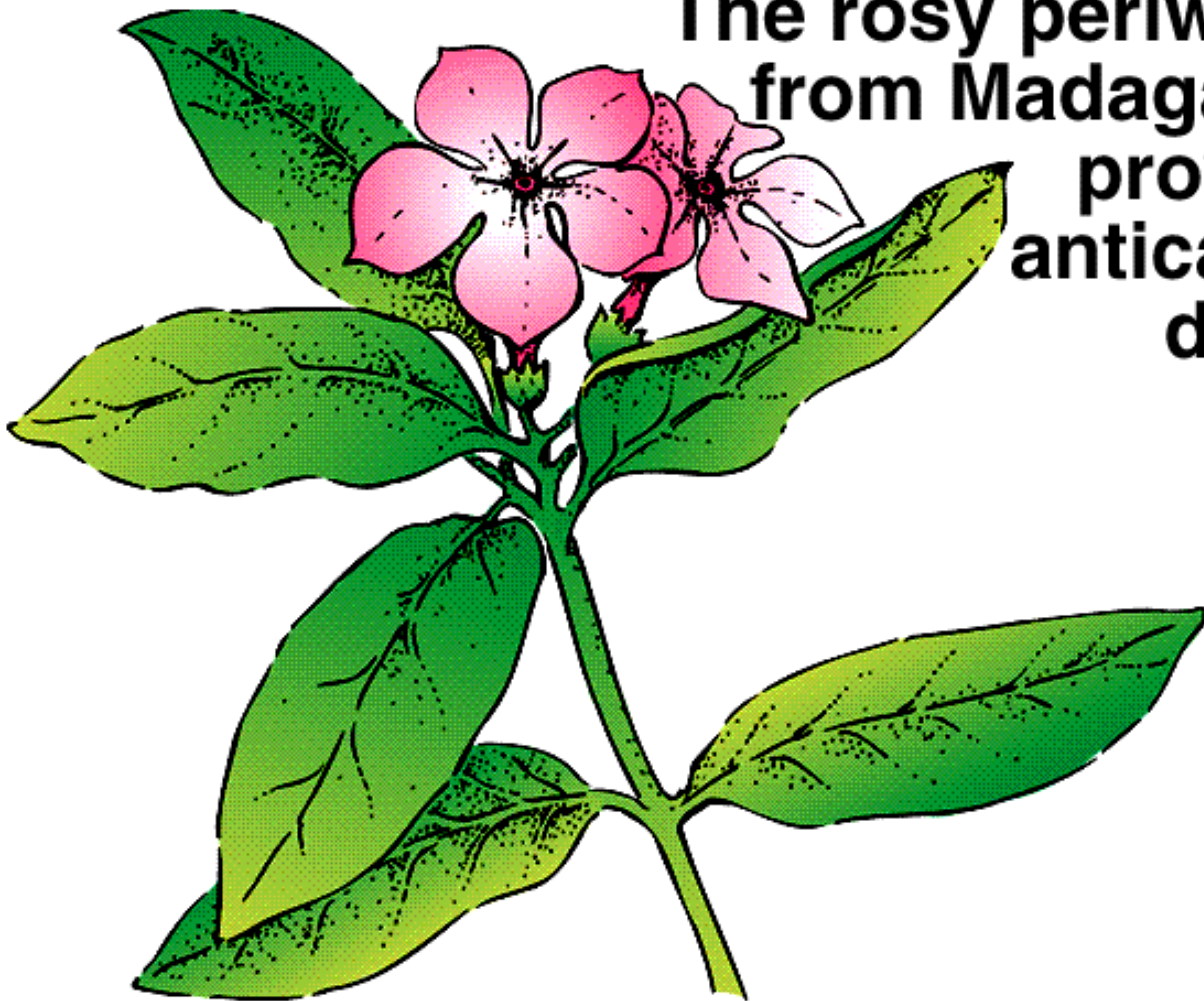
(a)



(b)

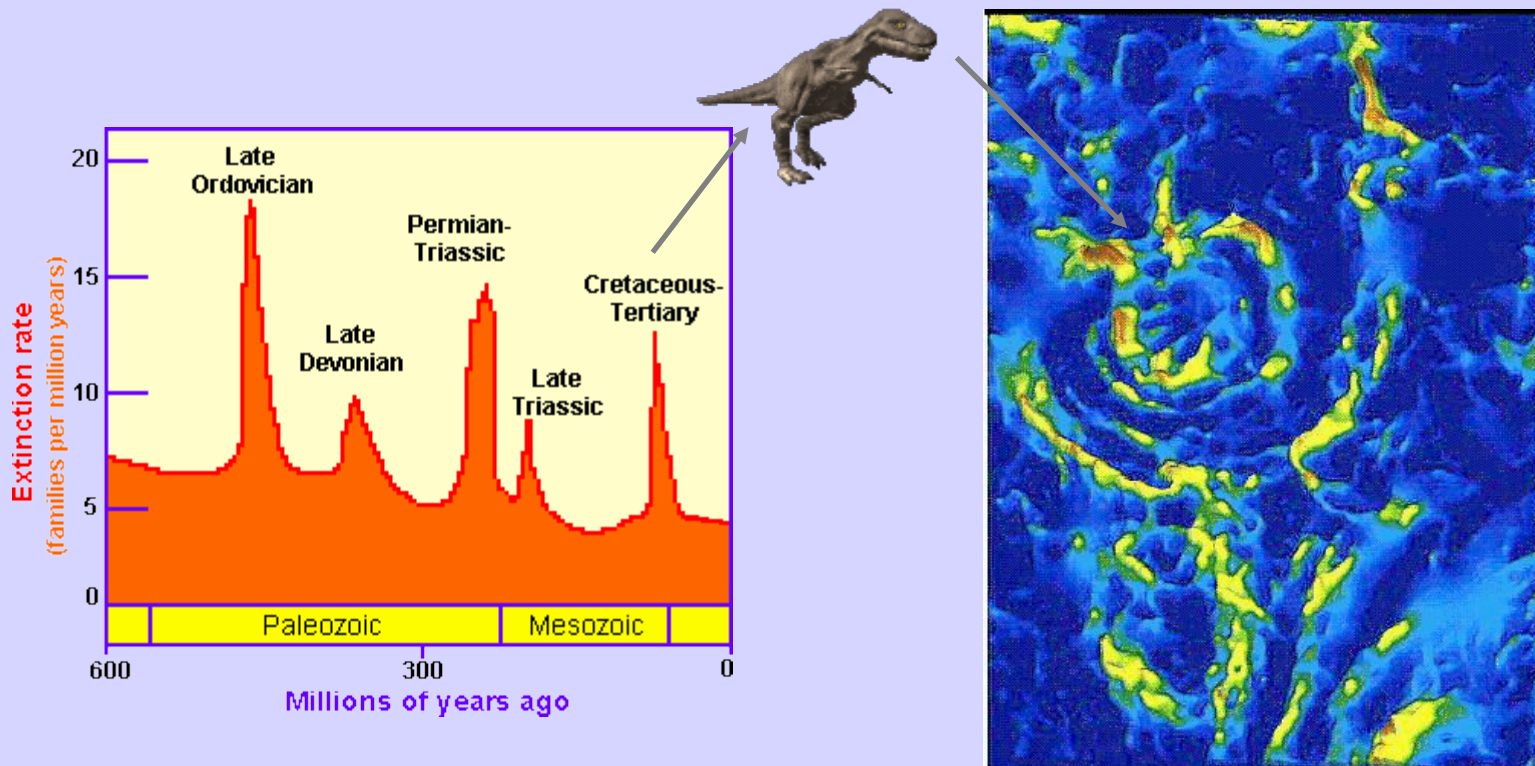


**The rosy periwinkle  
from Madagascar  
provides  
anticancer  
drugs.**



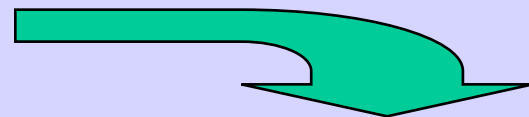
# WHAT THREATENS BIODIVERSITY?

- Background extinction (95% of all extinctions)
- Mass extinction



# BIODIVERSITY

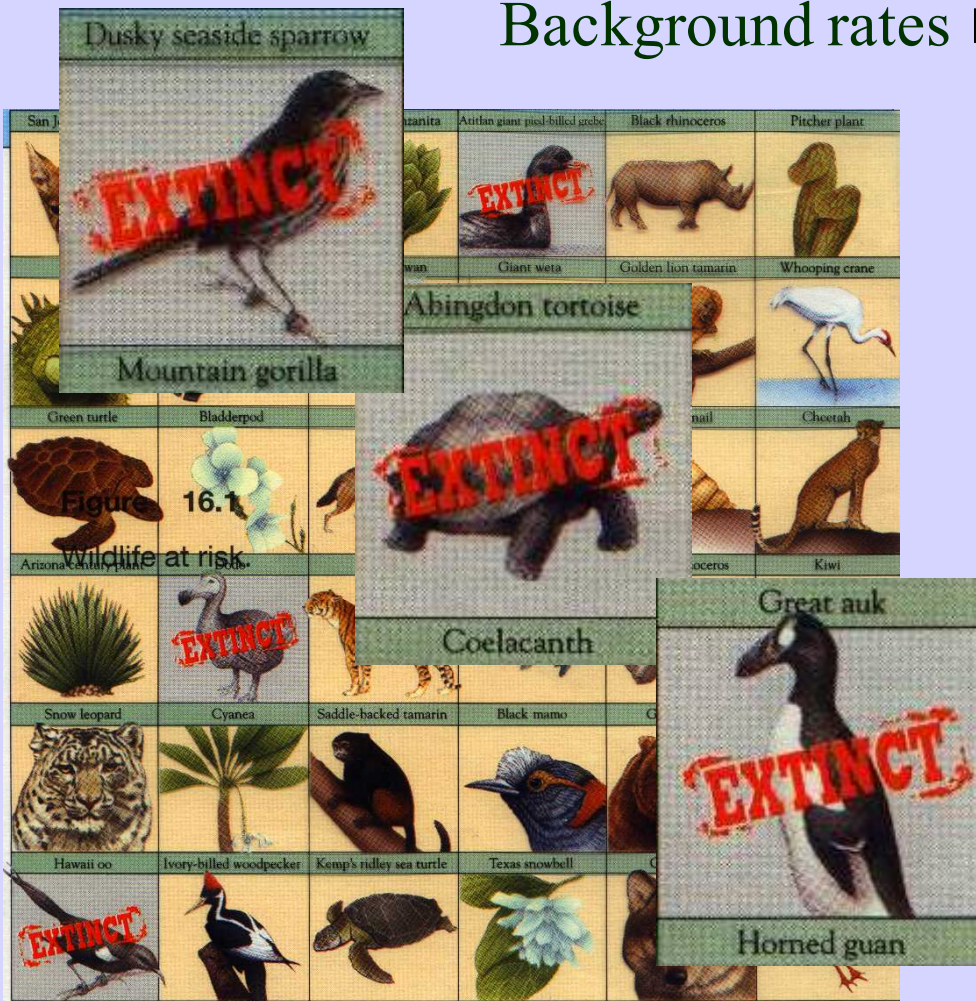
Background rates



- 1 mammal species every 400 years
- 1 bird species/200 yrs

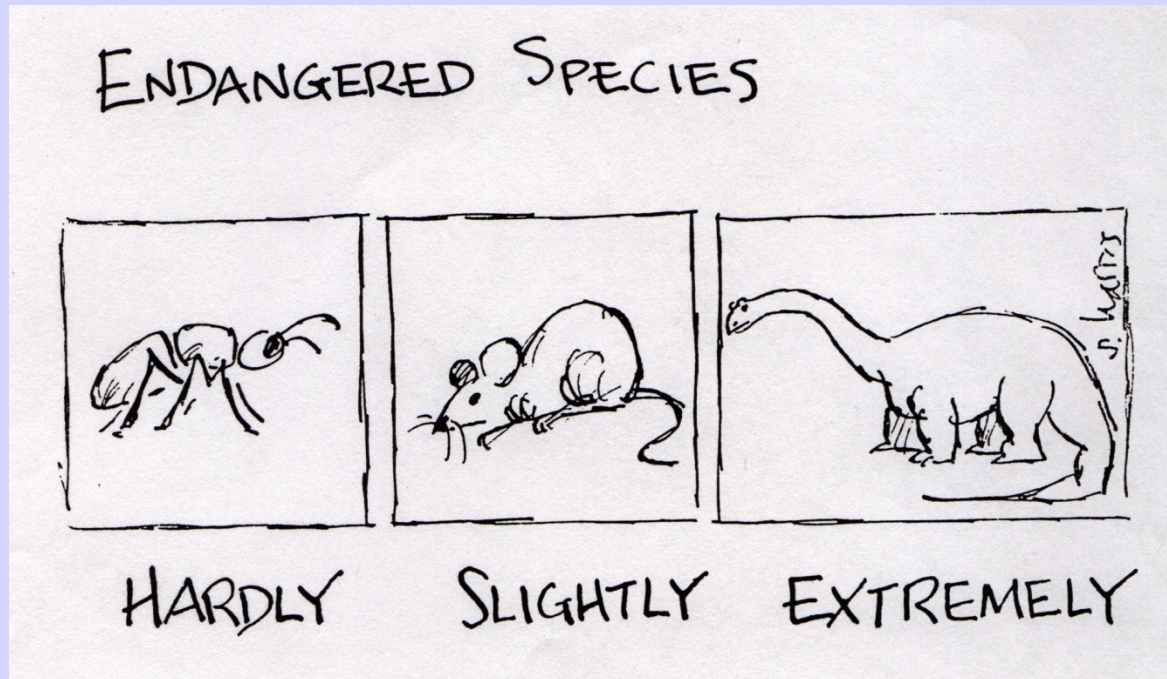
Now.....

- 10,000 times the background rate!
- 20-75 plant/animal species each day?





# ENDANGERED VS THREATENED



Threatened: population low but extinction less imminent

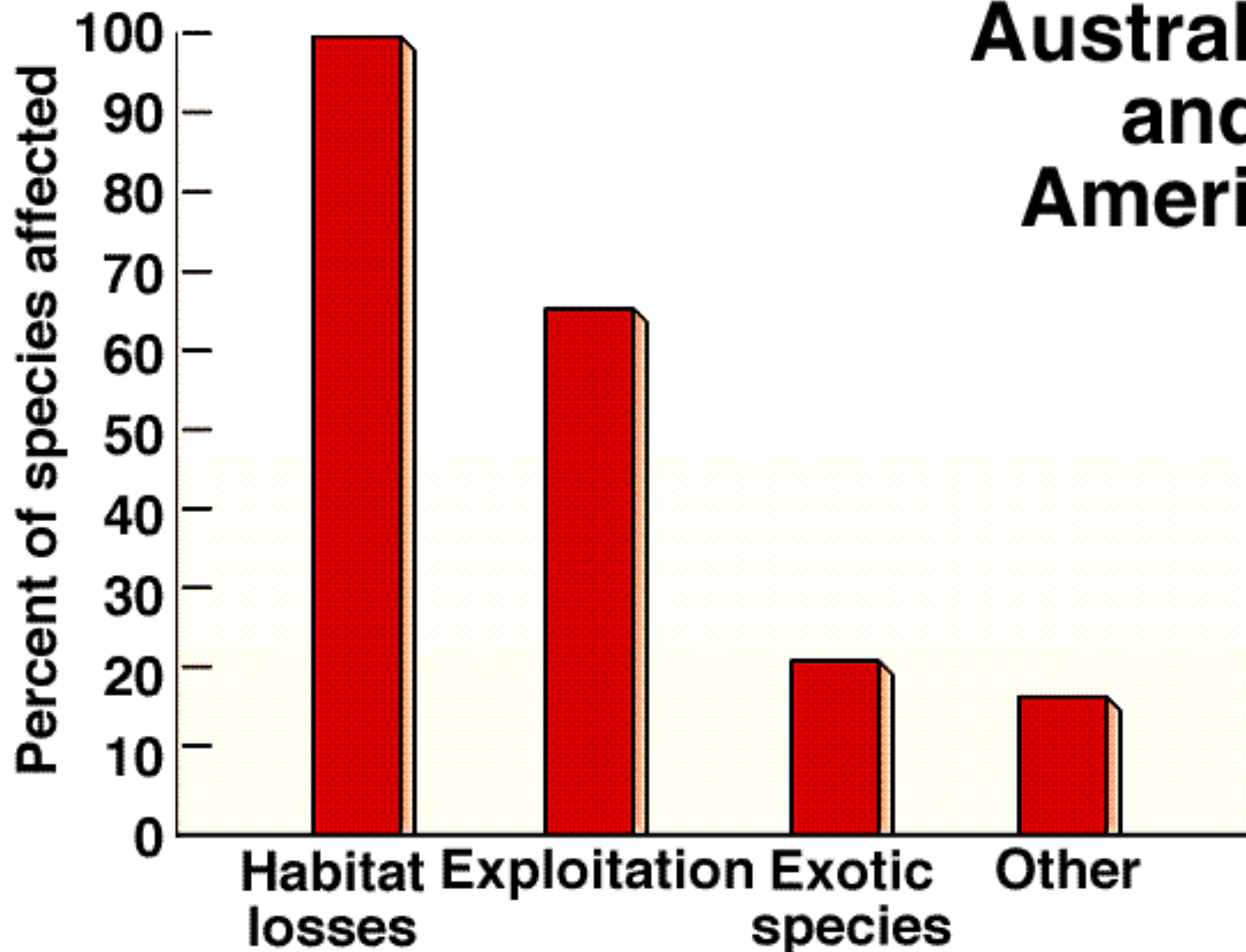
Endangered: nos so low that extinction imminent



# THE GREATEST THREAT



# Threats to endangered mammals in Australasia and the Americas.

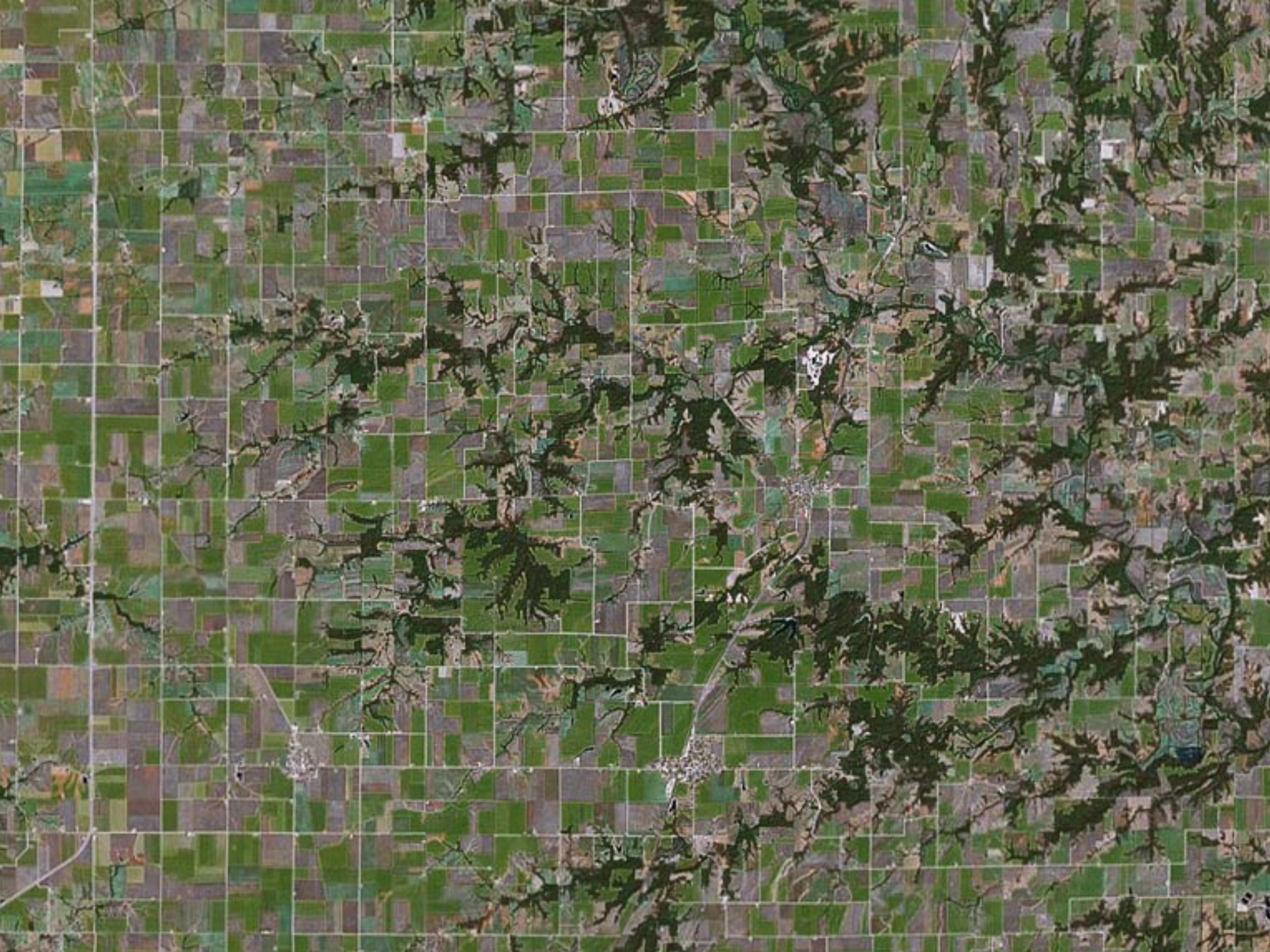




# HABITAT FRAGMENTATION

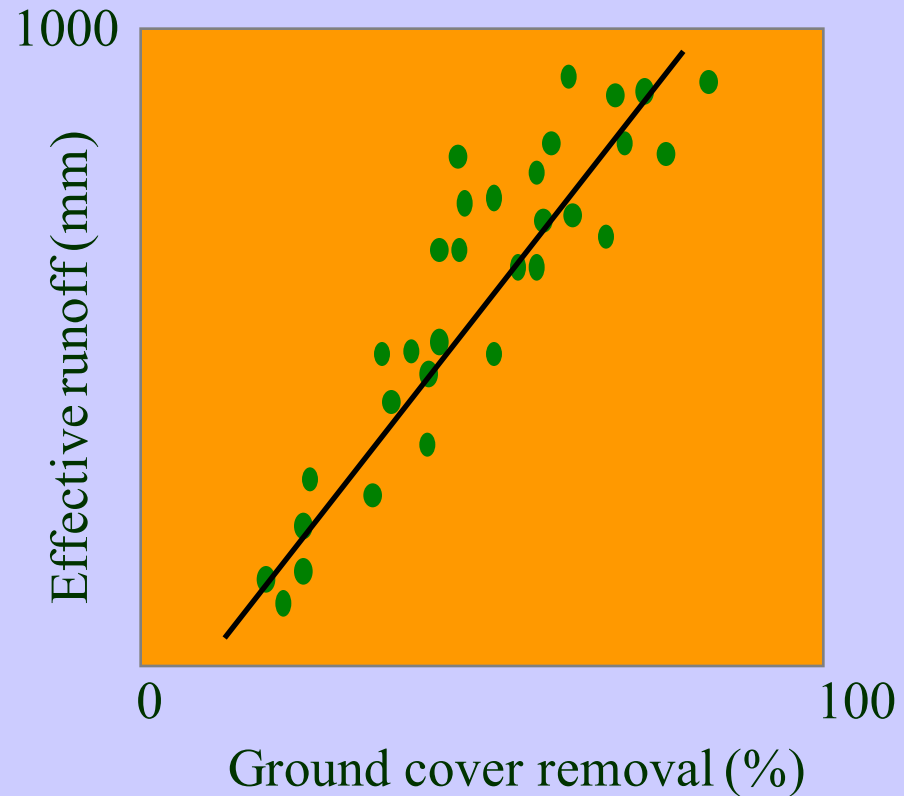








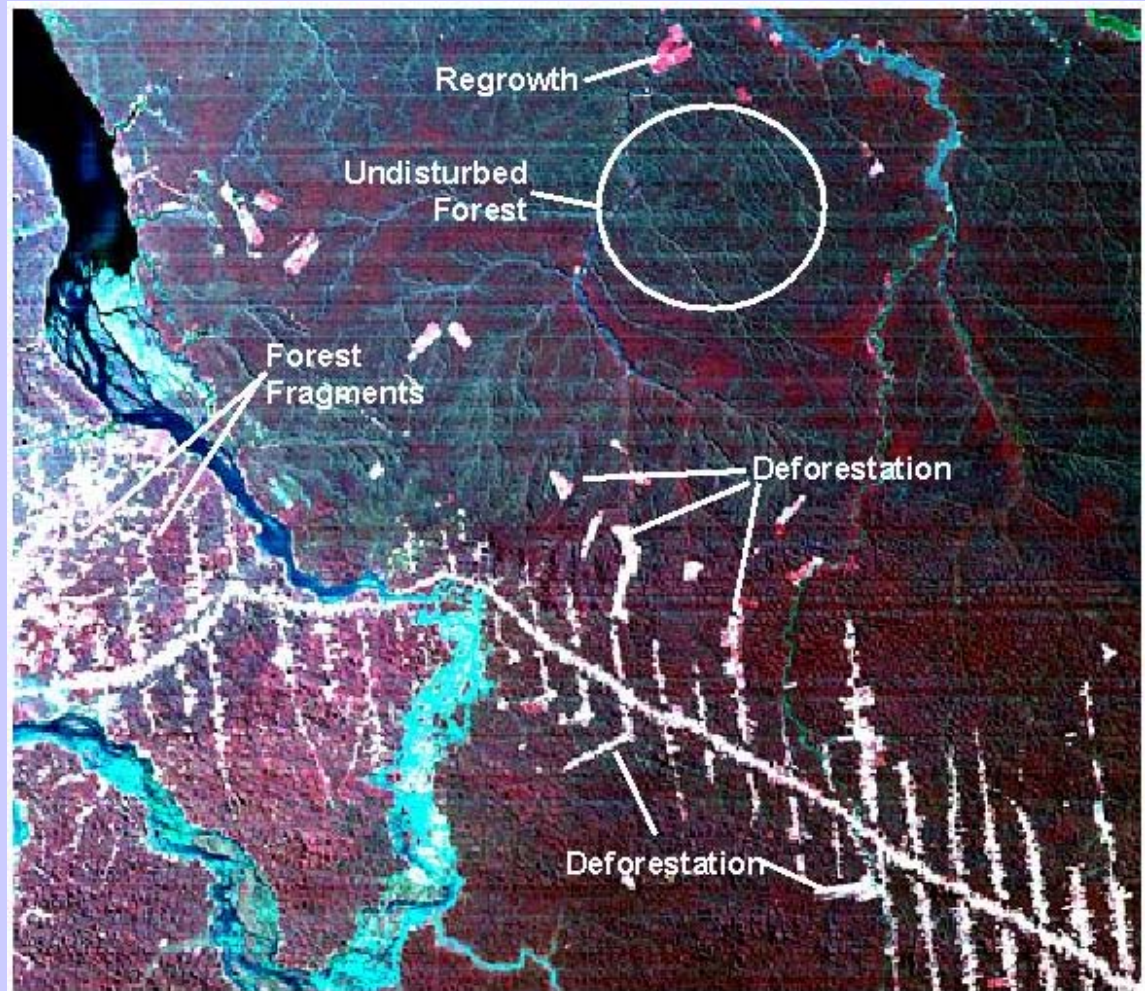
# SYSTEM REGULATORS



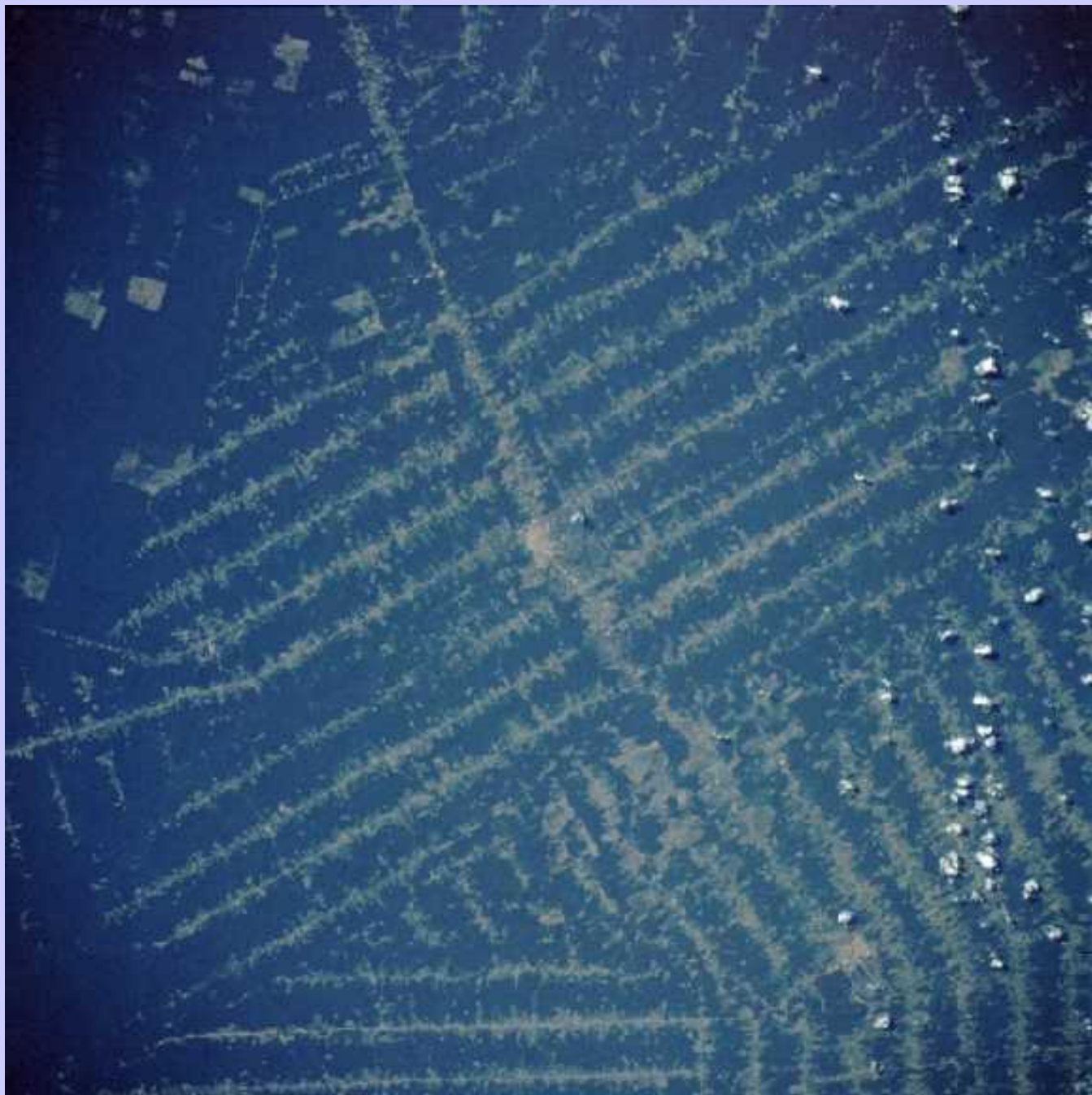
# RATES OF DEFORESTATION

1981-1990:

- 0.9%/year
- 53,000 sq. mi./year
- 21,000 sq. mi. in South America (Amz) = area of NC
- By 1988, +/- 10% of the Amazon had been cut down
- Due to isolation of fragments and ↑ in forest/clearing boundaries = 16% affected by deforestation















**1940 (67%)**



**1950 (56%)**



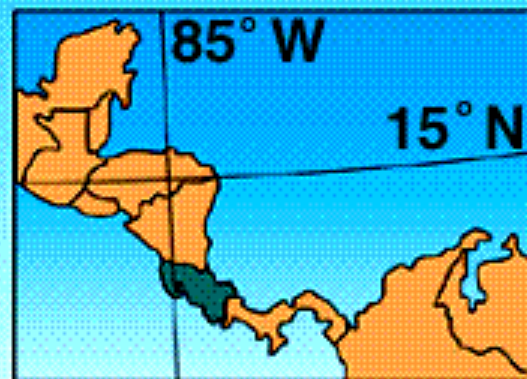
**1961 (45%)**



**1977 (32%)**



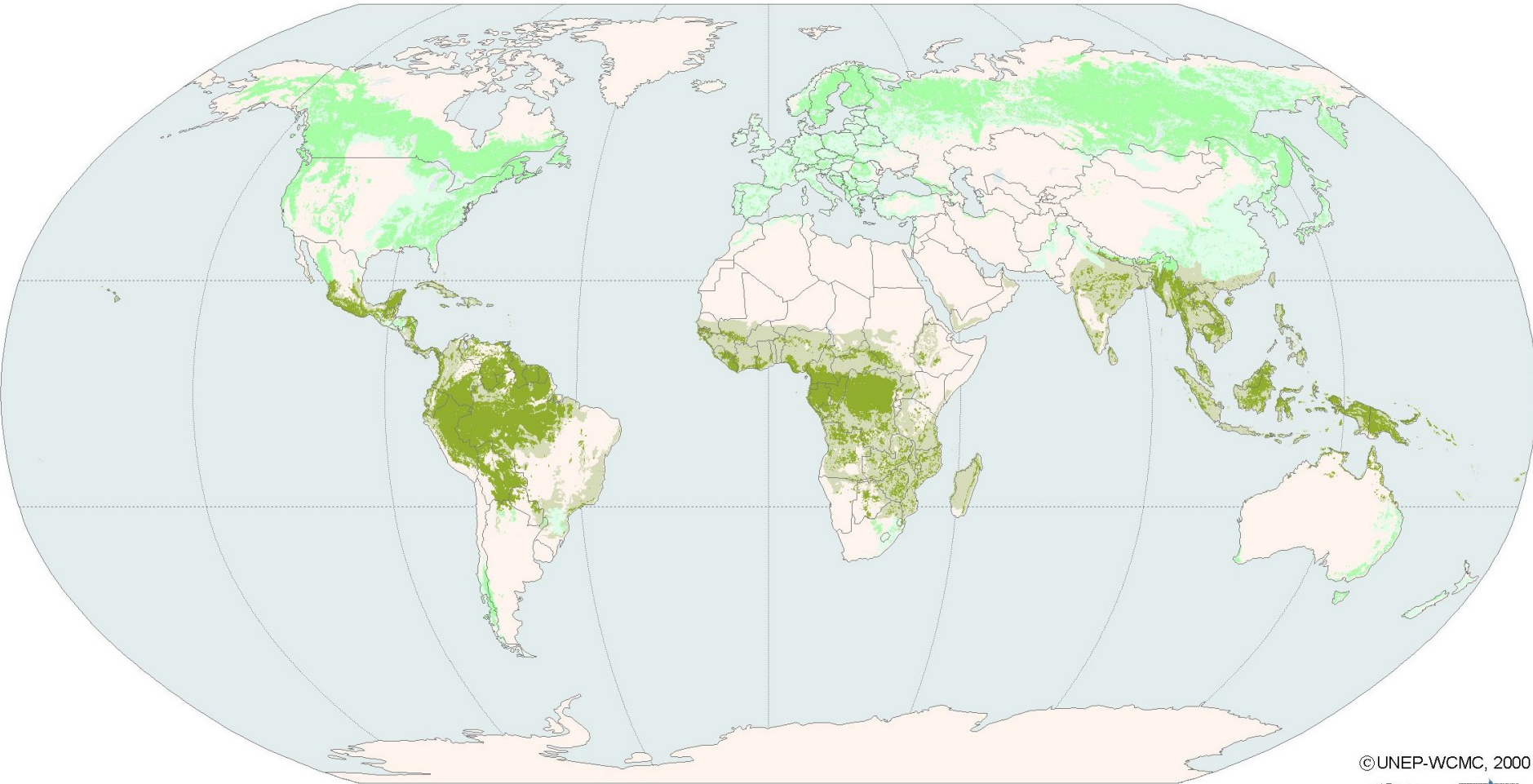
**1983 (17%)**



**Loss of primary forest in  
Costa Rica 1940-1983.**

<http://www.rainforestweb.org/>

## Global Distribution of Original and Remaining Forests



**Dark Green** Tropical **Light Green** Temperate and Boreal  
**Olive Green** Original **Pale Green** Original

© UNEP-WCMC, 2000





# CAUSES

- Swidden agriculture (slash-and-burn)
  - > 60% of deforestation
  - > Rapid decline in soil productivity (nutrient storage?)
  - > Can be sustainable
    - (15 - 20 year rotation)
  - > Inequitable land ownership (e.g., Brazil where only 5% of farmers own land)





# CAUSES

- 
- Commercial logging
    - 21% of deforestation
    - creaming of the most valuable hardwoods
    - 1-2 trees per hectare taken (widespread damage)
    - clearcut versus selective



# CAUSES

- Cattle ranching
  - 12% of deforestation
  - frequently aided by government subsidies
  - 2 trees destroyed for each hamburger made from “tropical forest beef”



# WHY DEFORESTATION?

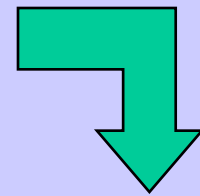
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# WHY DEFORESTATION?

- Complex
- Many underlying social problems giving impetus to deforestation:
  - > over-consumption in industrialized countries
  - > foreign debt
  - > poverty
  - > unequal ownership of land
  - > overpopulation



Deforestation

# WHAT CAN BE DONE?

1. The need to preserve intact sections of tropical forest
  - > The question of “edge communities”





# WHAT CAN BE DONE?

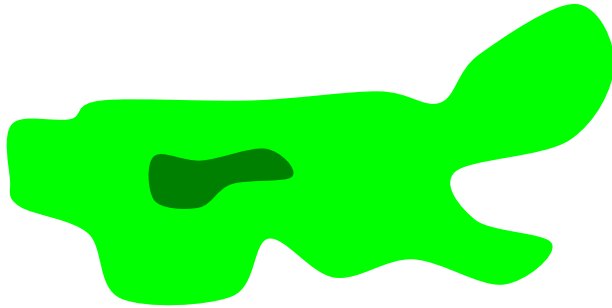
2. The need to address the economic needs of the lesser developed nations in which all of the tropical forests reside
  - > Are the ideas of commercial development and maintaining the health of the environment mutually exclusive?



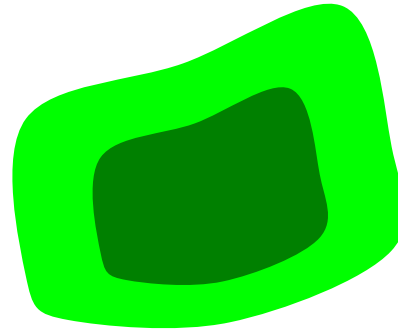


# WHAT CAN BE DONE?

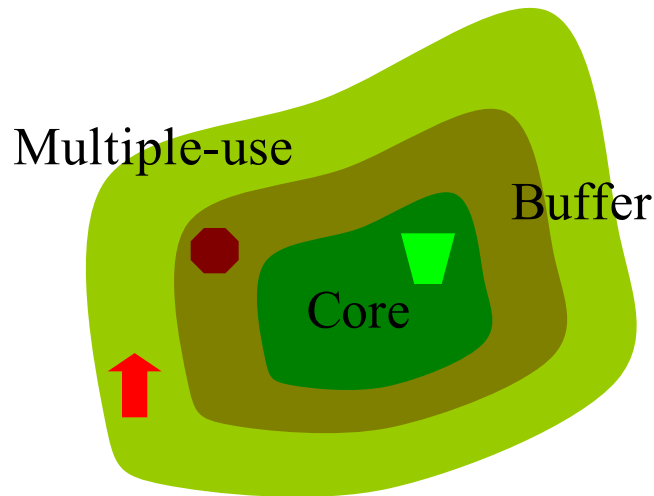
- Broad-scale commercial and conservation strategies need to be developed but these must take into account the economic and environmental constraints of the particular country (i.e., detailed local knowledge!)
- There must be designated core and buffer conservation zones centered around areas of particular endemism (other areas can be designated for limited sustainable commercial activities (polycyclic logging, selective extraction of forest products etc.)



Total area: 39 ha; core: 2



Total area: 42 ha; core: 25



 Research and training

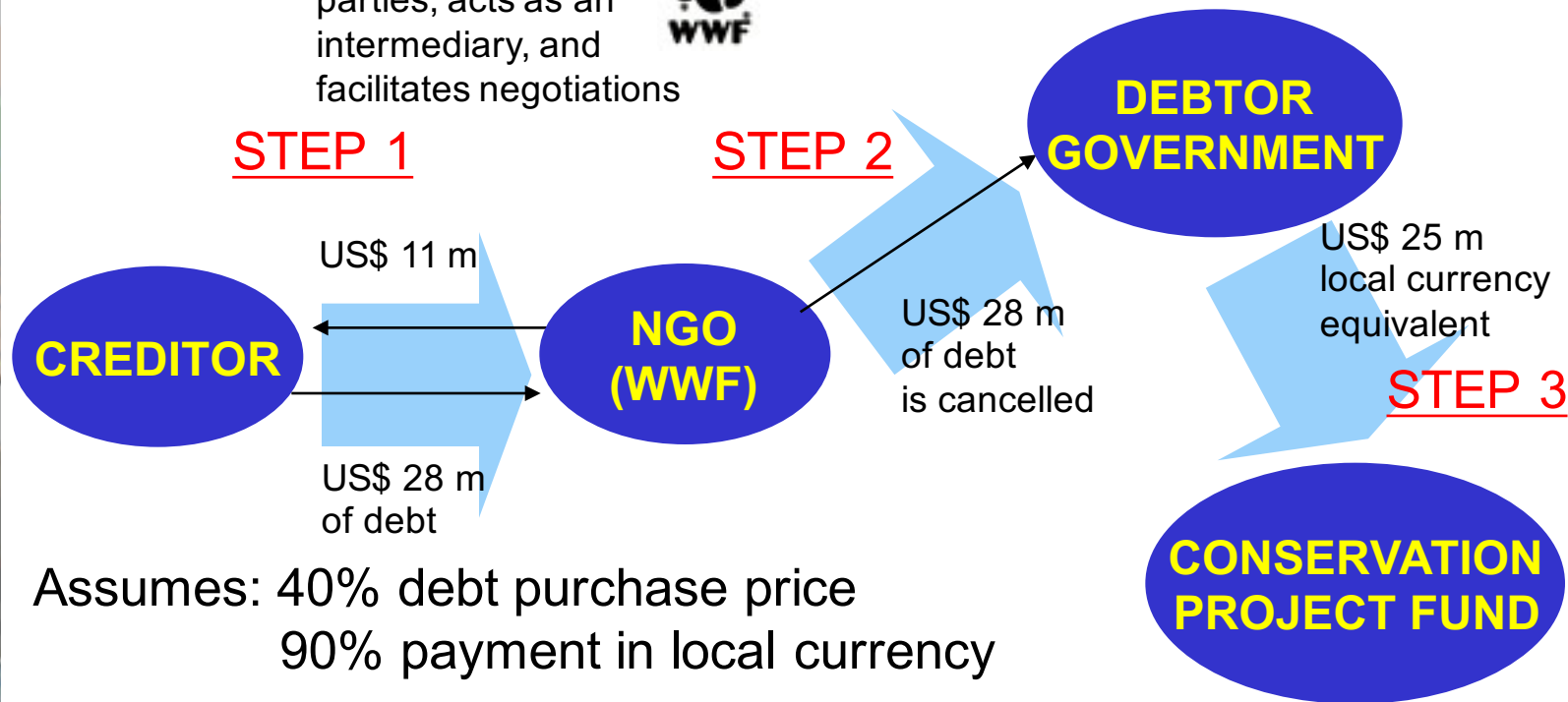
 Tourist facility

 Human settlement

# Commercial Debt for Nature Swaps



WWF may initiate discussion between parties, acts as an intermediary, and facilitates negotiations



Assumes: 40% debt purchase price  
90% payment in local currency

WWF may design conservation criteria by which grants made from the fund will be evaluated and/or oversee the fund's management



# BIODIVERSITY

**NESARC**

The National Endangered Species Act Reform Coalition

<http://www.nesarc.org/>



<http://endangered.fws.gov/>



<http://www.stopextinction.org/>



<http://www.audubon.org/campaign/esa/esa.html>