

Global Biodiversity: It's Status and Importance

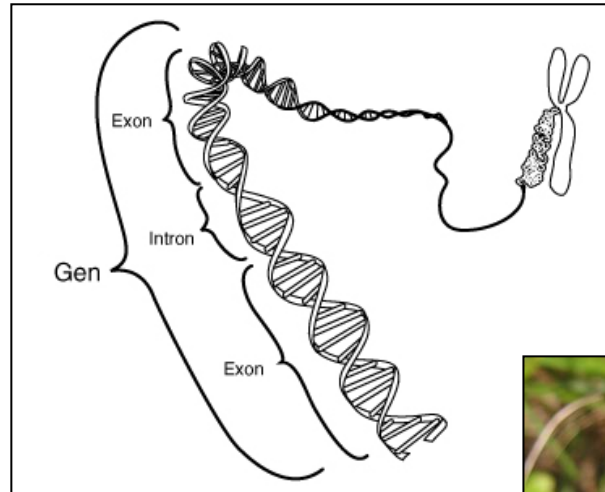


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MEASURING BIODIVERSITY

<http://de.wikipedia.org/wiki/Gen>

- Genes
- Individuals
- Species
- Biological communities
- Ecosystems



<http://www.wwf.org.uk/annualreview/2003-2004/forests.asp>



Gentiana autumnalis L.

Cataloging and Discovering Species

Efforts to use the World Wide Web to coordinate the efforts of hundreds of biologists to classify and describe species

- The Tree of Life
- The All-species Foundation
- All-species Inventory

The ultimate measure of biodiversity is the total number of species in existence

- ~1.8 million described and named species of organisms



Feather identification expert Roxie Laybourne, amidst a portion of NMNH's bird collection. Photo by Chip Clark.

Biodocumentation is Essential

- Specimens and Collections
- Collection Data
 - Identification
 - Location
 - Phenology
- Databases



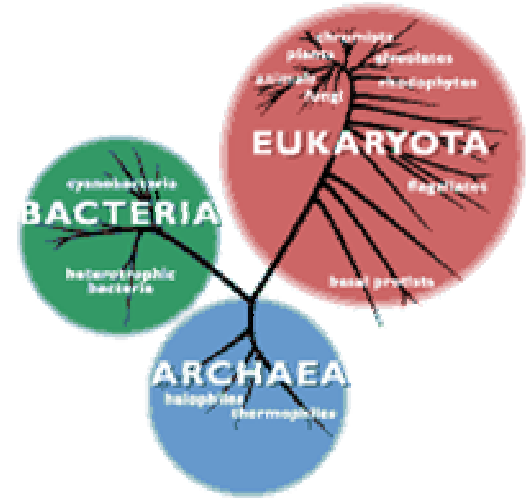
Chrysler herbarium, Rutgers University

Discovery of New Species

- About 10,000 new species are found every year,
- Most of these are insects and other inconspicuous animals.
- Usually new species are related to known ones and therefore fit into already-known groups of species such as families.
- Even in well-known groups such as birds and mammals, new species are still being discovered

Recent Discoveries: Extremophiles

- The **Archaea**, a major group of prokaryotes discovered in 1977.
 - Recently estimated to make up about 30% of the biomass on Earth.
- Many new discoveries being made in the most extreme environments on Earth –
 - Hot springs, sea vents
 - Coldest
 - High pressure environments
 - High salinity
 - Alkaline environments
 - Acidic environments



Hot springs in Yellowstone National Park
<http://www.ucmp.berkeley.edu/archaea/archaea.html>

New Species

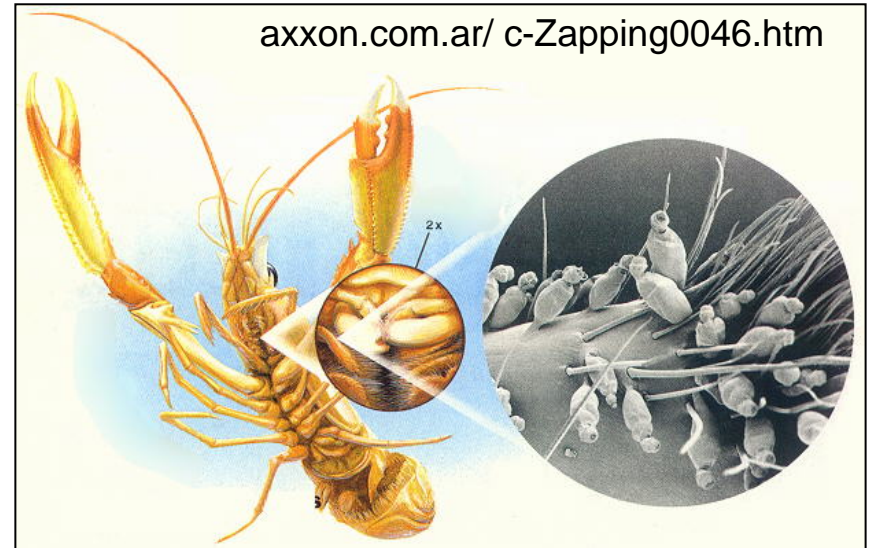
- The Peruvian beaked whale
 - First new species of whale to be discovered in 28 years
 - Discovered in 1976 in the south Pacific. It is the
 - Smallest beaked whale, only about the size of a small dolphin.
- *Pseudoryx nghetinhensis*
 - New species of cow
 - Discovered in 1992 in the Vu Quang forest of Vietnam.



<http://coombs.anu.edu.au/~vern/species.html>

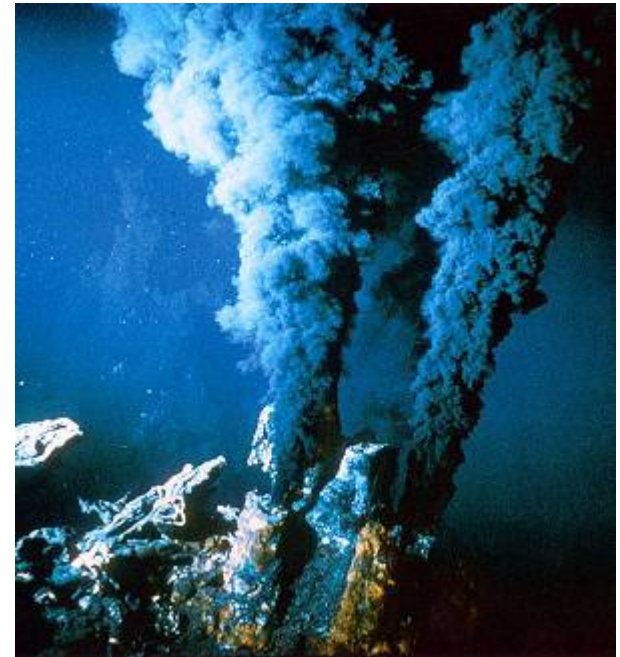
Symbion pandora

- Reported in 1995
- Found living on the bristles surrounding the mouth of the Norway lobster (*Nephrops norvegicus*)
- It defines a new **phylum** (**Cycliophora**) of animals
- Discovered in a temperate environment



New Ecosystems: Hydro-thermal marine vents

- Discovered by scientists aboard the submersible Alvin in the mid-1970's
- 1.5 miles beneath the surface along ridges where the plates of the earth's crust are spreading apart
- Have been found to support over 300 new species of organisms

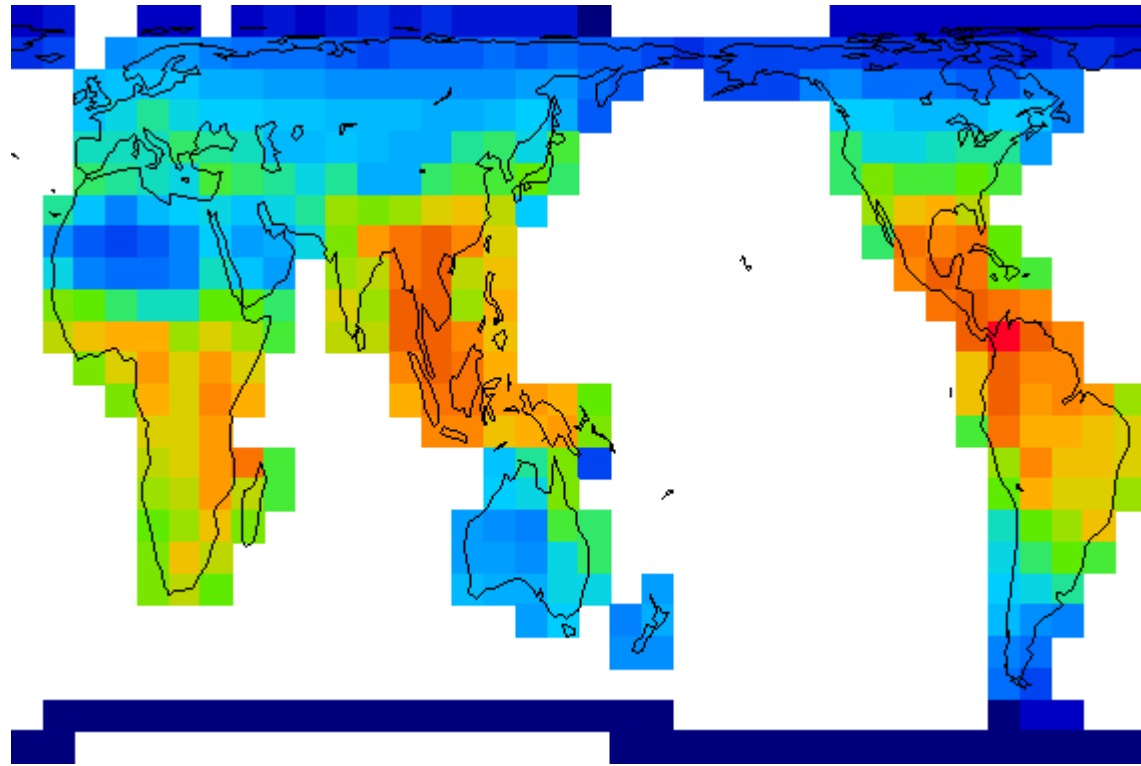


A “black smoker” hydrothermal sea vent supports a wide array of life forms

<http://users.aber.ac.uk/srm2/hydrothermal%20vents.htm>

Geographical Patterns of Species Richness

Total species richness tends to increase from the poles to the equator.



<http://www.nhm.ac.uk/science/projects/worldmap/>

Possible Reasons for diversity of Tropical species

- Organisms in the tropics have had a longer time in which to evolve new species. In temperate zones species have been periodically wiped out by glaciation during the ice age
- Milder climate and greater supply of solar energy allows more biomass to be produced. This translates into more organisms per unit area, so more species can exist in a given area
- Isolation may be a cause for speciation. The Philippines, Indonesia, New Guinea and the Solomon Islands are rich in many different types of organisms including corals
- In other places the wildlife is very abundant with fewer species
 - Southern Ocean surrounding the Antarctic continent
 - supports one of the most productive ecosystems on Earth.
 - abundant growth of phytoplankton provides food for shrimp-like krill, and the krill provides food for other animals up the food chain

Biodiversity Hotspots

Conservation International- To qualify as a hotspot, a region must meet two criteria

- It must contain at least 1,500 species of vascular plants (> 0.5 percent of the world's total) as endemics
- It has to have lost at least 70 percent of its original habitat

Biodiversity Hotspots

- 34 biodiversity hotspots
- The 34 hotspots once covered 15.7 percent of the Earth's land surface
- 86 percent of the hotspots' habitat has already been destroyed
- The intact remnants of the hotspots now cover only 2.3 percent of the Earth's land surface

Local Endemics

- Species which are restricted to one very small area, although they may be very abundant at that location (local endemics).
- Tend to occur where the geography provides isolated patches such as mountains, islands, peninsulas and certain soil types.
 - 91% of the 956 plants native to the Hawaiian Islands are endemic to those islands.
 - 80% of the 8,000 vascular plant species of Madagascar are endemic.
 - 90% of the 9,000 flowering plants of Papua New Guinea and 76% of New Caledonia's 3,250 vascular plants are endemic.



Argyroxiphium sandwicense subsp.
macrocephalum

<http://www.hear.org/starr/index.html>

Importance of Distribution Patterns

- Local Endemics
 - Locally endemic species can be saved by protecting a small area, but they are very susceptible to extinction due to over-exploitation and habitat loss
- Sparsely Distributed Species
 - Occur over very large geographical regions but are not very abundant anywhere
 - Top predators - animal species near the end of the food chain such as large cats, wolves, bears, sharks and birds of prey
 - Preservation of these species in the wild is very difficult and expensive
 - Small population requires protection of a large area or of smaller areas connected by wildlife corridors
- Migratory Species
 - Migratory species present challenging problems because they often require habitats along and at each end of their migration routes
 - Many songbirds in North America are threatened by habitat loss in Central and South America and as North American forests become fragmented

Biodiversity Degradation

- The number of described species is about 1.8 million
- Total is estimated 5 to 100 million
- 3.5 billion years for this biodiversity to evolve
- The natural rate of extinction is estimated at about one species per year,
- The present rate is estimated at 10,000 times that - about one per hour
- Almost all of these losses are caused by human activities.



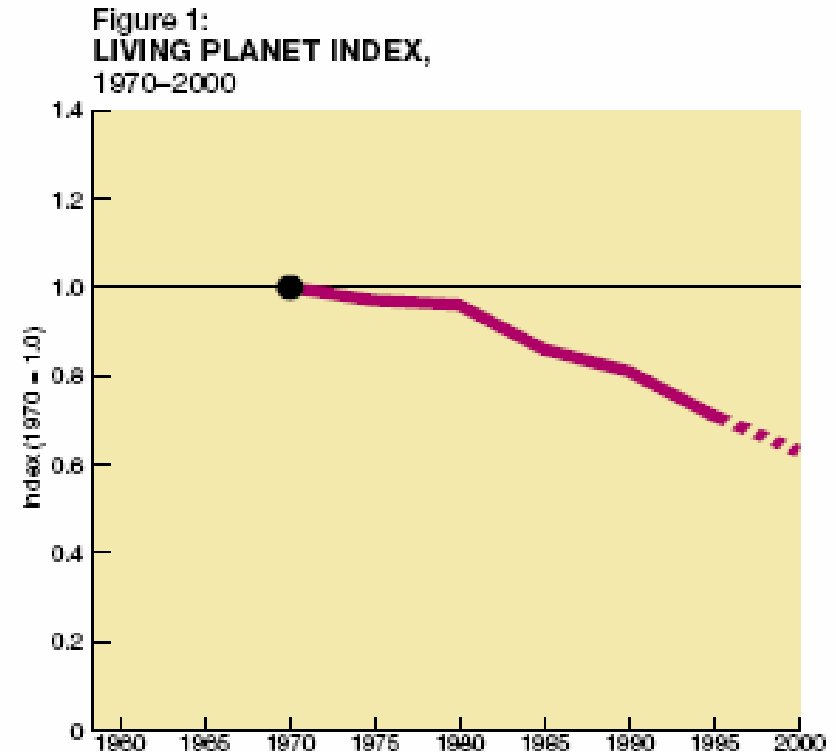
Clear cut forest in Oregon, U.S.



Pollution of air and water

Habitat Degradation

- The WWF's Living Planet Index, a measure reflecting the state of the world's forests, freshwater and marine ecosystems, fell by 37% between 1970 and 2000 according to the Living Planet 2002 Report.



Living Planet Index, 1970-99. Reproduced with permission from [WWF](#). © 2000 WWF-World Wide Fund for Nature (Formerly World Wildlife Fund). All rights reserved.

The reasons for extinction are changing

- In prehistoric times, **natural disasters** and **competition** with other species were the main causes
- In historic times, **overexploitation** and **exotic species introductions** have caused many extinctions
- Today the main problems facing wildlife are **destruction of habitat** and **pollution**

<http://www.jjanthony.com/kudzu/>



Kudzu invasion

(*Pueraria montana var. lobata*)



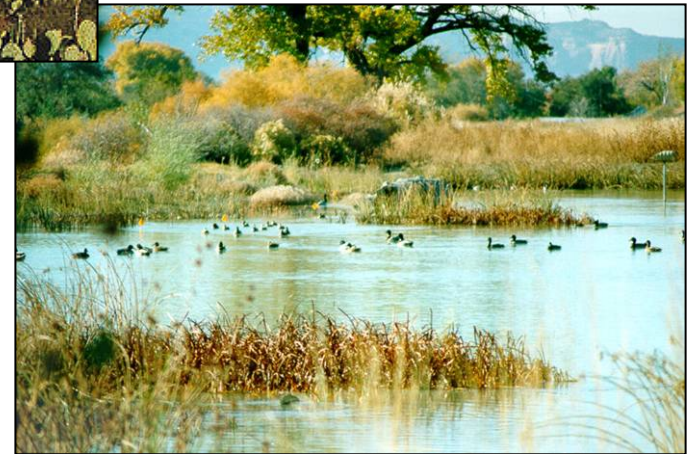
<http://www.nps.gov/vick/preserve/exotics.htm>

Tropical Forest Destruction

- **Tropical forest** is being destroyed at the rate of 40,000 square miles (~64,000 square kilometers)
- This is mainly due to slash-and-burn agriculture in areas of high population growth, in which small areas are cleared and used for a few years until they become infertile, and then more acreage is cleared.
- About **44%** of the original tropical moist forest on the earth is now gone.
- It has been estimated that **15-20%** of all species will become extinct by the year 2000 because of the destruction of tropical forests.

Other endangered habitats

- forests
- deserts
- wetlands
- coral reefs



Loss of Biodiversity

- The fundamental reason for the degradation and loss of habitat is the explosive growth of the **human population**.
- Since 1900 the world's population has more than tripled.
- Since 1950 it has more than doubled, to 6 billion. Every year 90 million more people are added to the planet.

THE CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

The CBD has three overall goals:

- the conservation of biological diversity
- the sustainable use of its components
- the fair and equitable distribution of benefits derived from "genetic resources".

By signing the CBD, participating governments agree to carry out various measures to conserve biodiversity. The measures include (among other things):

- to create national plans for protection of biodiversity.
- to identify ecosystems, species and genomes important for conservation and sustainable use of biodiversity
- to monitor biological diversity and any factors that might have impacts on it.

CBD Continued

- to establish a system of protected areas
- to manage biological resources to ensure conservation and sustainable use
- to rehabilitate and restore ecosystems
- to take measures for ex situ conservation.
- The CBD has also published a useful Global Biodiversity Outlook.
- The CBD also includes agreements for **using** biological diversity. And governments must provide for "fair sharing" of the benefits derived from genetic resources (i.e. compensation for its use or transfer of technology derived from genetic resources).

Signed by over 150 governments at the 1992 Earth Summit in Rio de Janeiro, and became effective as international law in December 1993.

CITES

- Convention on International Trade in Endangered Species of Wild Fauna and Flora
- Aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.
- Today, it accords varying degrees of protection to more than 30,000 species of animals and plants
- 167 member countries

ARGUMENTS FOR CONSERVATION

- Food Supplies and Genes
- Natural Products
- Environmental Services

Food Supplies and Genes

Plant breeding and engineering for Disease resistance

- Wild potato plants from Peru resistant to early blight.
- Wild barley plant from Ethiopia provided a gene that protects the \$160 million California barley crop from lethal yellow dwarf virus.
- Rice grown in Asia is protected from the four main rice diseases by genes brought in from a wild species from India.
- In both India and Africa, yields of cassava (tapioca) - one of the most important root crops throughout the tropics - were drastically increased because of disease resistance brought in from wild Brazilian cassava.
- The sugar cane industry in the U.S. was saved from collapse by disease-resistance genes brought in from wild Asian species.

Natural Products

- Medicines and nutrition
 - Anti-malarials
 - Anti-cancer drugs
 - Anti-inflammatory
 - Antibiotic phytochemicals
 - Antivirals
 - Sedatives



Taxus brevifolia Nutt. The source of Taxol

http://courses.washington.edu/bot113/conifer_slides/source/taxus_brevifolia.html

Environmental Services

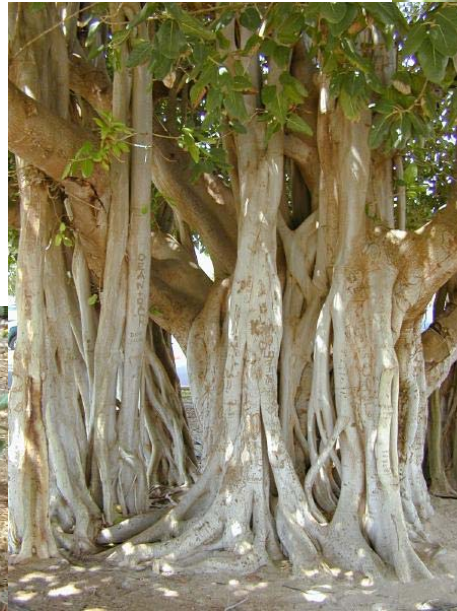
- Water cycling and purification
- Regulation of climate and atmospheric gases
- Stabilization and erosion control
- Soil formation
- Nutrient cycling
- Purification of wastes
- Phyto-remediation
- Valued at nearly 20 trillion dollars (really priceless)

Beauty and Interest

- Human enjoyment
- Beauty
- Wonder



Cypripedium acuale Ait.



Ficus benghalensis L.



Kalanchoe thyrsiflora Harv.

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