# Biodiversità e Conservazione animale

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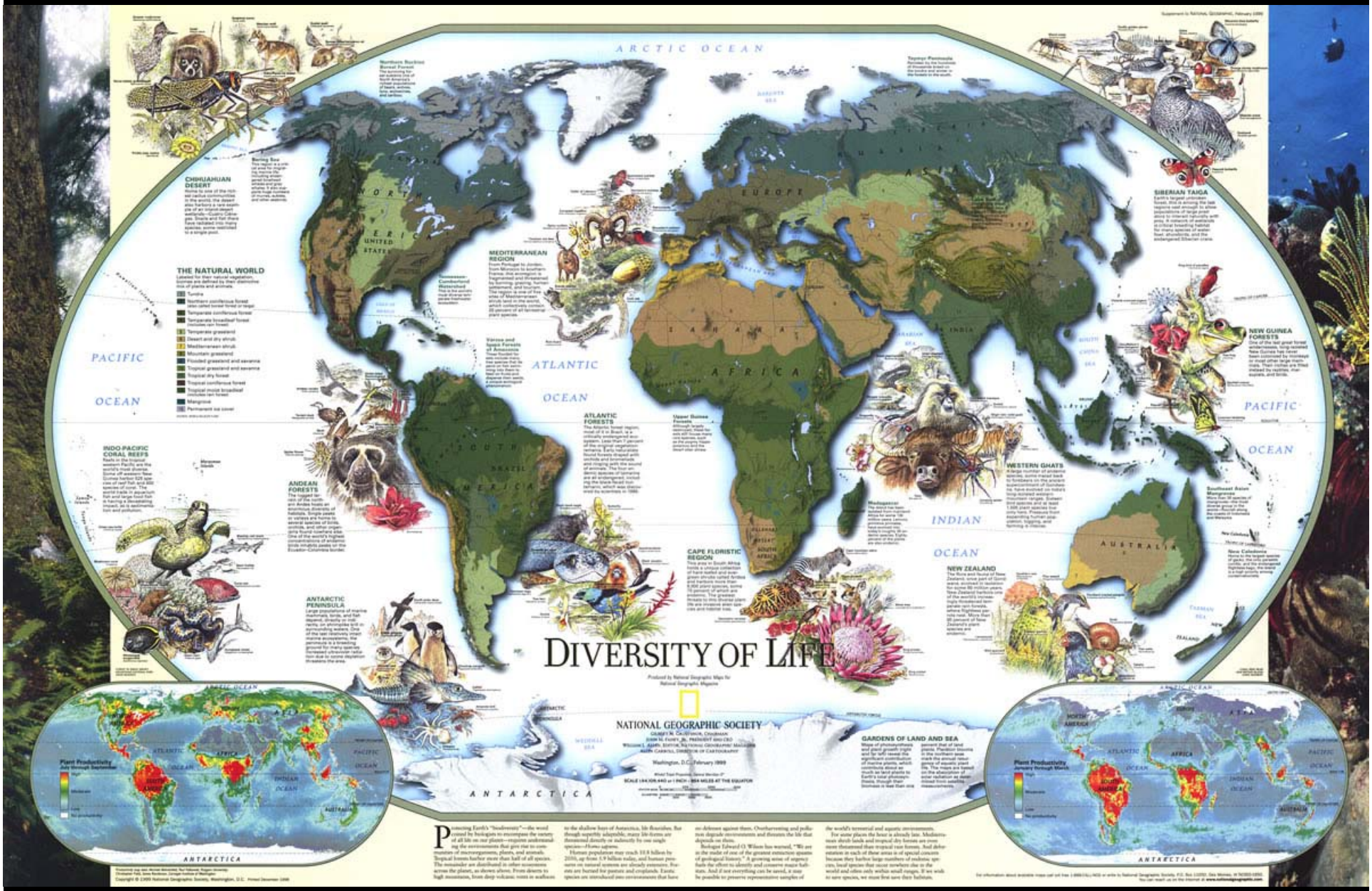
# Biologia della conservazione

Con sito web

ZANICHELLI




Protecting Earth's "biodiversity"—the word coined by biologists to encompass the variety of all life on our planet—requires understanding the environments that give rise to communities of microorganisms, plants, and animals. Tropical forests harbor more than half of all species. The remainder are distributed in other ecosystems across the planet, as shown above. From deserts to high mountains, from deep volcanic vents in seafloors to the shallow bays of Antarctica, life flourishes. But through superbly adaptable, many life-forms are threatened directly or indirectly by one single species—Homo sapiens.

Human population may reach 10.8 billion by 2050, up from 5.9 billion today, and human pressures on natural systems are already extensive. Forests are burned for pasture and croplands. Exotic species are introduced into environments that have no defenses against them. Overharvesting and pollution degrade environments and threaten the life that depends on them.

Biologist Edward O. Wilson has warned, "We are in the midst of one of the greatest extinction spasms of geological history." A growing sense of urgency fuels the effort to identify and conserve major habitats. And if not everything can be saved, it may be possible to preserve representative samples of the world's terrestrial and aquatic environments.

For some places the hour is already late. Mediterranean shrub lands and tropical dry forests are even more threatened than tropical rain forests. And deforestation in each of these areas is of special concern because they harbor large numbers of endemic species, local species that occur nowhere else in the world and often only within small ranges. If we wish to save species, we must first save their habitats.

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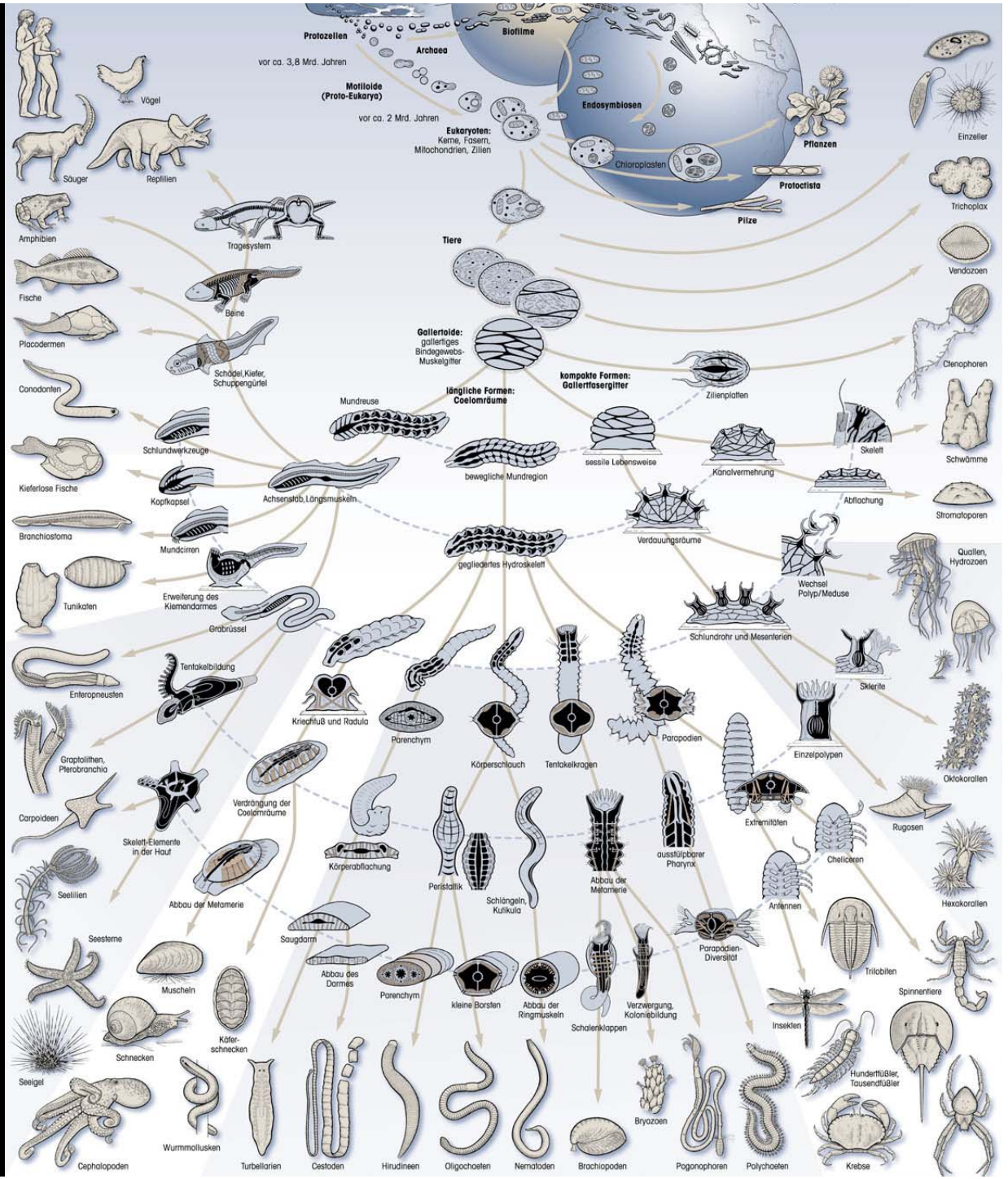
**EVOLUZIONE**

**BIODIVERSITÀ**



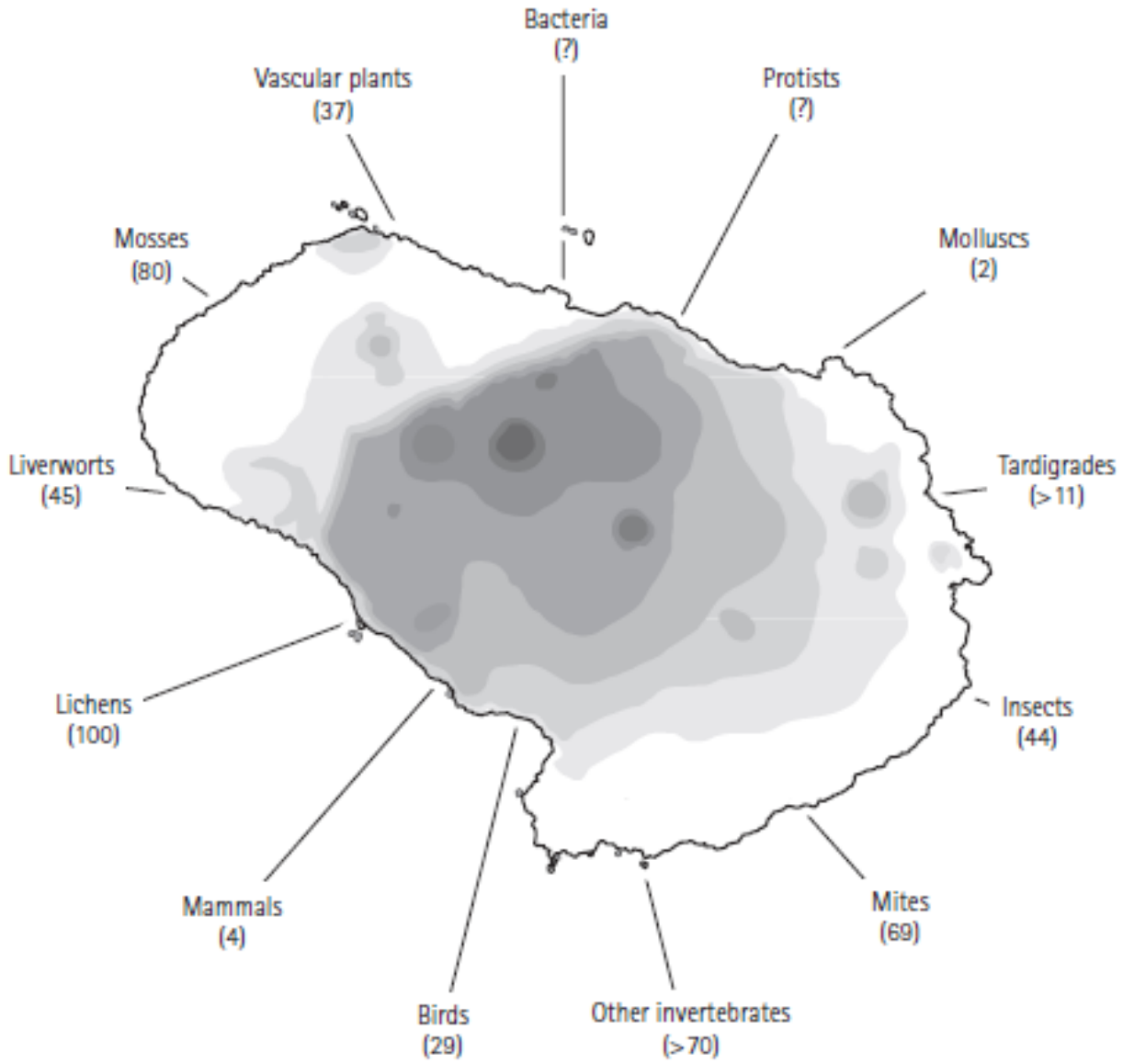



**Fig. 1.1** The breeding species of sub-Antarctic Marion Island, one of the two remote Prince Edward Islands. Grey scales indicate variation in elevation. (Data from a variety of sources, including Gremmen 1981; Hänel & Chown 1999; Gaston et al. 2001; Øvstedal & Gremmen 2001; S.L. Chown pers. comm.)

# BIODIVERSITY LEVELS

- ***ECOLOGICAL/ECOSYSTEM***
  - different habitats, niches, species interactions
- ***SPECIES***
  - different kinds of organisms, relationships among species
- ***GENETIC***
  - different genes & combinations of genes within populations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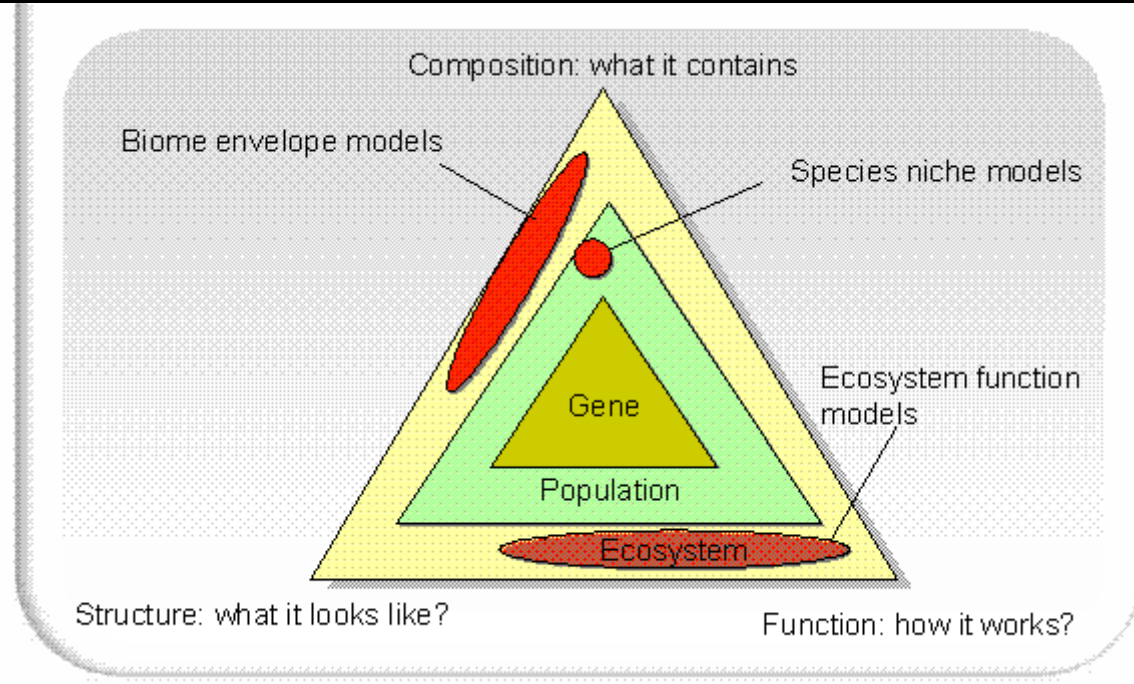
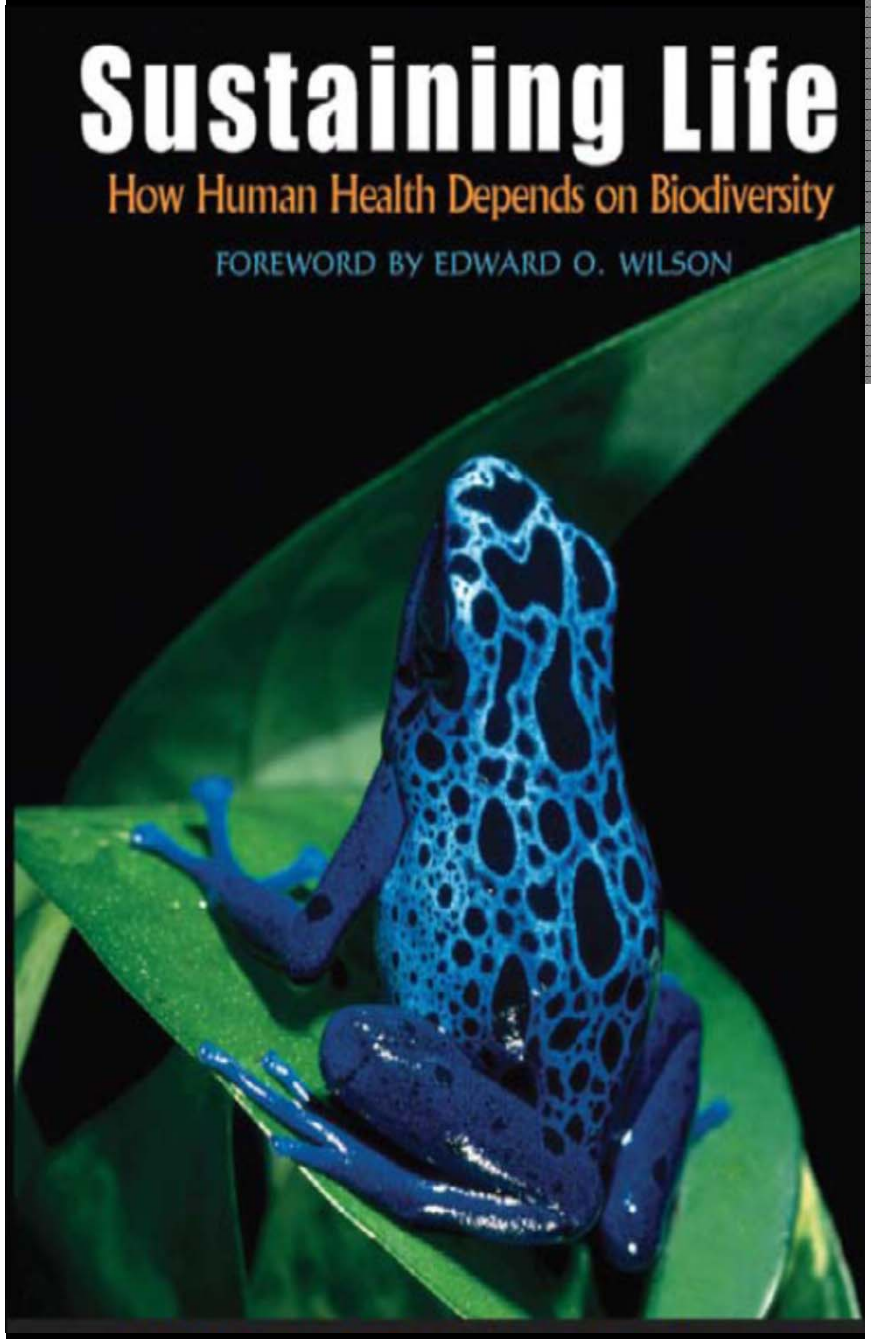

Composition: what it contains
Biome envelope models
Species niche models
Gene
Population
Ecosystem
Ecosystem function models
Structure: what it looks like?
Function: how it works?




Una delle tante domande che ci si può porre sulla biodiversità

## How Many Species Are There?

About 1.5 million species have been identified and given scientific names (other more recent estimates have put this number at 1.75 million),[6] but only about 100,000 of these—including some terrestrial vertebrates, flowering plants, and invertebrates with pretty shells or wings—are popular enough for taxonomists to know them well. Birds and mammals are particularly well known, with roughly 10,000 avian and 4,300 mammalian species described. Many new species are found each year, though a taxonomist cannot always be certain whether the specimen in hand has not already been given a name by someone else in a different country or, sometimes, by someone from a previous century. Some of these newly discovered species make news, such as a new baleen whale found off Japan in 2003, new types of deep sea squids identified in 2001 at various ocean sites, 361 new species (mostly insects) identified in the inland rainforests of Borneo from 1999 to 2004, a new giant deer species discovered in a remote nature reserve in Vietnam in 1992 (belonging to a group called Muntjac deer, and now almost extinct due to loss of habitat), and a new monkey found in South America in 2002, *Callibebus bernhardi*. Numerous other species discoveries in both accessible and inaccessible habitats may not be as widely publicized. These include, among others, some new frogs and insects found in the

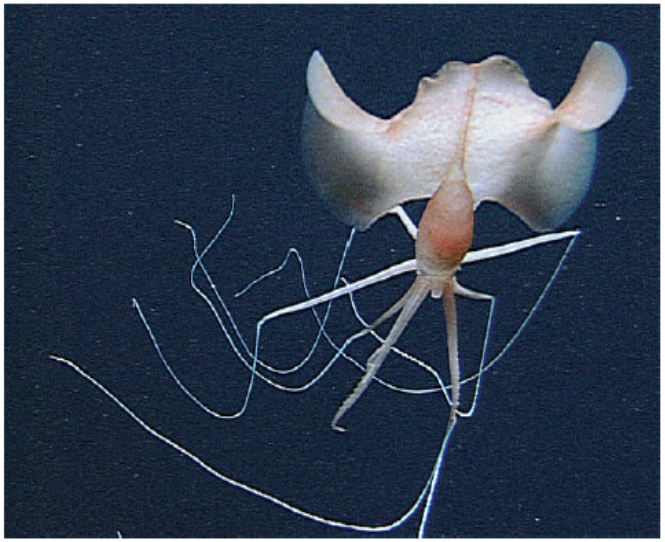
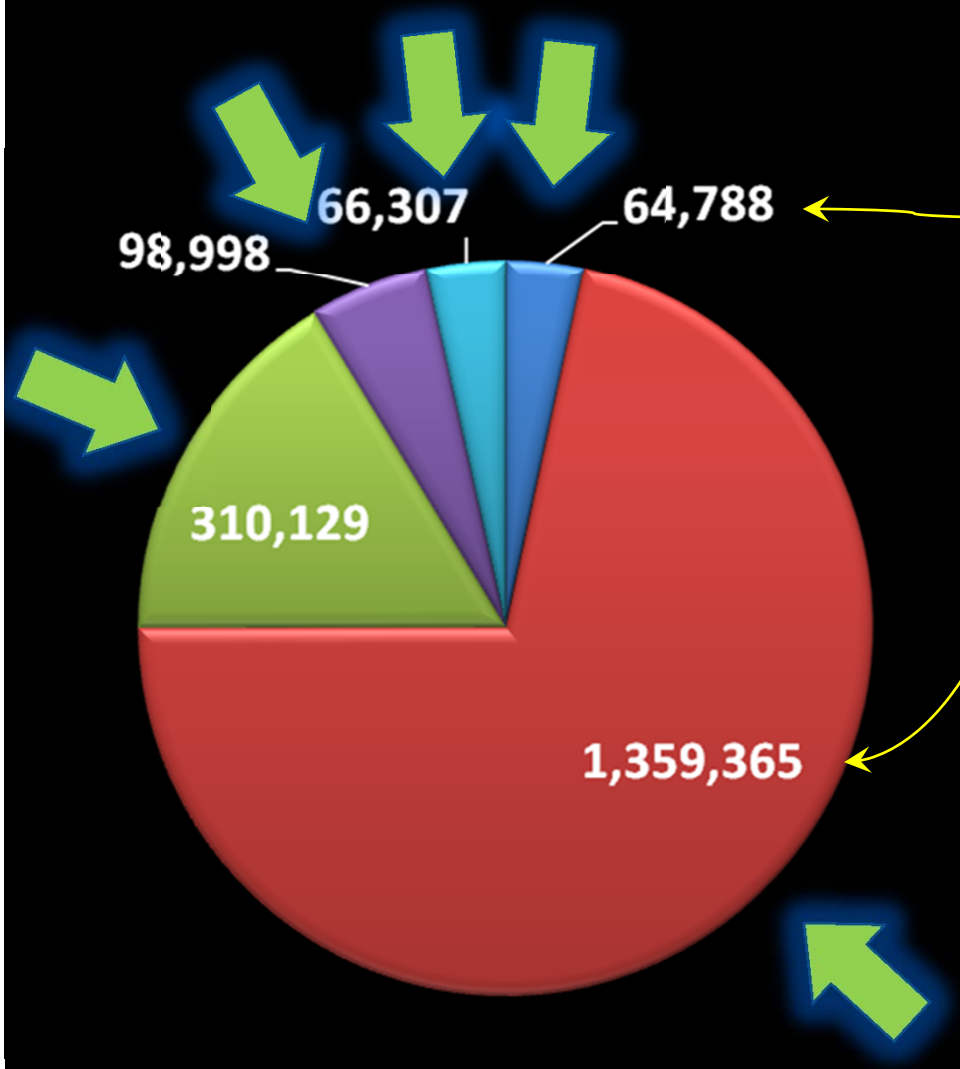


**Figure 1.5. Newly Discovered Squid.** This large squid (an unnamed species), estimated to be 4 to 5 meters (roughly 13 to 16.5 feet) in length, was encountered by the ROV (remotely operated vehicle) *Tiburon* at a depth of 3,380 meters (more than 2 miles) off the coast of Oahu, Hawaii. (© 2001 Monterey Bay Aquarium Research Institute.)

# Biodiversità tassonomica



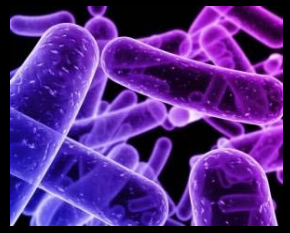

Chordates

Invertebrates

Plants

Fungi

Others: Prokaryota
Cyanophyta
Chromista
Viruses
Protoctista



**Specie note: 1.899.587**
**[Tutti i Regni di tutti i Domini]**

**Specie Regno animale: 1.424.153**
**[Cordati & "invertebrati"]**

(aggiornamento 2009)

# Biodiversità tassonomica

**Regno animale: 1.424.153 specie**
**“invertebrati” (95,5%): 1,359,365 specie**

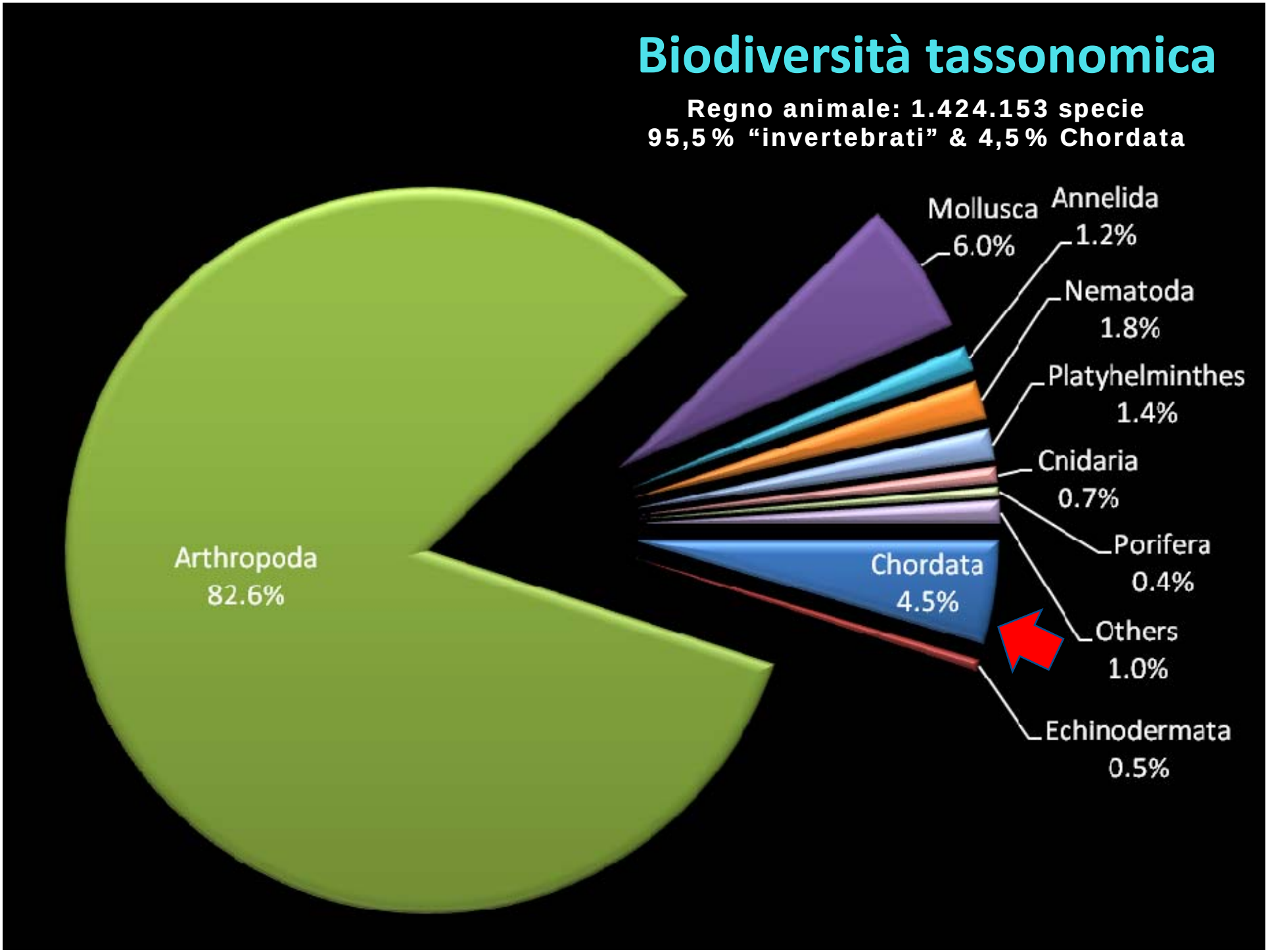







# Biodiversità tassonomica

**Regno animale: 1.424.153 specie**
**95,5% "invertebrati" & 4,5% Chordata**



# Biodiversità tassonomica

**Regno animale: 1.424.153 specie**
***Phylum Cordata* (4,5%): 64.788 specie**
***Subphylum Vertebrata*: 61.995 specie**


Agnati: 116


Cefalocordati: 33


Tunicati (Urocordati): 2.760


Pesci: 31.153


Anfibi: 6.515


Mammiferi: 5.487

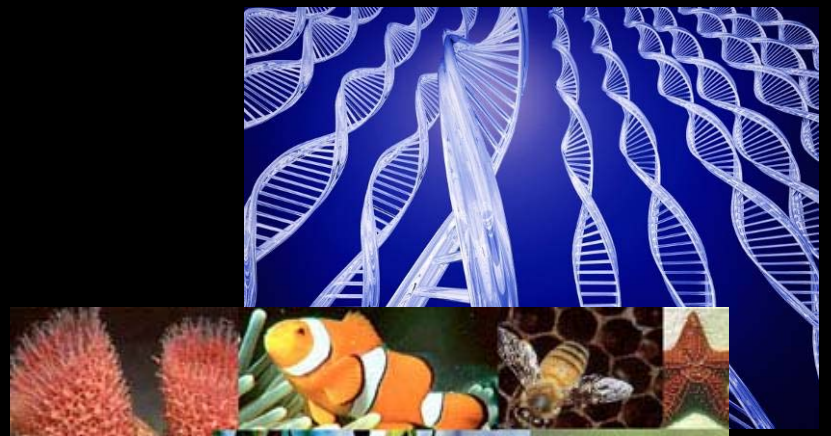

Rettili: 8.734


Uccelli: 9.990

*“Furthermore, there are currently about 1.5 to 1.8 million named species, but it is estimated that the actual number of species in the world ranges from 5 to 10 million (May et al. 1995).”*

*“The most commonly quoted estimate is somewhere between 30 and 50 millions based on Erwin's (1988,1997) study of tropical insects.”*

*“'Right now we can only guess that the correct answer for the total number of species lies between 2 and 100 million, says Rosenzweig.”*



# *Quantifying Uncertainty in Estimation of Tropical Arthropod Species Richness*

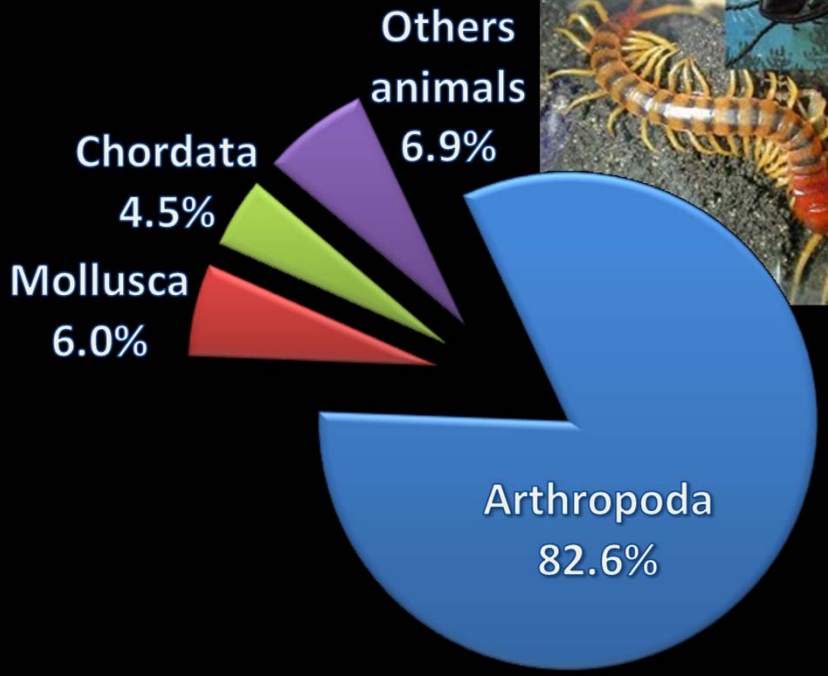
**Andrew J. Hamilton, Yves Basset, Kurt K. Benke, Peter S. Grimbacher, Scott E. Miller, Vojtech Novotný, G. Allan Samuelson, Nigel E. Stork, George D. Weiblen, Jian D. L. Yen**

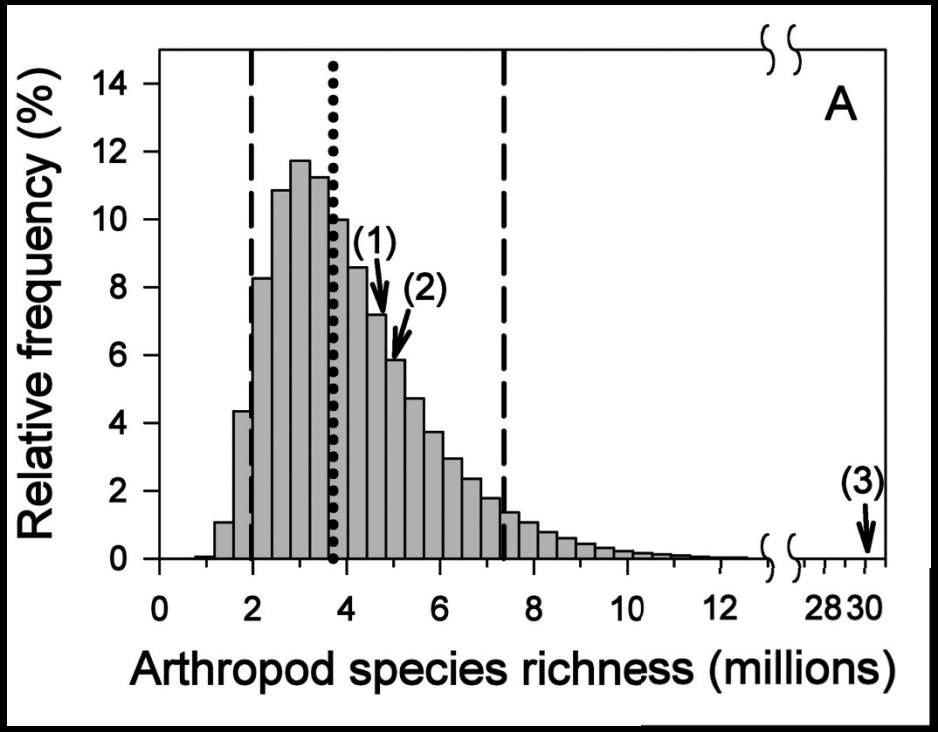
*The American Naturalist,*
*Vol. 176, No. 1 (July 2010), pp. 90-95*

**RESULTS**

Models produced right-skewed distributions for global **arthropods species richness** median for one model of **3.7 million** and 90% confidence intervals of **[2.0, 7.4]** million.

**They suggest probabilities of P<0.00001 for estimates of ≥30 million (i.e., <0.001% chance).**



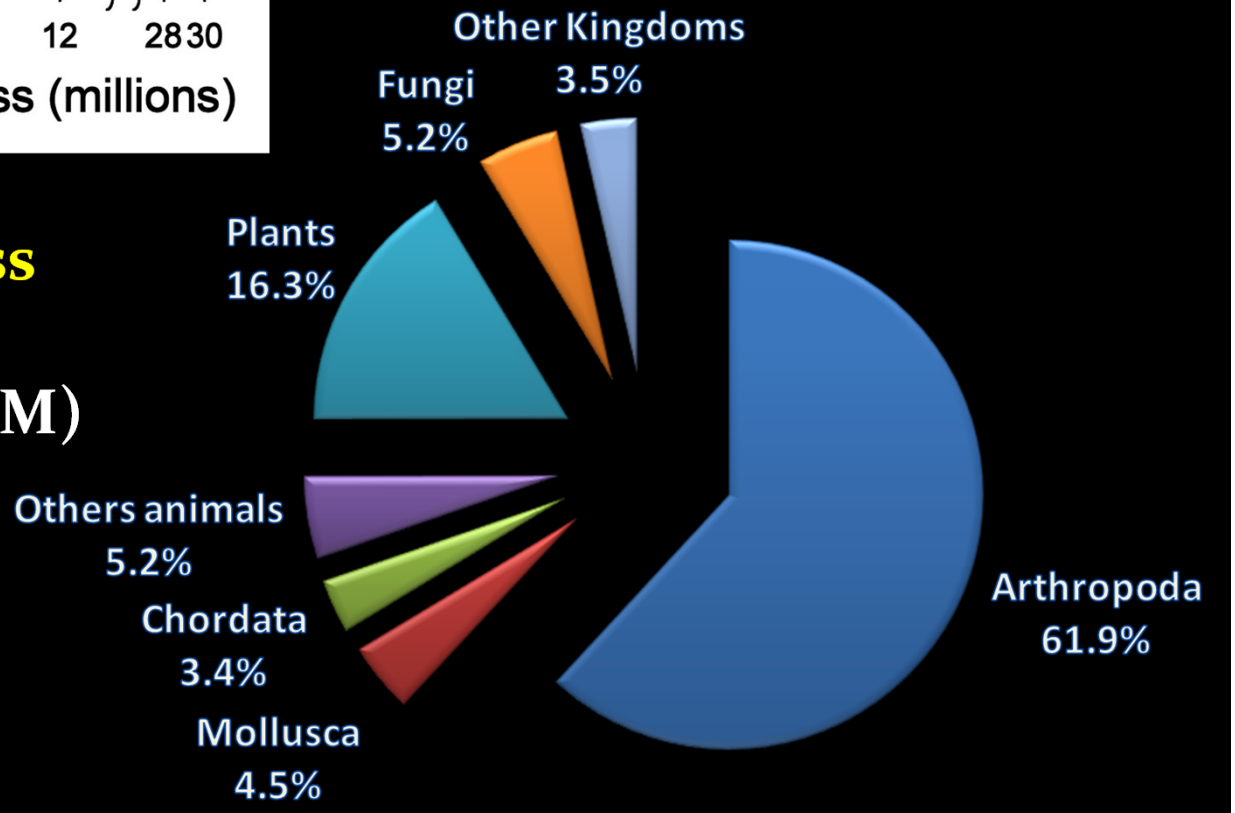



**Probability distributions for estimates of tropical arthropod species richness arising from model A.**
**The dotted vertical line denotes the median, and the left and right dashed lines mark the 5% and 95% confidence limits.**
**Arrows indicate point estimates made by others (1, Ødegaard 2000;**
**2, Stork 1993; 3, Erwin 1982).**
**Note break in X-axis.**

## World Species Richness [All Kingdoms]

## = 6.000.000 (3.2 M – 12 M)

[*using 3.7 M Arthropods median estimate*]



# Biodiversità tassonomica

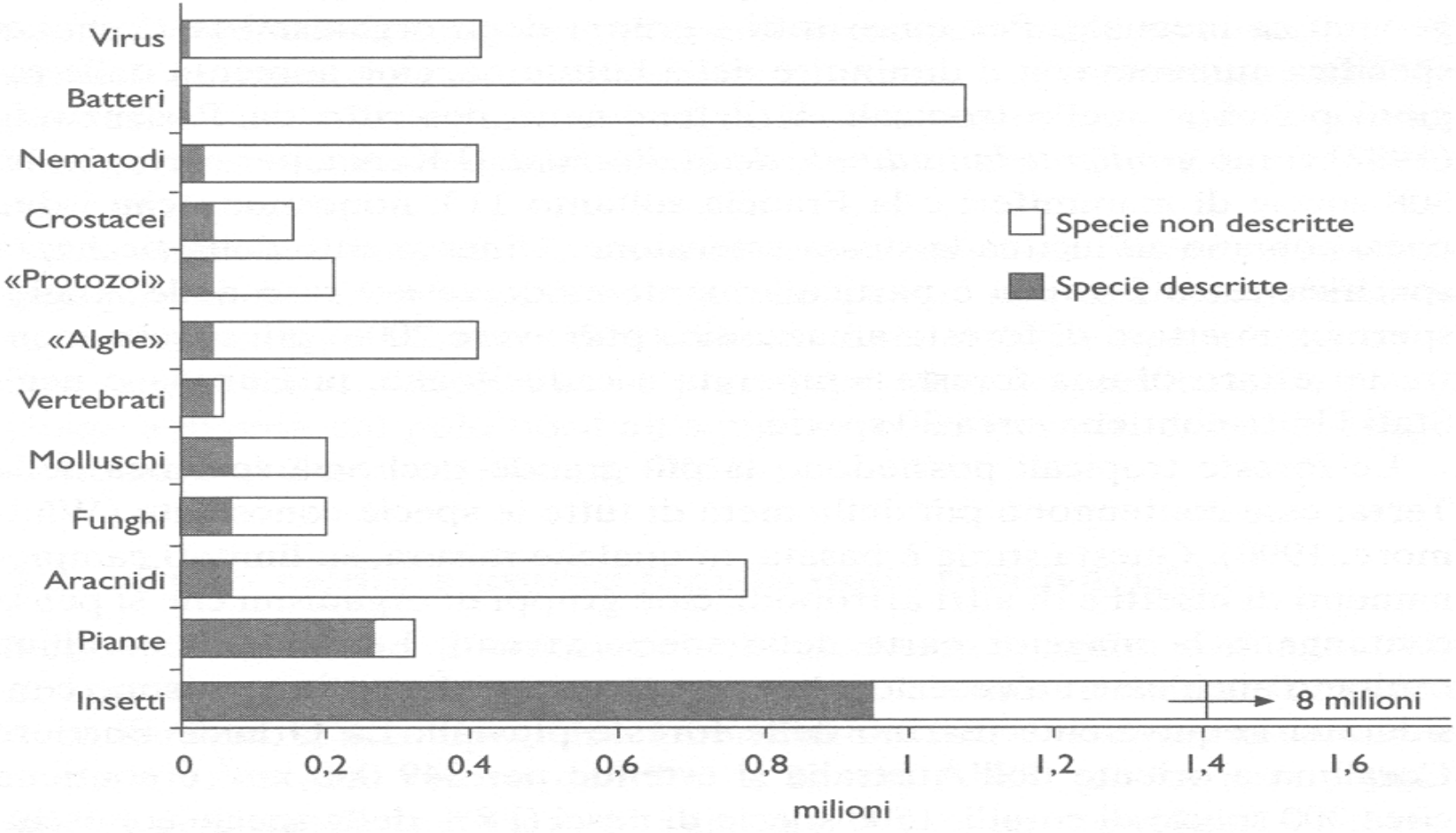



**Figura 3.1**
Specie note e specie che si suppone esistano, secondo le stime di Hammond (1992) e Heywood (1995).

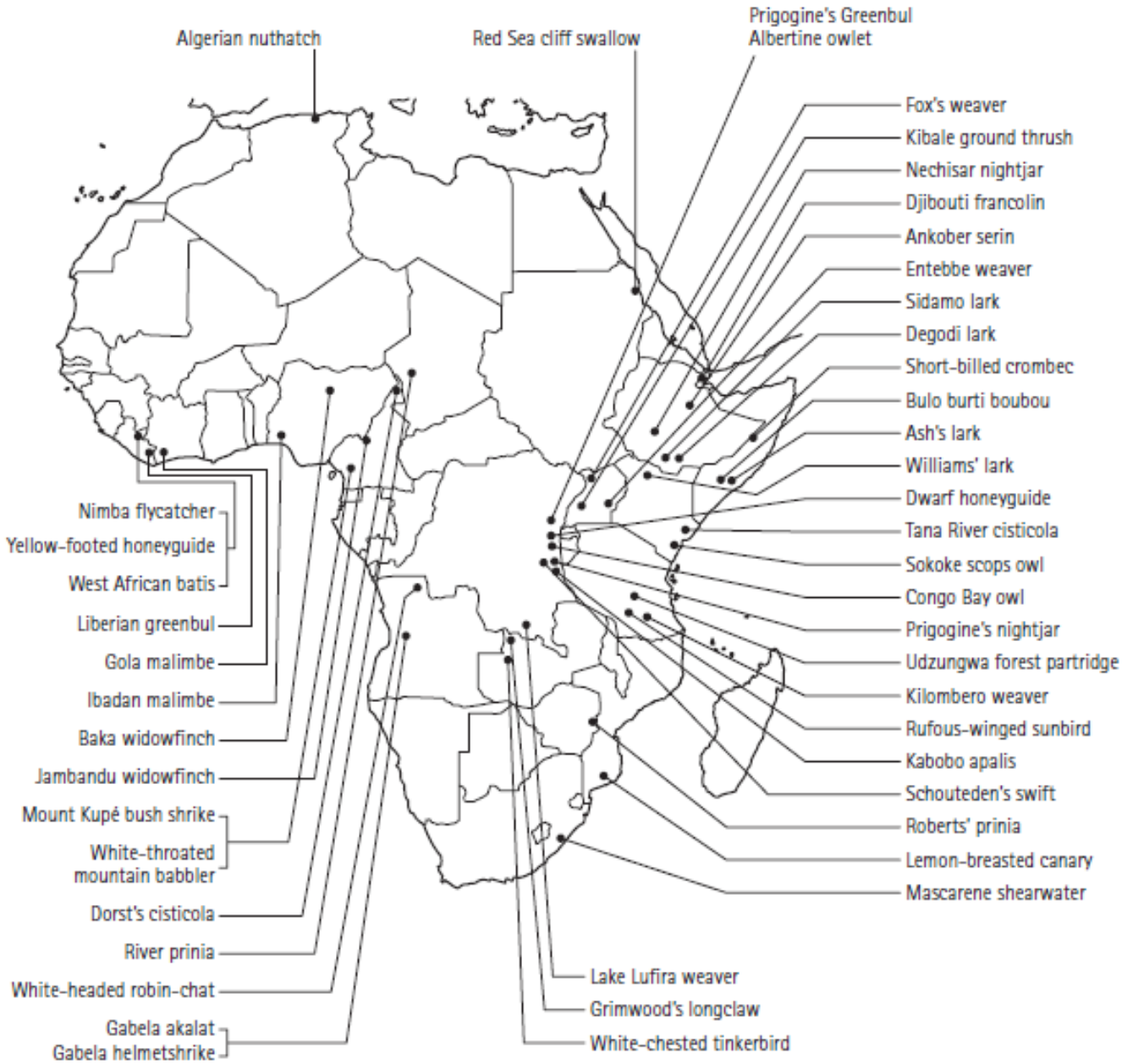


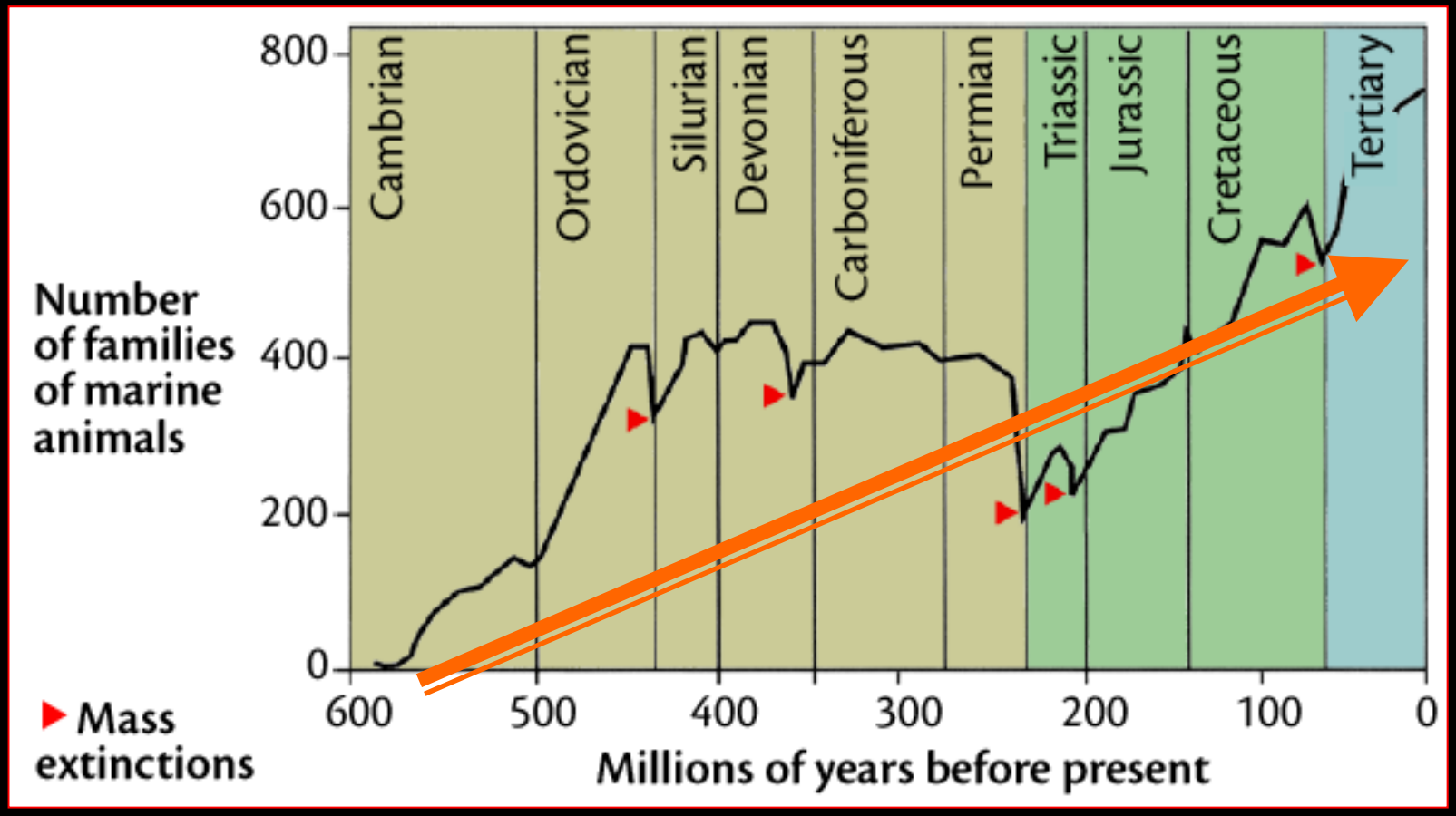

**Fig. 2.13** Sites of the discoveries of 47 of the 48 new species of birds recorded from Africa between 1946 and 1995 (in addition, Forbes-Watson's swift was also described from the island of Socotra). (From Hockey 1997a,b.)

# Fattori limitanti la distribuzione e l'abbondanza degli organismi e la biodiversità

- Fattori biotici
  competizione
  predazione
  parassitismo
  etc.

- Fattori abiotici
  [climatici, edafici]

# La diversità biologica nel tempo




- 5 estinzioni di massa

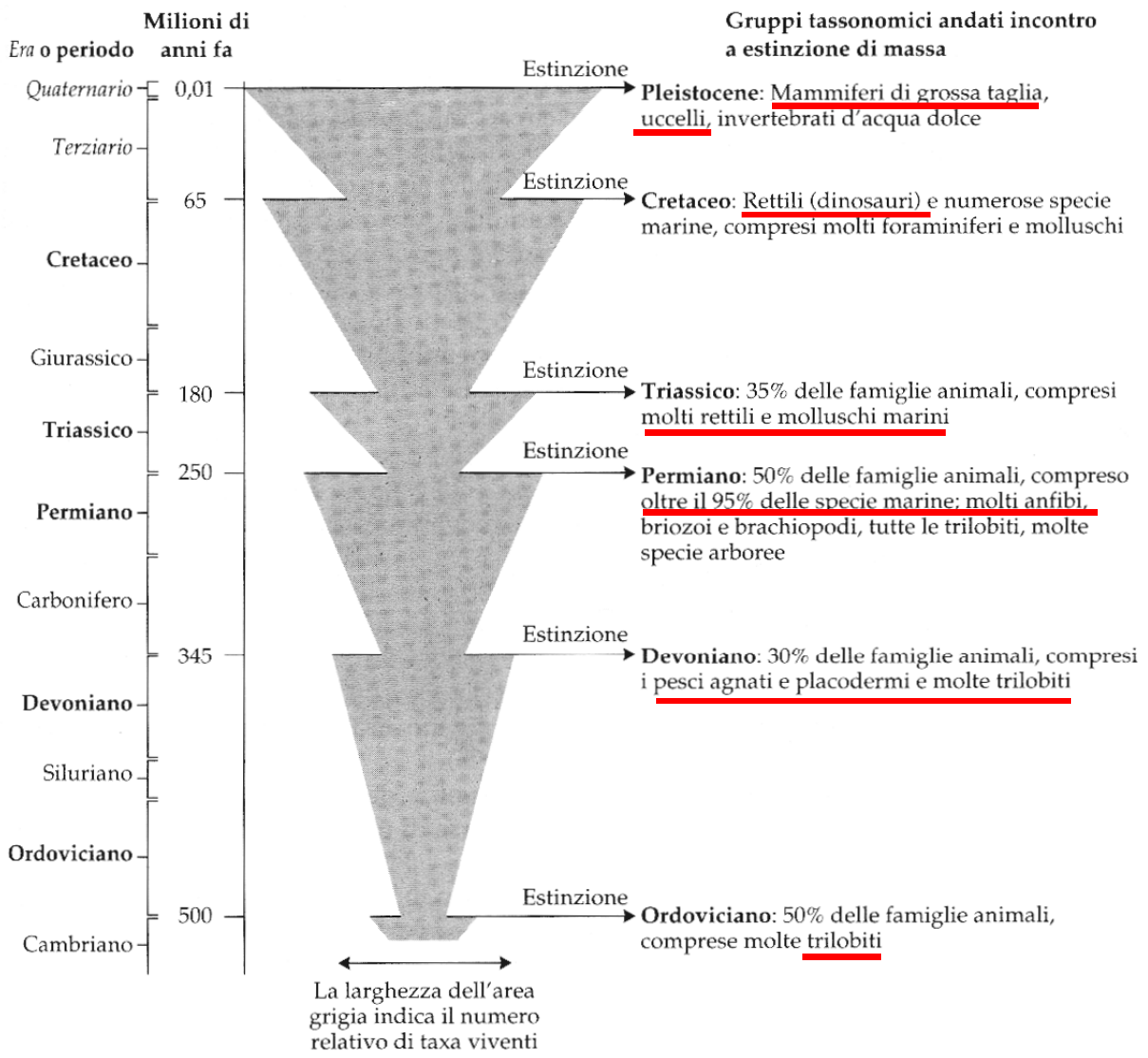
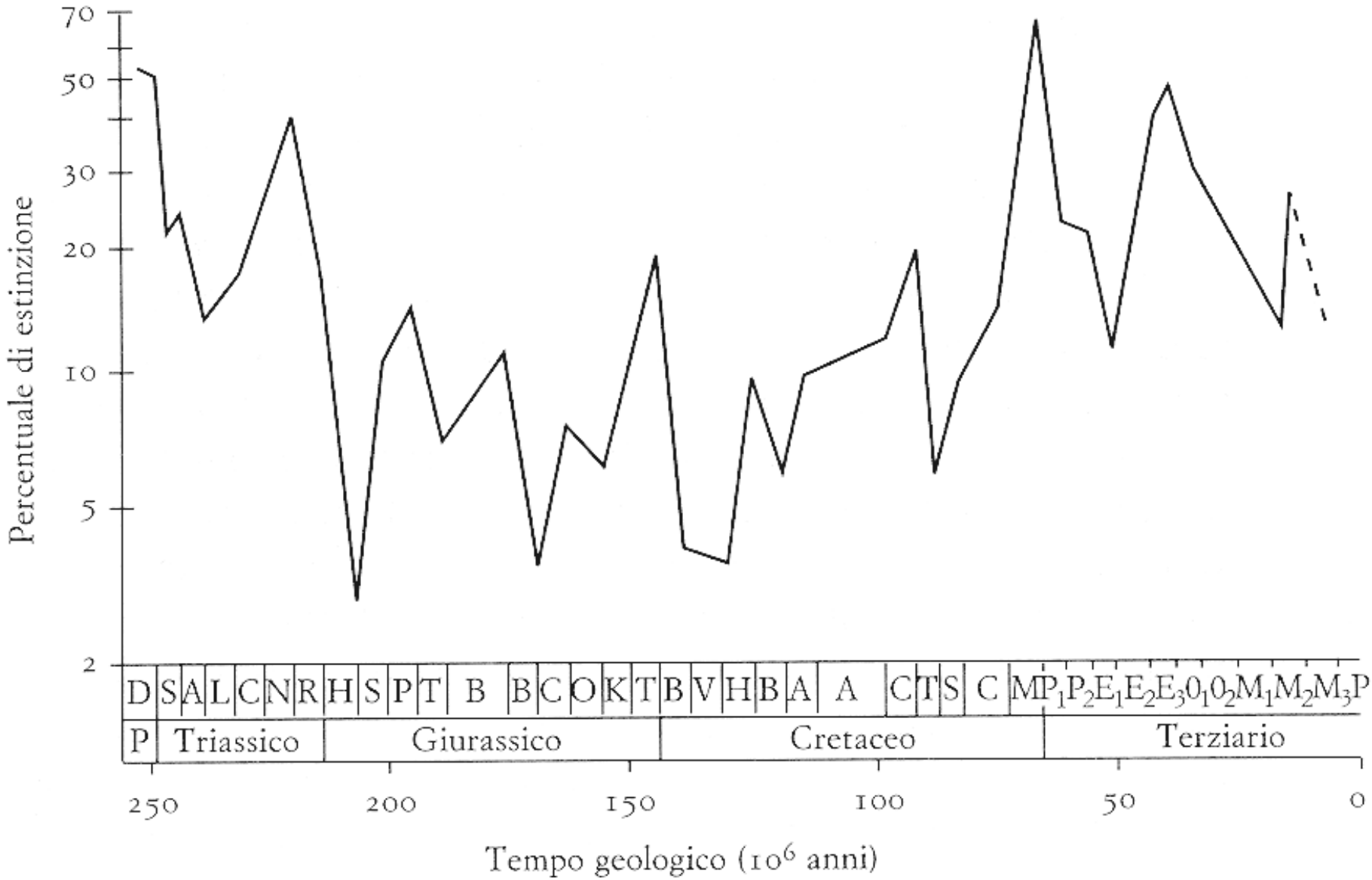



**Figura 2.1** Variazione del numero di taxa dall'Era Primaria all'Era Quaternaria ed estinzioni di massa. Il numero di famiglie e di specie sulla Terra è andato complessivamente aumentando nel corso delle ere geologiche. Tale aumento non è stato regolare ma è stato segnato da cinque episodi di estinzioni naturali di un numero considerevole di taxa: le *estinzioni di massa*. Esse sono denominate in base al periodo geologico in cui si verificarono (in grassetto nella colonna di sinistra). L'estinzione più massiccia avvenne alla fine del Permiano, circa 250 milioni di anni fa. Attualmente potremmo essere all'inizio di una sesta estinzione di massa, l'estinzione pleistocenica, causata non più da eventi naturali ma dall'azione dell'uomo attraverso la distruzione di habitat, il sovrasfruttamento delle risorse naturali, l'immissione di specie esotiche.

# Biodiversità ed Estinzioni di massa:

## le "5 estinzioni di massa"



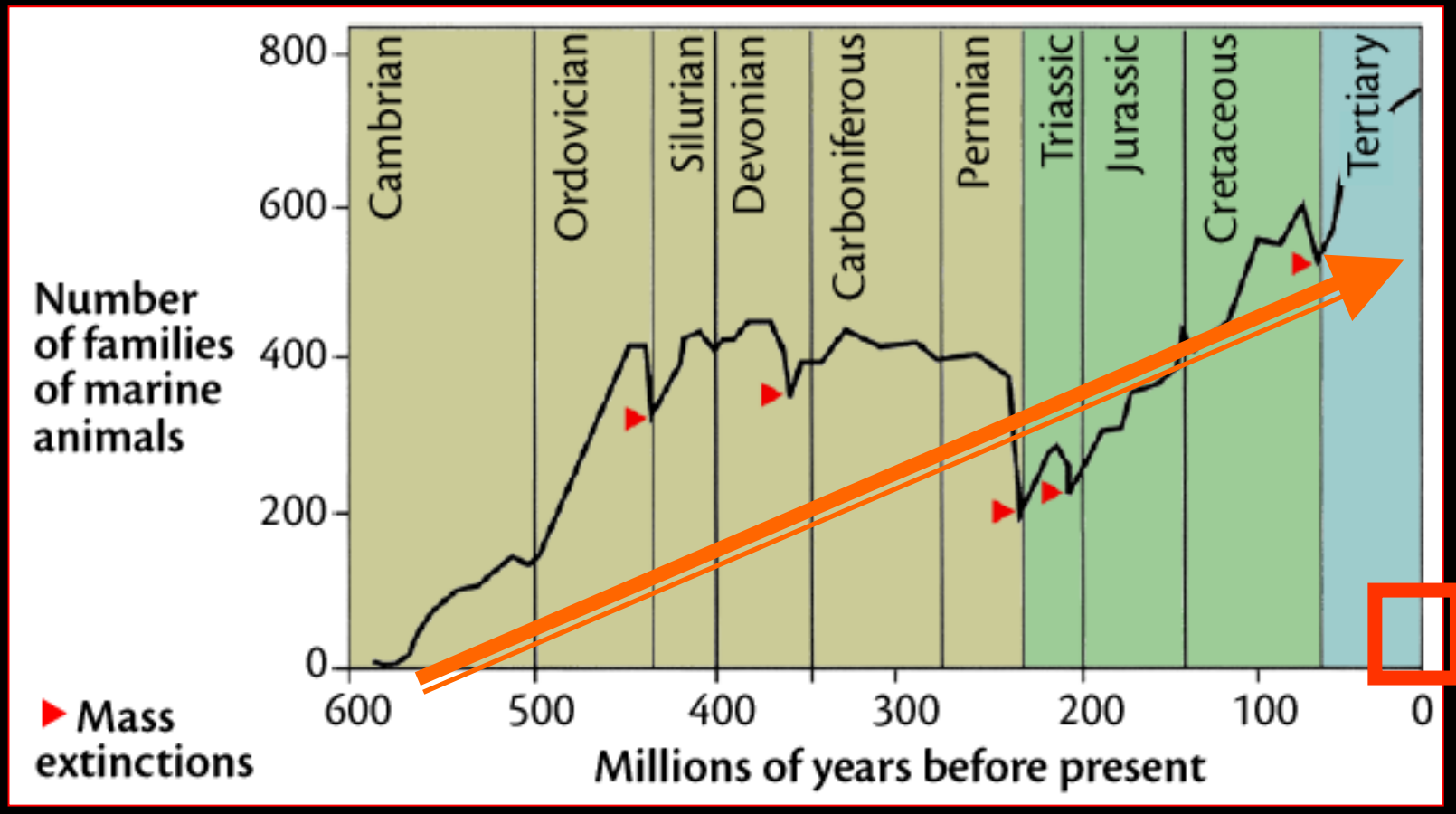

Secondo alcune teorie estinzioni significative – comprese le cinque più grandi – hanno luogo regolarmente, ogni 26 milioni di anni. Una delle cause ipotizzate è il periodico bombardamento della Terra da parte degli asteroidi. (Ristampa autorizzata da David Raup e Jack Sepkoski.)


L'evidenza di un vasto cratere nella penisola dello Yucatan, risalente a circa 65 milioni di anni fa, dimostra che la causa dell'estinzione verificatasi alla fine del Cretaceo fu l'impatto con un asteroide.

# La 5ª estinzione di massa del Cretaceo (65 milioni di anni fa)

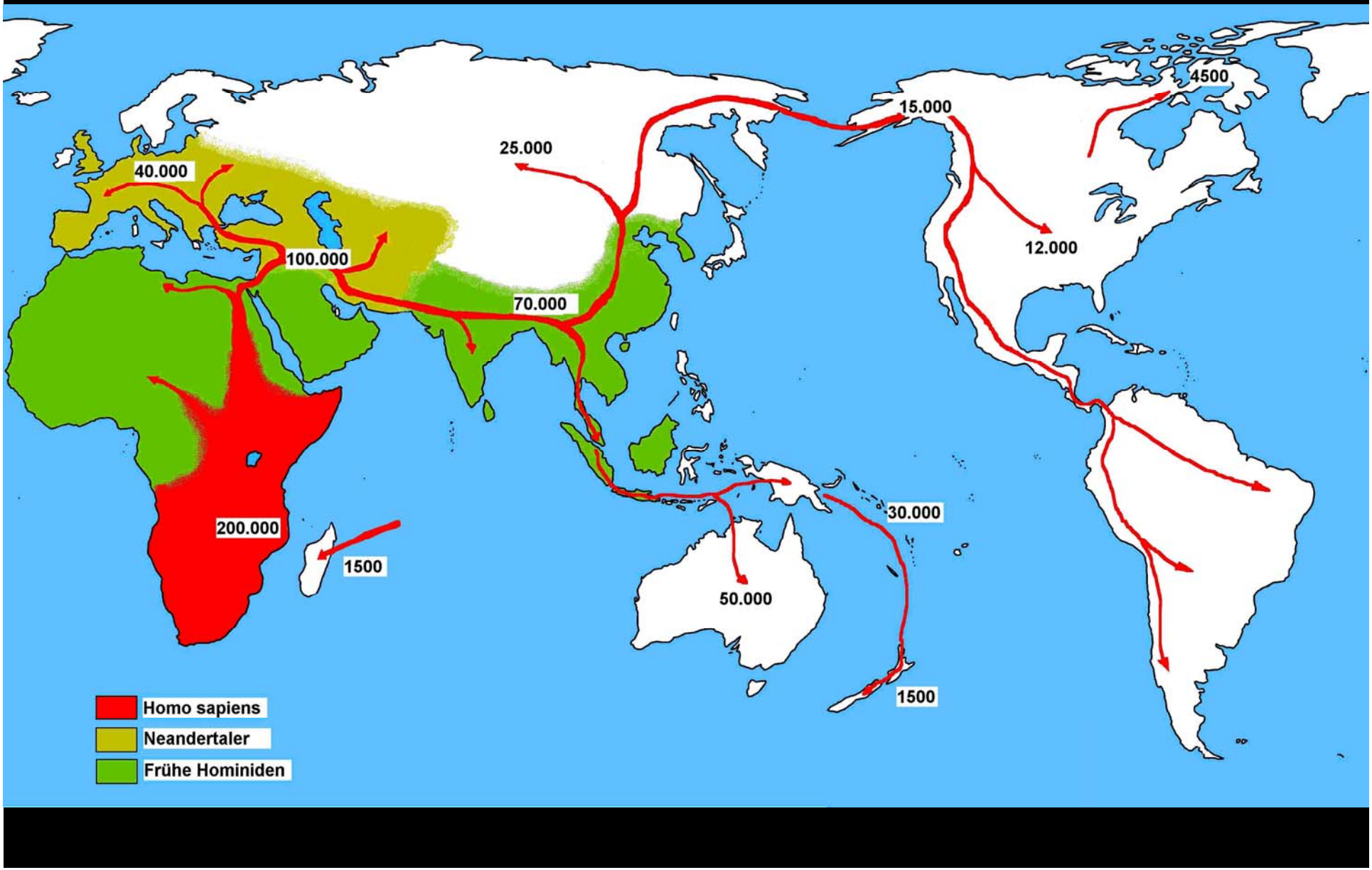
## Sito d'impatto di asteroide nella penisola dello Yucatan (Messico)

# La diversità biologica nel tempo

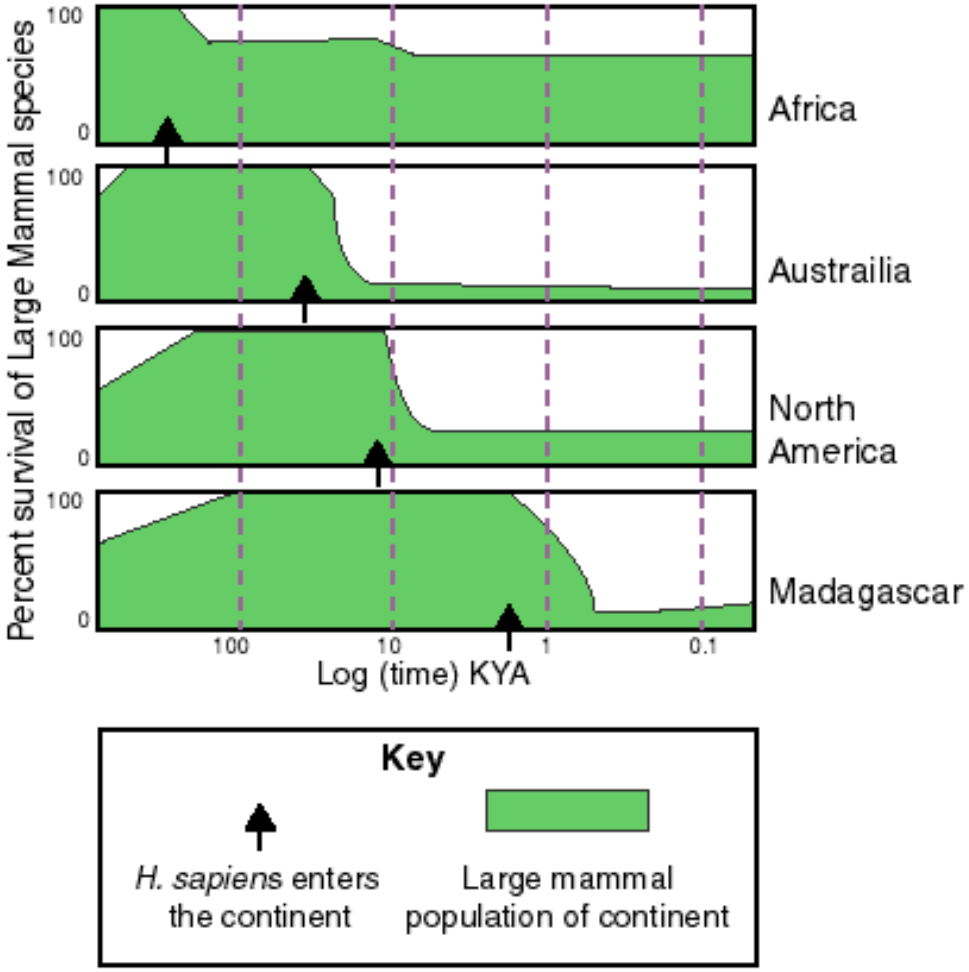



- 5 estinzioni di massa

# *HOMO SAPIENS* SPREADING



Blitzkrieg hypothesis (overkilling)

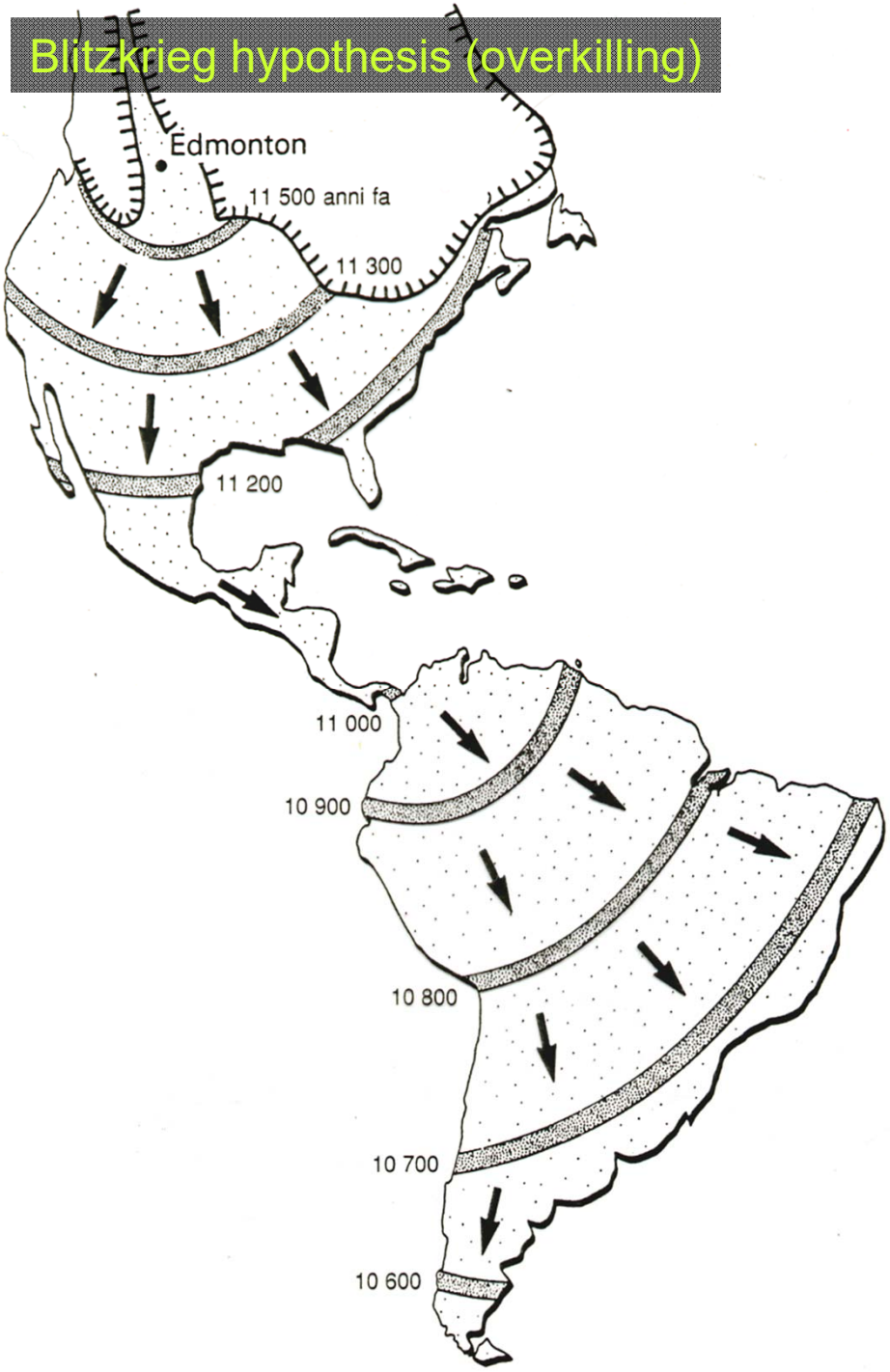



## Estinzioni pleistoceniche

- **Durante il Pleistocene molte regioni hanno subito la perdita di specie animali di grossa taglia; tuttavia queste estinzioni hanno avuto luogo in tempi diversi.**
- **Nel caso di Australia, Nord America, Nuova Zelanda e Madagascar la perdita di specie coincise con la colonizzazione da parte degli esseri umani.**
- **Le estinzioni furono causate dalla combinazione di una eccessiva pressione venatoria con la distruzione dell'habitat da parte dell'uomo.**
- **E in Africa? Co-evoluzione uomo-fauna.**

Da: Leakey R. & R. Lewin, 1996. The Sixth Extinction. Patterns of Life and the Future of Humankind. Doubleday, Anchor, New York. **[1998. La sesta estinzione. La vita sulla Terra e il futuro del genere umano. Bollati Boringhieri, Torino.]**

**http://en.wikipedia.org/wiki/Quaternary_extinction_event**



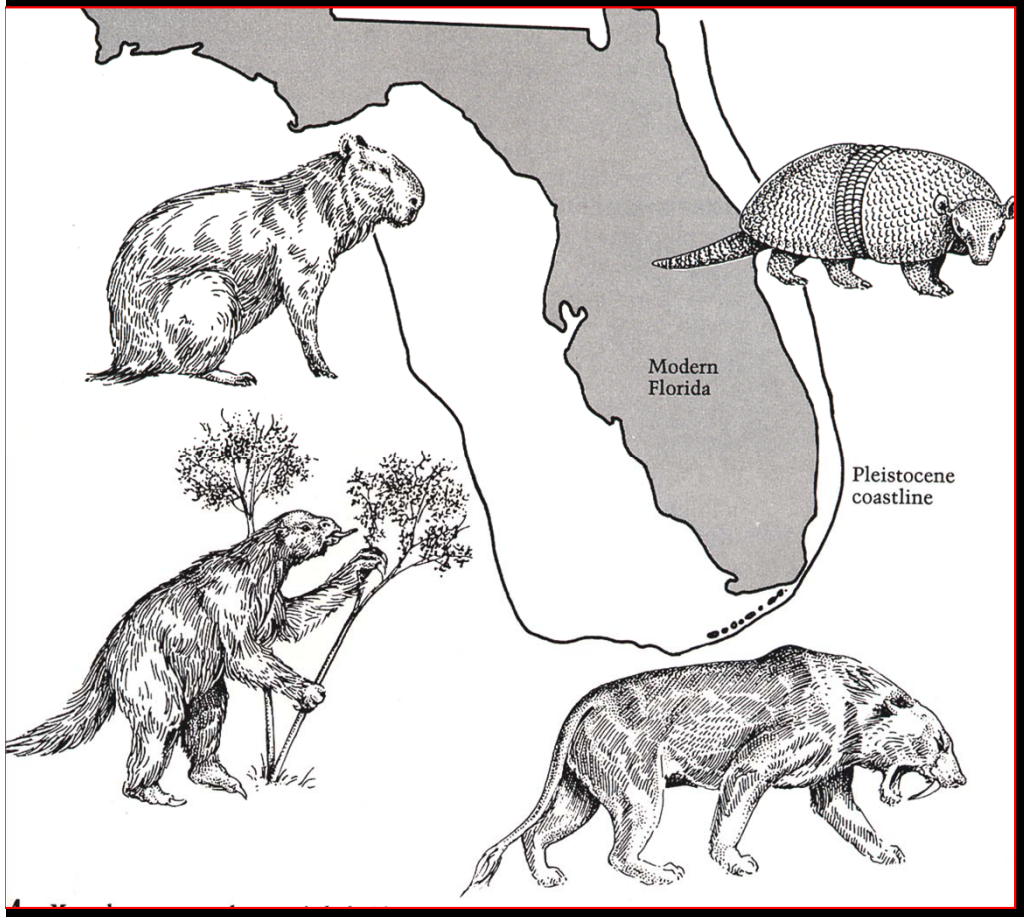

# La scoperta dell'America

**Secondo i calcoli di Martin & Klein (1984), un gruppetto di 100 paleo-indiani, partiti da Edmonton 11.500 anni fa, avrebbero migrato verso sud uccidendo 5.850 kg di biomassa animale all'anno per ogni cacciatore.**

**293 anni dopo, arrivati ai confini del Messico, erano aumentati a 300.000, avendo ucciso 100 milioni di capi di mega-fauna.**

Martin P.S. & R.G. Klein, 1984. Quaternary Extinction: A Prehistoric Revolution. Arizona University Press, Tucson.

Blitzkrieg hypothesis (overkilling)

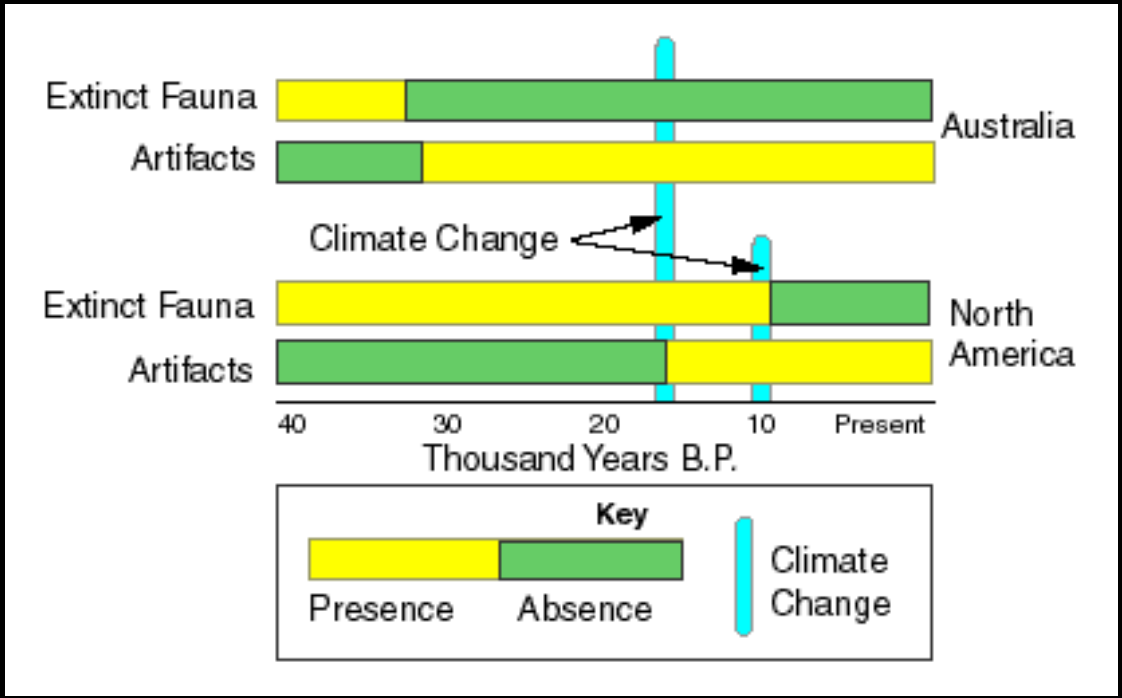



## La scoperta dell'America

**In Florida, 13.000 anni fa, quasi tutti i grandi mammiferi si estinsero improvvisamente.**

**Martin & Klein (1984) hanno ipotizzato che la causa sia stata la predazione degli esseri umani sopraggiunti attraverso lo stretto di Bering.**

# Climate change hypothesis




Extinctions occur in relation to human artifacts regardless of climate change in Australia, but appear linked to climate change in North America

## 2nd order predation hypothesis

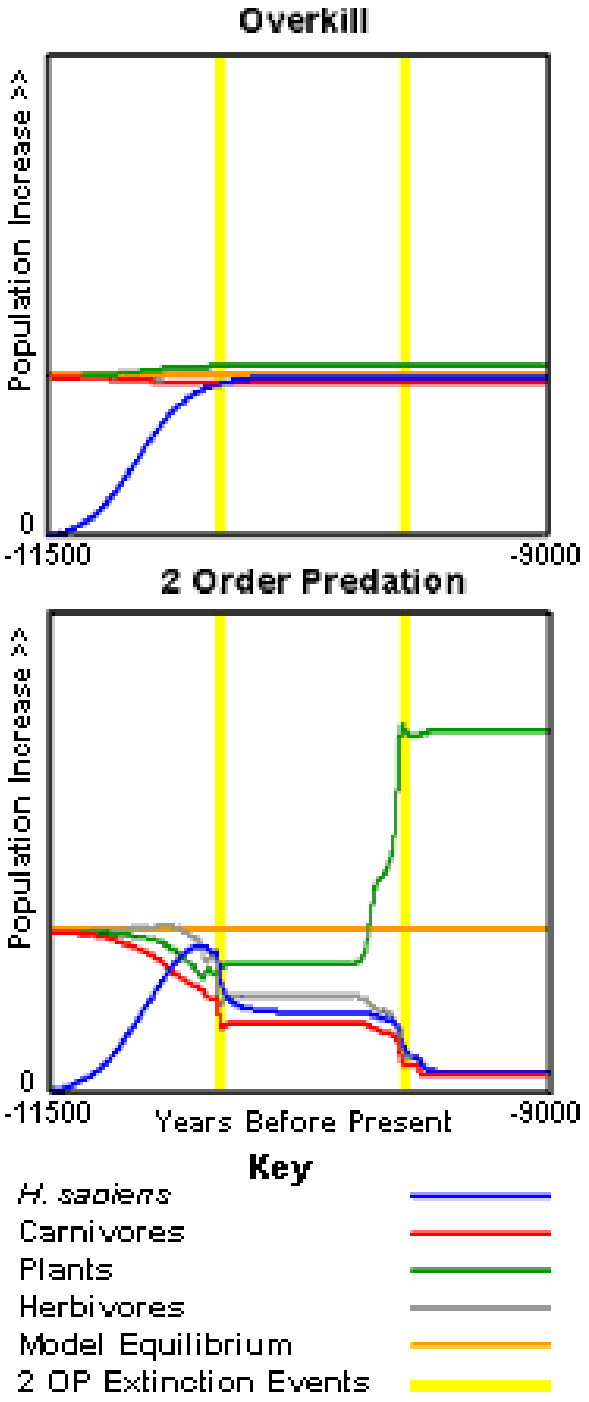
After the arrival of ***H. sapiens* in the New World**, existing predators must share the prey populations with this new predator. Because of this **competition**, populations of original, or first-order, **predators cannot find enough food** they are in direct competition with humans.

**Second-order predation begins as humans begin to kill predators.**

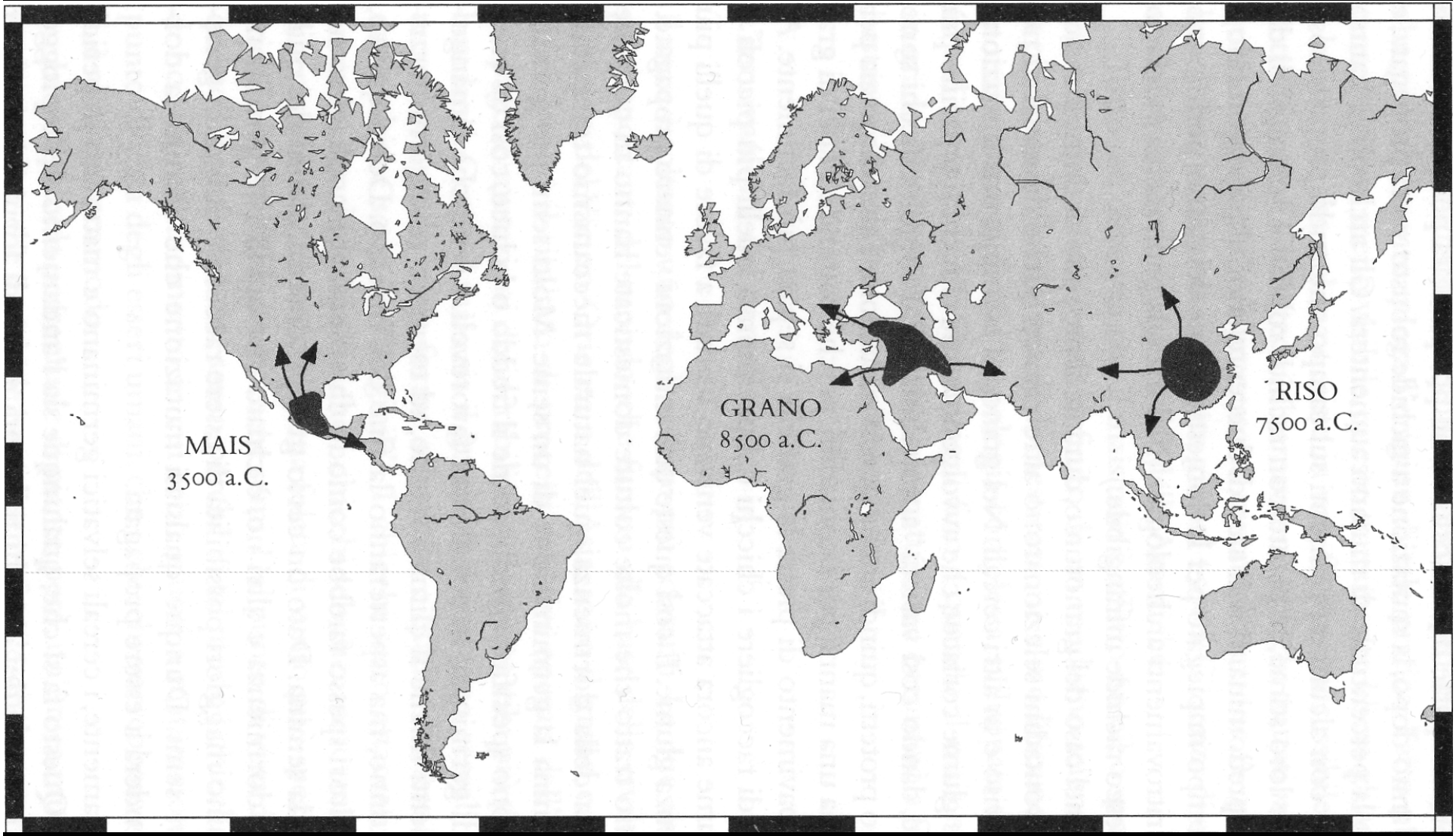
Prey populations are no longer well controlled by predation. **Killing of nonhuman predators by *H. sapiens* reduces their numbers to a point where these predators no longer regulate the size of the prey populations.**

Lack of regulation by first-order predators triggers **boom-and-bust cycles in prey populations**. Prey populations expand and consequently **overgraze** and over-browse the land. Soon the environment is no longer able to support them. As a result, many herbivores starve. Species that rely on the slowest recruiting food become extinct, followed by species that cannot extract the maximum benefit from every bit of their food.

Boom-bust cycles in herbivore populations **change the nature of the vegetative environment, with consequent climatic impacts** on relative humidity and continentality. Through overgrazing and overbrowsing, mixed parkland becomes grassland, and climatic continentality increases.



# *AGRICOLTURA*

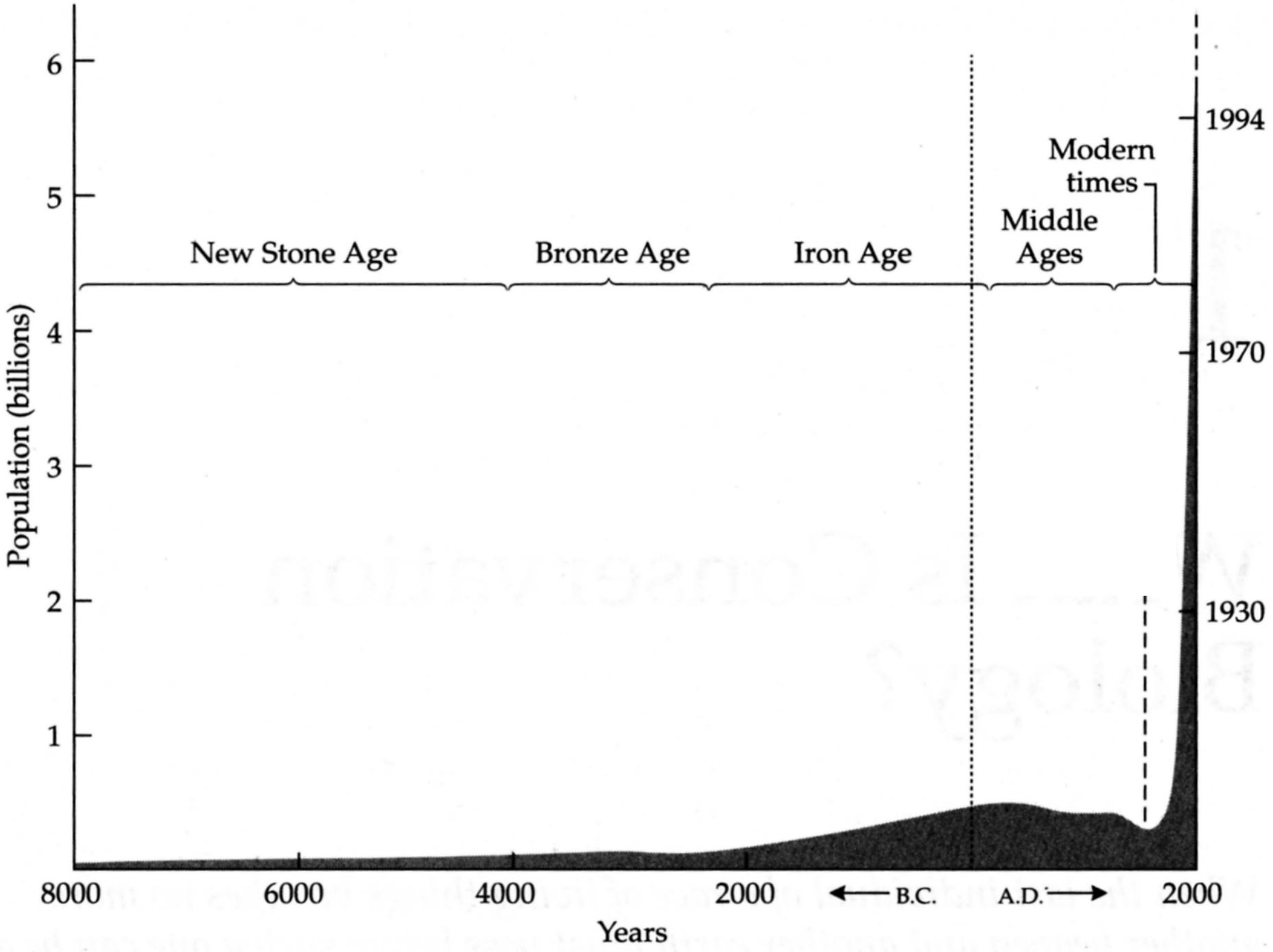


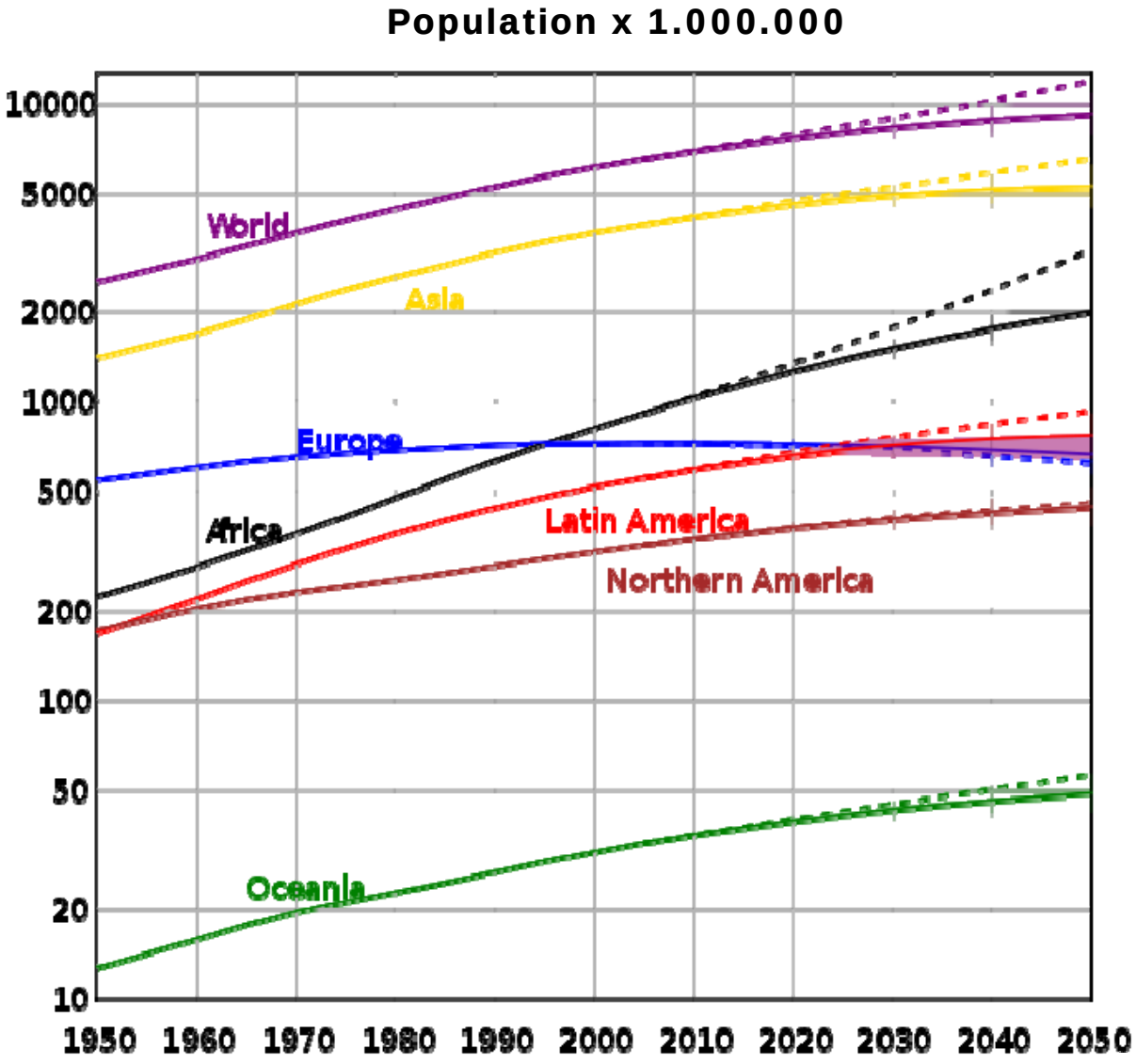
Incas and…

…Mayan societies

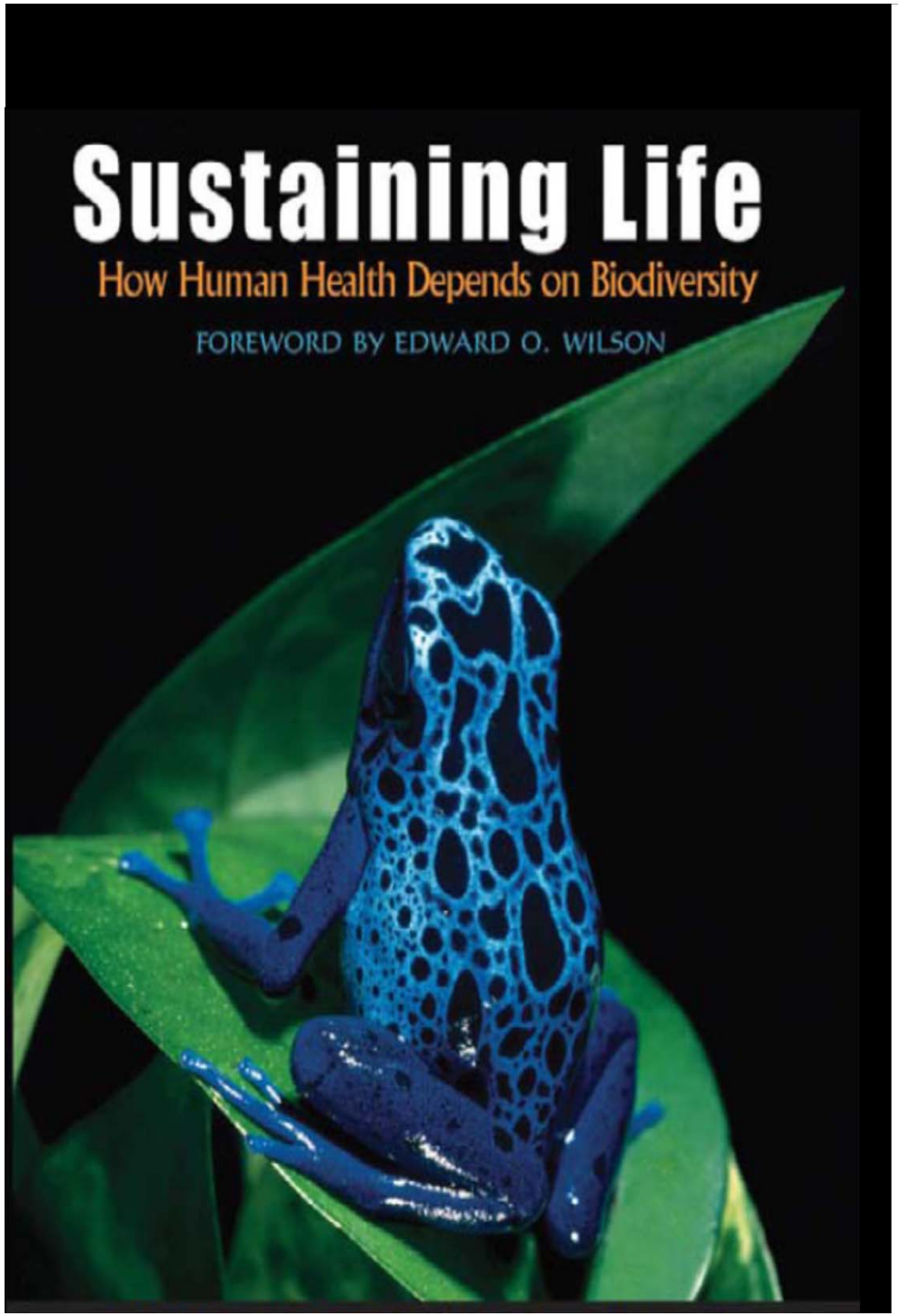
# Storia della popolazione umana sulla Terra

| Anni fa | Epoca | Aree popolate | Pop/kmq | Pop (milioni) |
|---|---|---|---|---|
| 1.000.000 | Paleolitico inf. | Africa | 0,004 | 0,120 |
| 300.000 | Paleolitico med. | Africa, Eursasia | 0,012 | 1 |
| 25.000 | Paleolitico sup. | Africa, Eursasia | 0,04 | 3,3 |
| 10.000 | Mesolitico | Tutto il pianeta | 0,04 | 5,3 |
| 6000 | Babilonia | “” | 1,0 | 86 |
| 2000 | Roma | “” | 1,0 | 130 |
| 300 | Capt. Cook | “” | 3,7 | 550 |
| 200 | Napoleone | “” | 4,9 | 730 |
| 80 | Vittorio Em. III | “” | 11,0 | 1600 |
| 0 | - | “” | 46,0 | 6790 |


6
5
4
3
2
1
Population (billions)
New Stone Age
Bronze Age
Iron Age
Middle Ages
Modern times
1994
1970
1930
8000
6000
4000
2000
B.C.
A.D.
2000
Years




| *Year* | *Population (in billions)* |
|---|---|
| 0 | 0.30 |
| 1000 | 0.31 |
| 1250 | 0.40 |
| 1500 | 0.50 |
| 1750 | 0.79 |
| 1800 | 0.98 |
| 1850 | 1.26 |
| 1900 | 1.65 |
| 1910 | 1.75 |
| 1920 | 1.86 |
| 1930 | 2.07 |
| 1940 | 2.30 |
| 1950 | 2.52 |
| 1960 | 3.02 |
| 1970 | 3.70 |
| 1980 | 4.44 |
| 1990 | 5.27 |
| **1999** | **5.98** |
| 2000 | 6.06 |
| 2010 | 6.79 |
| 2020 | 7.50 |
| 2030 | 8.11 |
| 2040 | 8.58 |
| 2050 | 8.91 |
| 2100 | 9.46 |
| 2150 | 9.75 |
| Near stabilization (after 2200) | Just above 10 billion |




*(left)*
**The Development of Dead Zones in the Gulf of Mexico Secondary to Discharge from the Mississippi River.** Sediment and nutrients from fertilizer runoff and sewage discharge, as shown in this NASA satellite image taken October 15, 2001, spill from the Mississippi River into the Gulf, leading to the formation of dead zones. Phytoplankton blooms (the cloudy greenish areas off the coastline), which are also present in areas closer to the land, where they mix with suspended sediment (which has a brownish hue), lead to oxygen depletion in the water column and on the ocean floor and the death of marine life. (Image courtesy of MODIS Rapid Response Project at NASA/Goddard Space Flight Center. See also disc.gsfc.nasa.gov/oceancolor/scifocus/oceanColor/dead_zones.shtml.)

CHAPTER 2

# How is Biodiversity Threatened by Human Activity?

*Eric Chivian and Aaron Bernstein*

*He [modern man] commonly thinks of himself as having been here since the beginning—older than the crab—and he also likes to think he's destined to stay to the bitter end. Actually, he's a latecomer, and there are moments when he shows every sign of being an early leaver, a patron who bows out after a few gaudy and memorable scenes.*

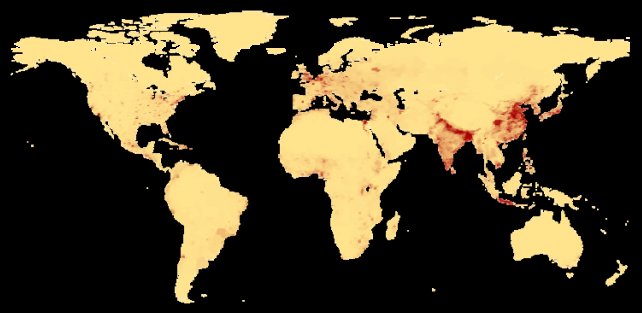
—E.B. WHITE, *Second Tree from the Corner*

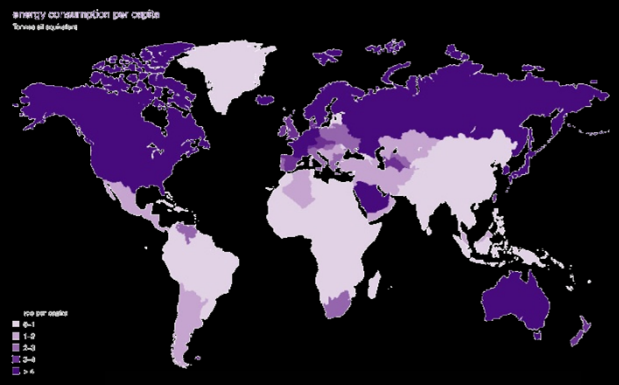
Although species have gone extinct since life began, what distinguishes present-day extinctions from those that have occurred in the past is a distinctive human fingerprint. This chapter considers how human activity has resulted in environmental changes that are known to threaten species. Although each of these changes is discussed as if it were acting in isolation, the reality is that threatened species most often come under pressure from several environmental assaults at once. In some cases, these changes may even work synergistically, such that their combined impact is greater than the sum of their individual effects. They can also act in such a way that one insult sets the stage for another, as may have occurred with the demise of some species of harlequin frogs in Costa Rica, where climatic changes are thought to have predisposed them to chytrid fungal infections[1] (see chapter 6, page 212).

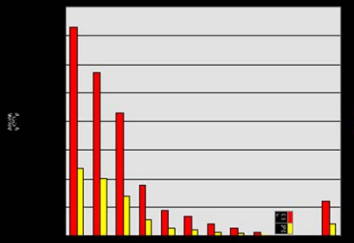
Such a one-two punch, or one involving several human-caused factors acting together, may threaten many species on Earth. For example, research performed in northwestern Ontario lakes has shown that climate change and acid rain may act together to make water clearer and thus more easily penetrated by harmful ultraviolet (UV) radiation. Dissolved organic carbon, which consists of a variety of natural compounds that come from soils and plants, serves as an important UV radiation shield for aquatic life. More than twenty years of observation by David Schindler and his colleagues at the University of Alberta has demonstrated that the total amount of dissolved carbon in the lakes is lowered both by droughts associated with climate change (which result in a reduction of organic carbon flowing into the lakes from

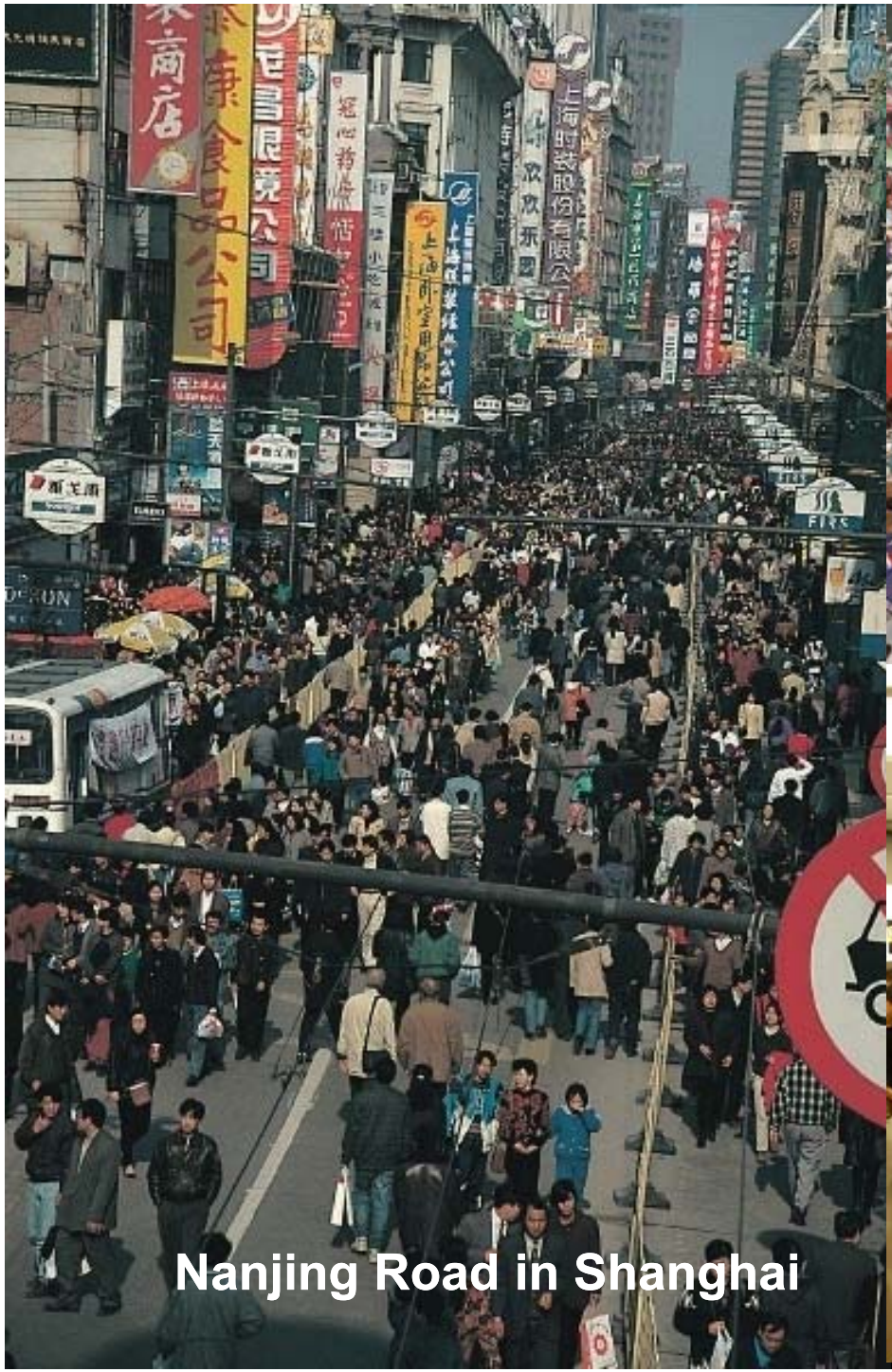
# Fattori antropici che influenzano la biodiversità

- Densità di popolazione
- Consumo di energia pro-capite
- Inefficienza e futilità nell'utilizzazione dell'energia (tecnologia, etica)







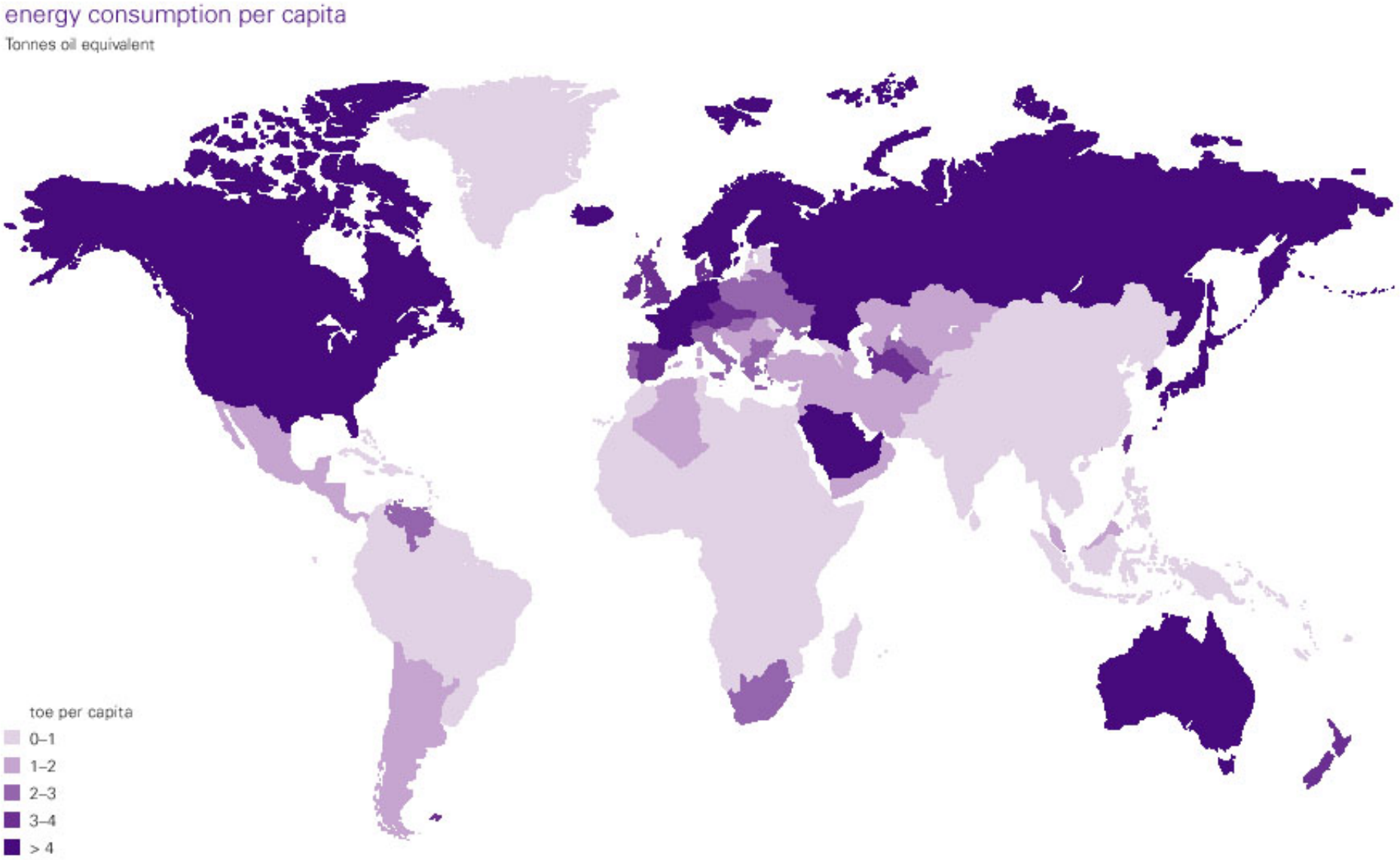


Nanjing Road in Shanghai

# Fattori antropici che influenzano la biodiversità

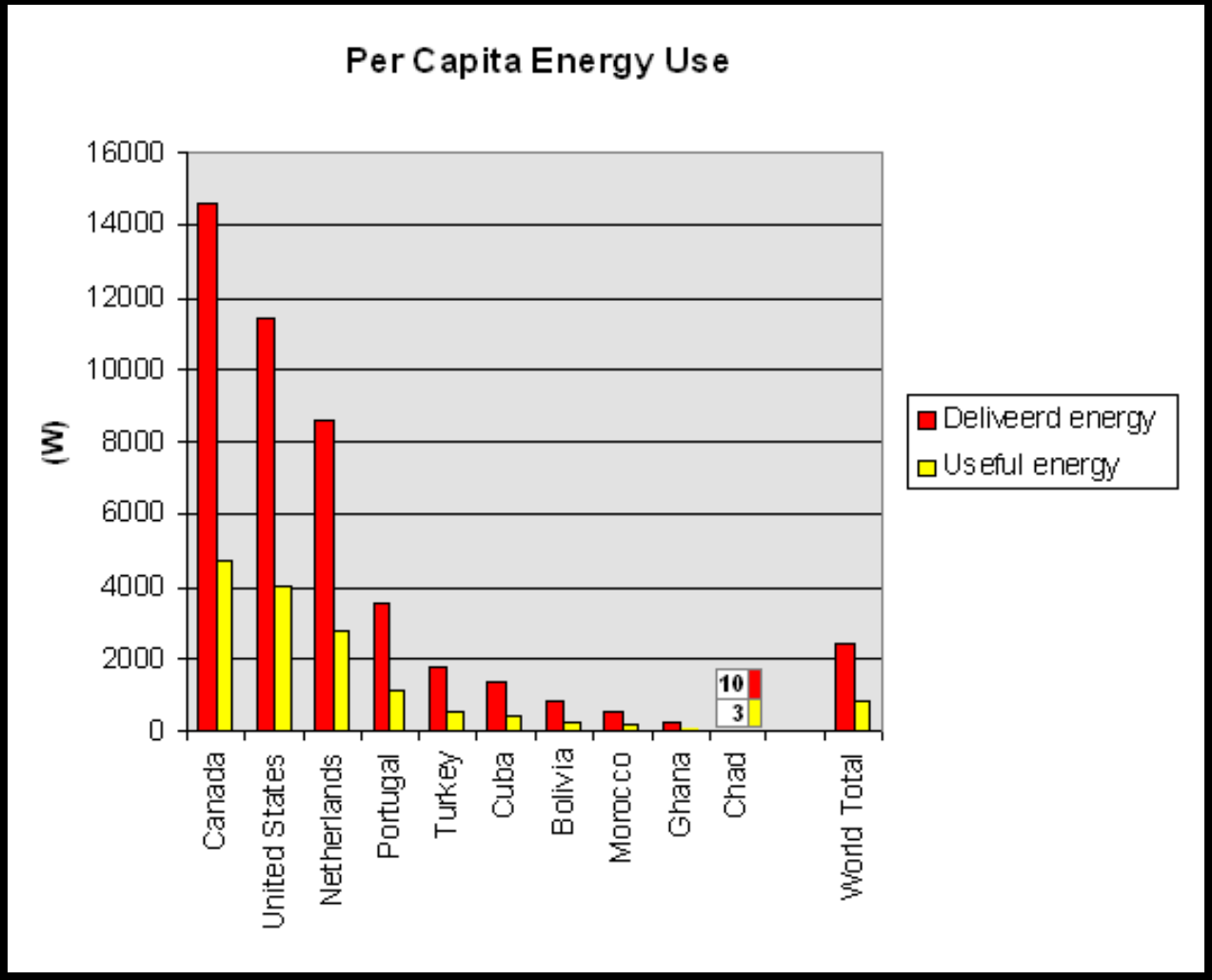
Densità di popolazione

# Fattori antropici che influenzano la biodiversità



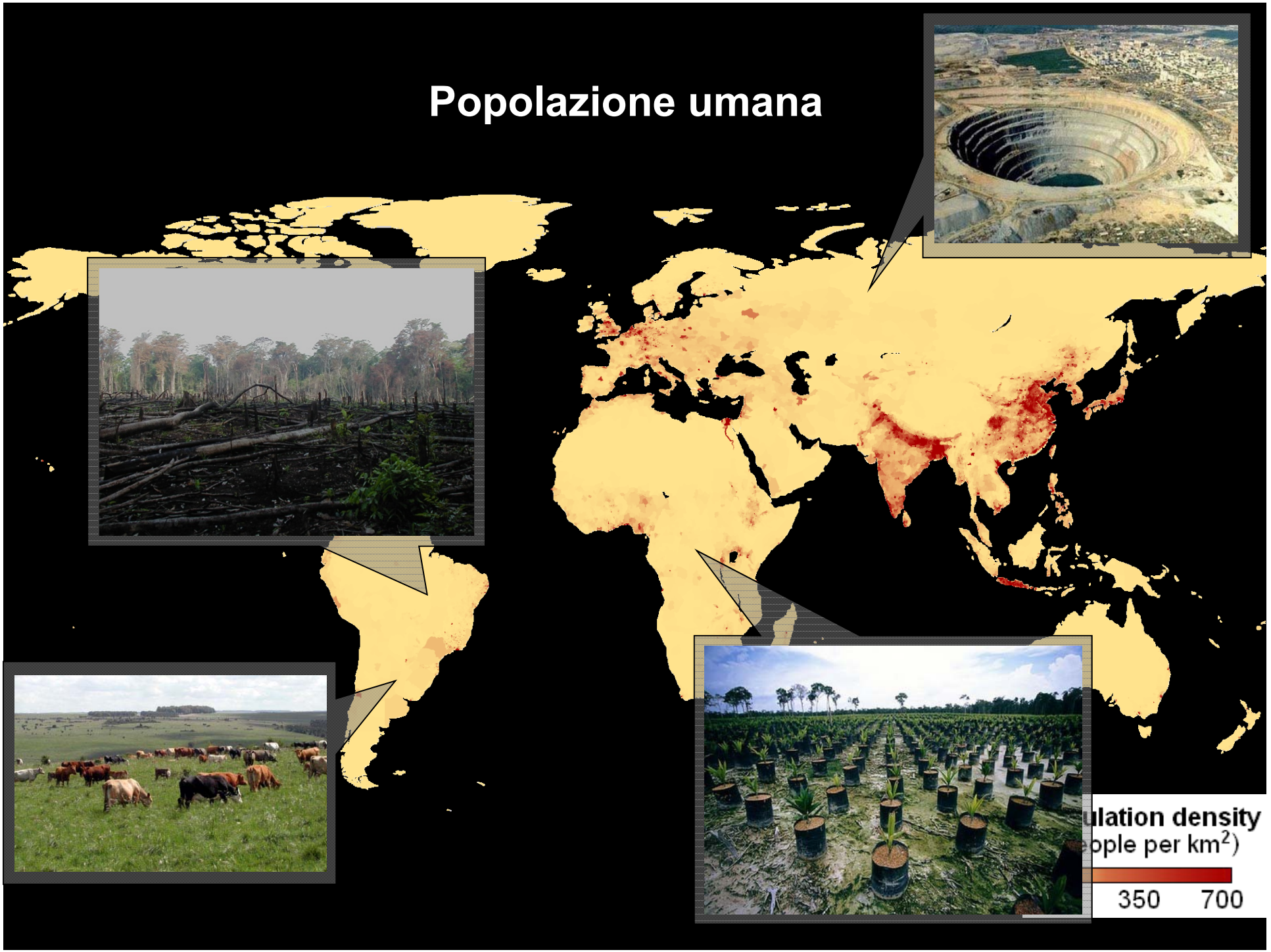

Consumo di energia pro-capite

# Fattori antropici che influenzano la biodiversità

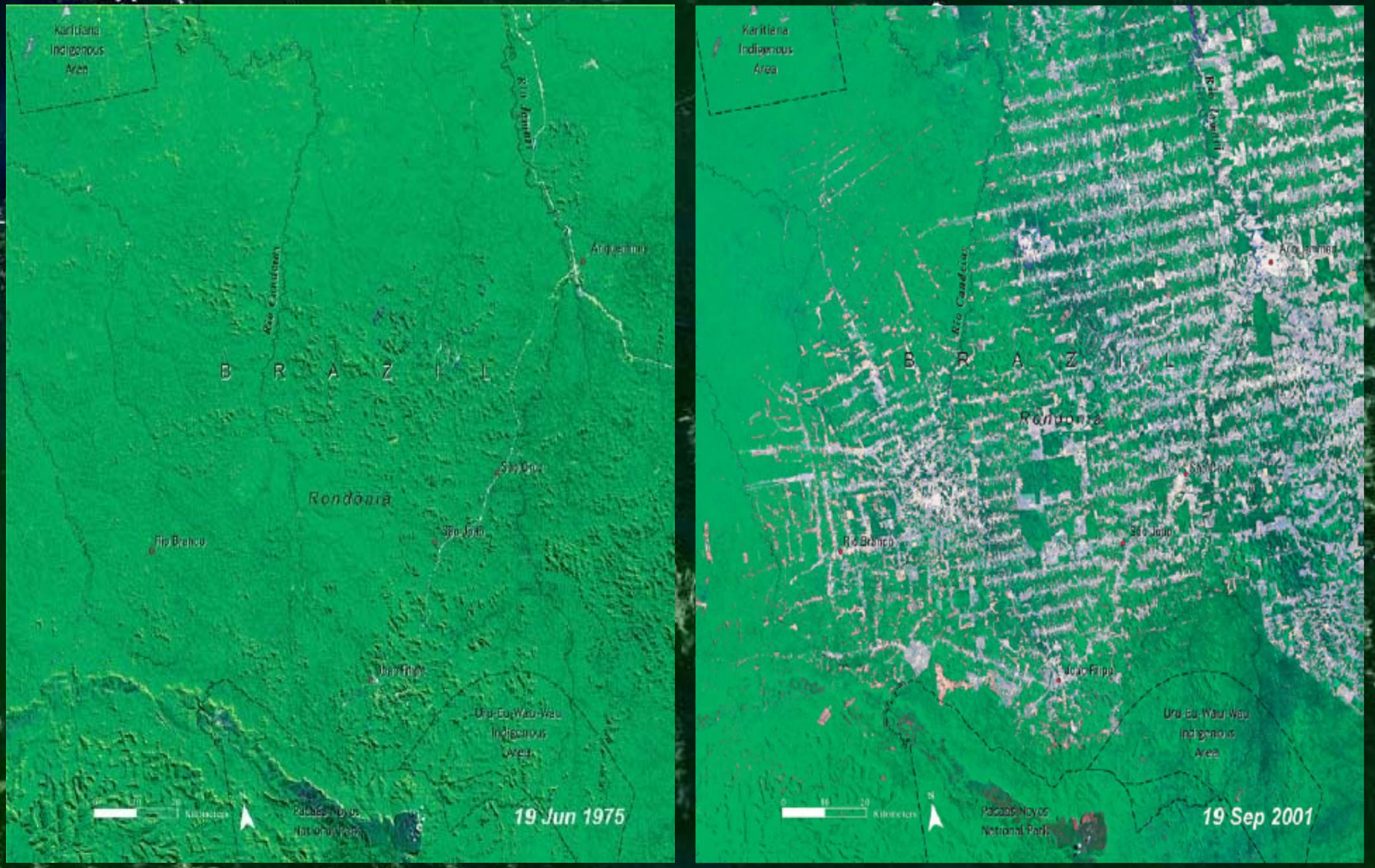



Inefficienza e futilità nell'utilizzazione dell'energia (tecnologia, etica)

# Popolazione umana



# Distruzione e degrado degli habitat




Rhondonia, BRASILE

# Distruzione e degrado degli habitat

**Deforestazione**
**Tierras Bajas project**
**Bolivia orientale.**
*Photograph courtesy NASA*.

# Distruzione e degrado degli habitat

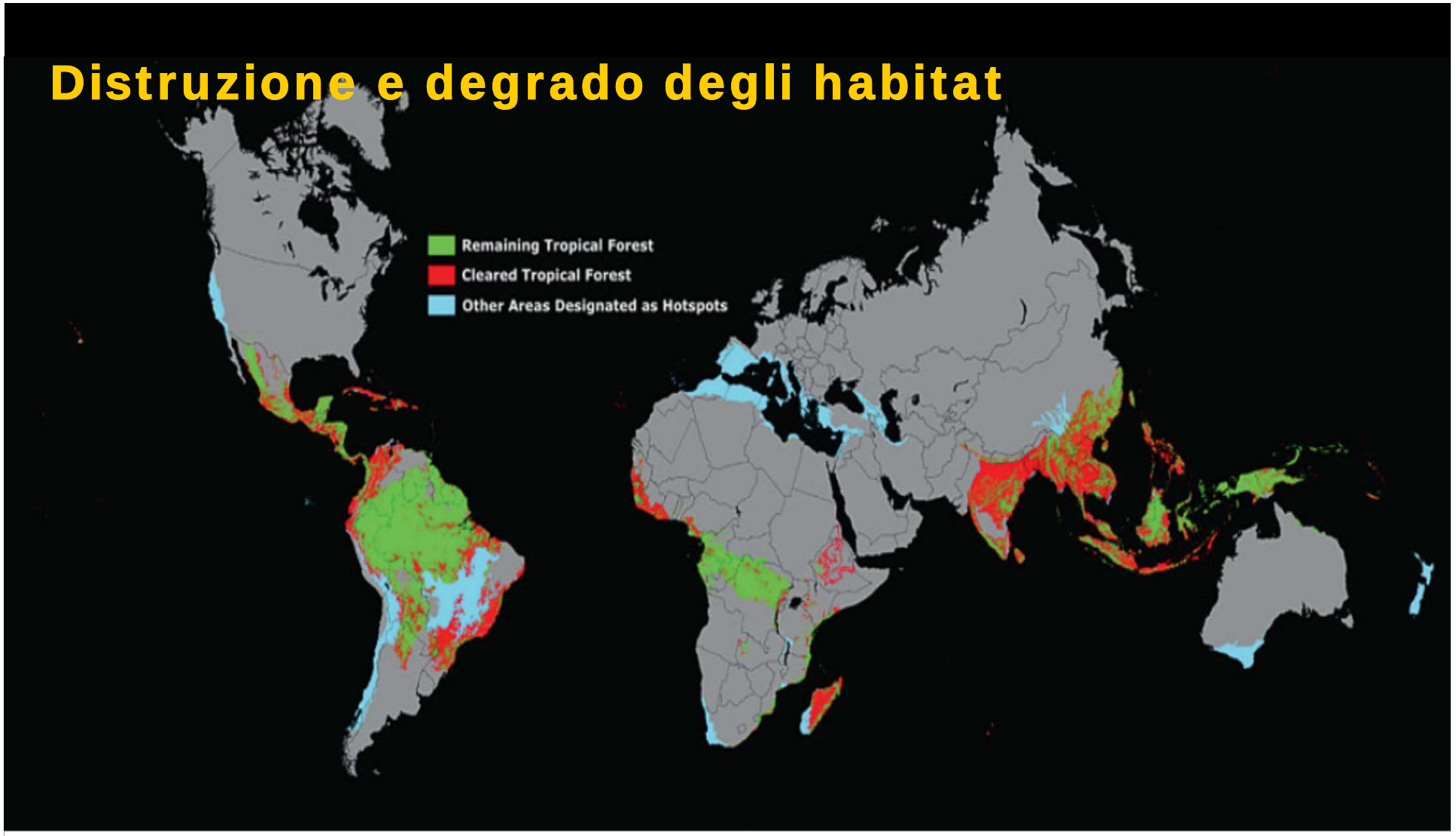



**Figure 2.2. Global Fuller Projection Map Showing Tropical Deforestation and Biodiversity "Hotspots."** This map has been created by repositioning the Fuller Projection continents, and by using the Environmental Systems Research Institute's (ESRI) ArcGIS software, which allows GIS data to be plotted onto a Fuller Projection. It shows both cleared and remaining tropical forests, along with other areas that are designated as biodiversity "hotspots." Scientists have been showing increasing interest in Fuller Projections, because of their ability to preserve the relative sizes and shapes of land masses. (Map created by Clinton Jenkins, using Fuller world projection; originally appeared in S.L. Pimm and C. Jenkins, Sustaining the variety of life. *Scientific American*, 2005;293(3):66–73.)


1987
2006
CINA: La diga delle Tre Gole
Distruzione degli habitat
Lunga 2,3 km ed alta 185 metri, taglia in due il fiume più lungo del continente, lo Yangtze (6300 km).
1200 villaggi sono stati sommersi dalle acque e gli sfollati sono oltre un milione

# Eccessivo sfruttamento delle risorse naturali:

## tasso di prelievo delle risorse naturali superiore al tasso di rinnovazione

# Eccessivo sfruttamento delle risorse naturali:

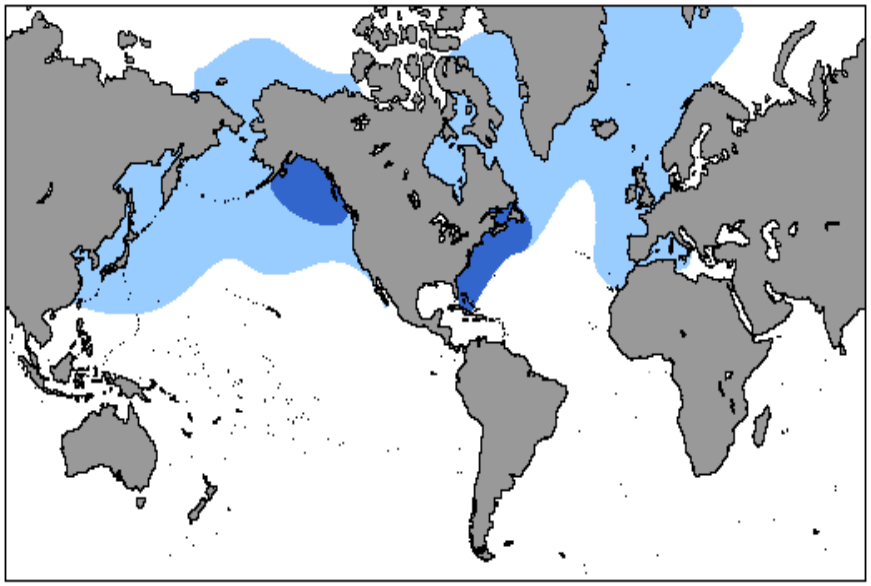
## tasso di prelievo delle risorse naturali superiore al tasso di rinnovazione


Italia, anni ’70:
allodole vendute al mercato

# Eccessivo sfruttamento delle risorse naturali:

## tasso di prelievo delle risorse naturali superiore al tasso di rinnovazione

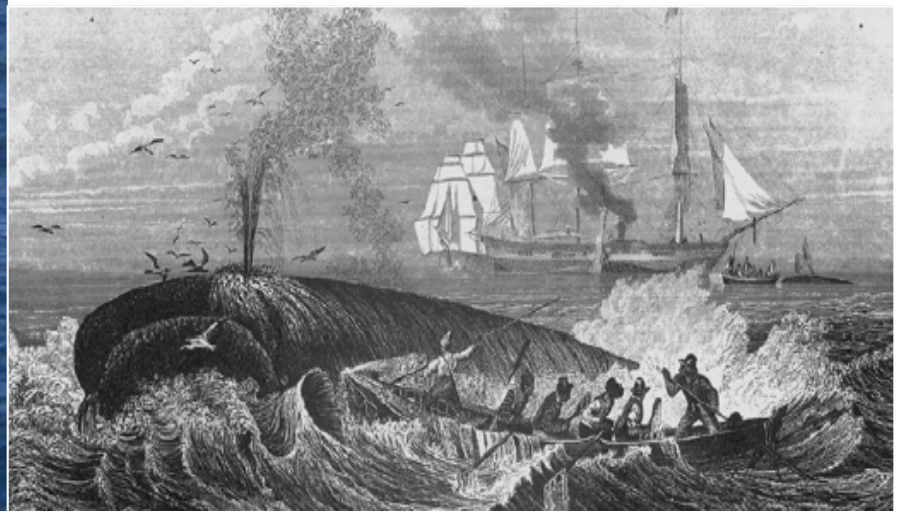
Caccia alle balene



Distribution of the northern right whale.

Original range

Current range



# Eccessivo sfruttamento delle risorse naturali:

## tasso di prelievo delle risorse naturali superiore al tasso di rinnovazione

# Introduzione di specie esotiche (alloctone):

**riuscendo ad insediarsi all'interno di comunità locali, le specie esotiche producono alterazioni nei naturali rapporti di competizione e predazione tra le specie indigene (autoctone o native).**


# Lista nera delle specie alloctone di “piccola fauna”
# L’esempio della Lombardia

**Rana toro**

**Cerambicide dalle lunghe antenne**

**Testuggine dalle orecchie rosse**

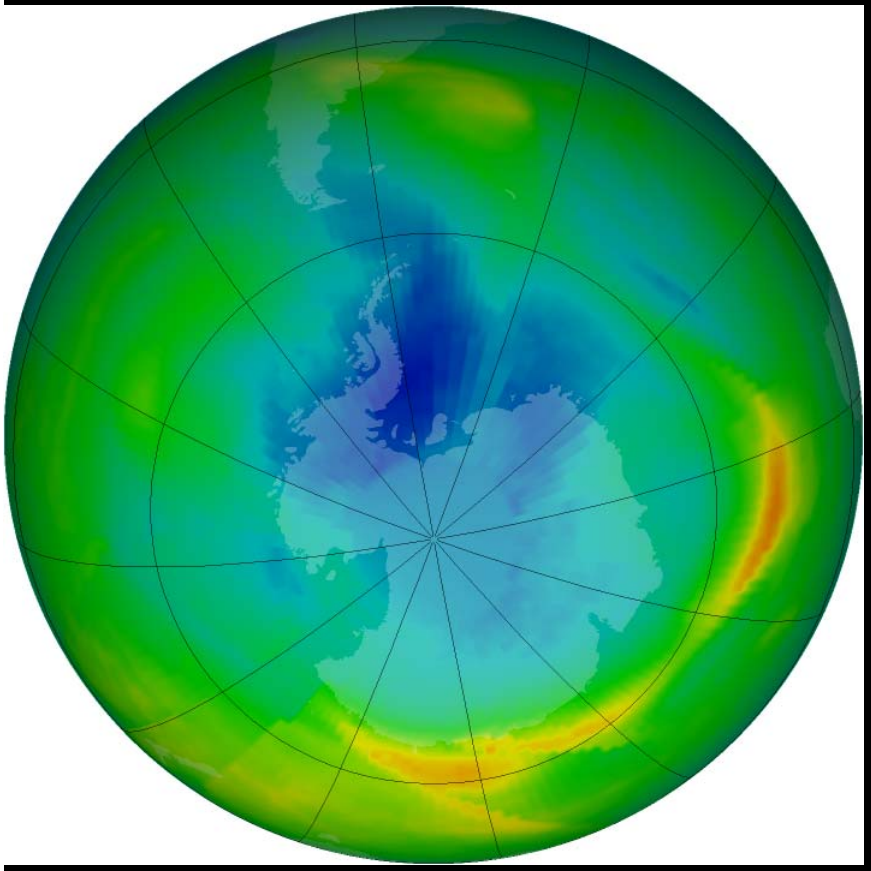
***Orconectes limosus***

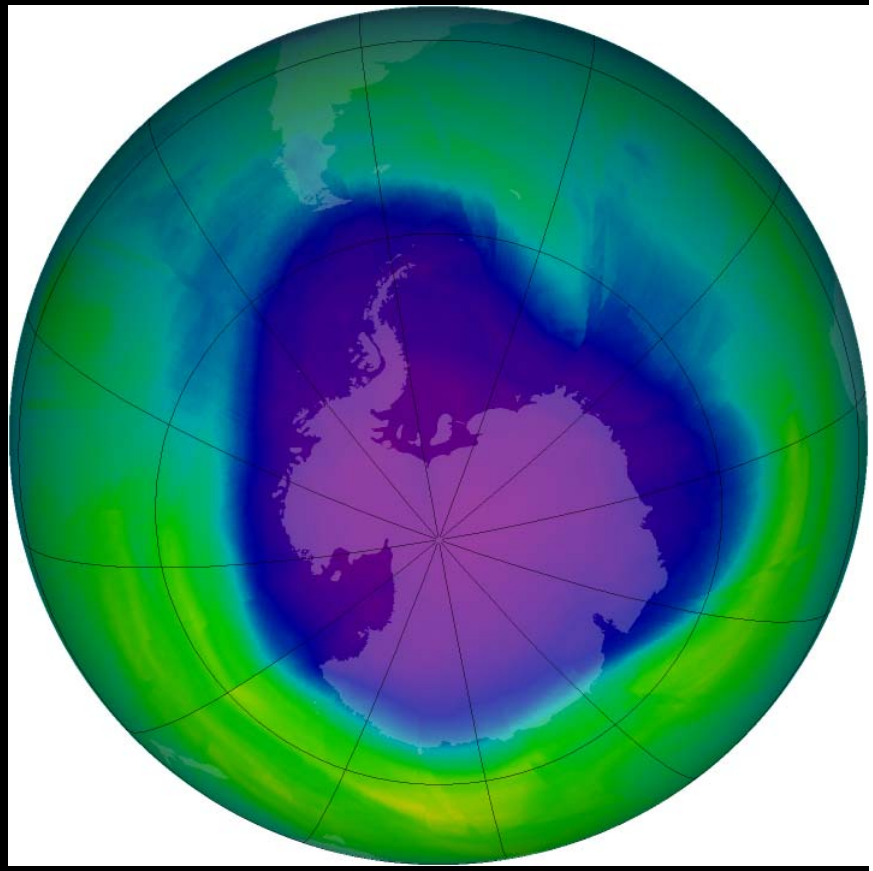
**Gambero rosso della Louisiana**

**Gambero turco**

# Inquinamento

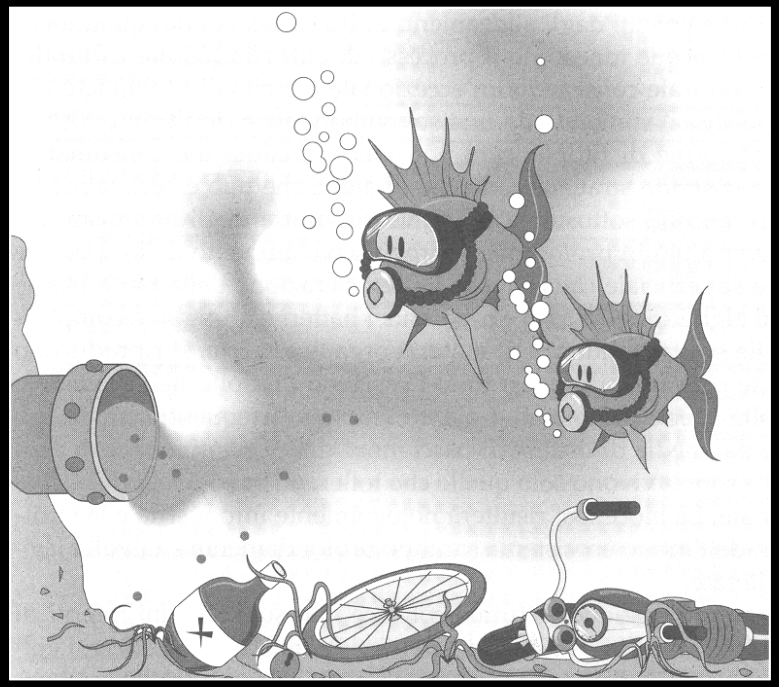
# Inquinamento



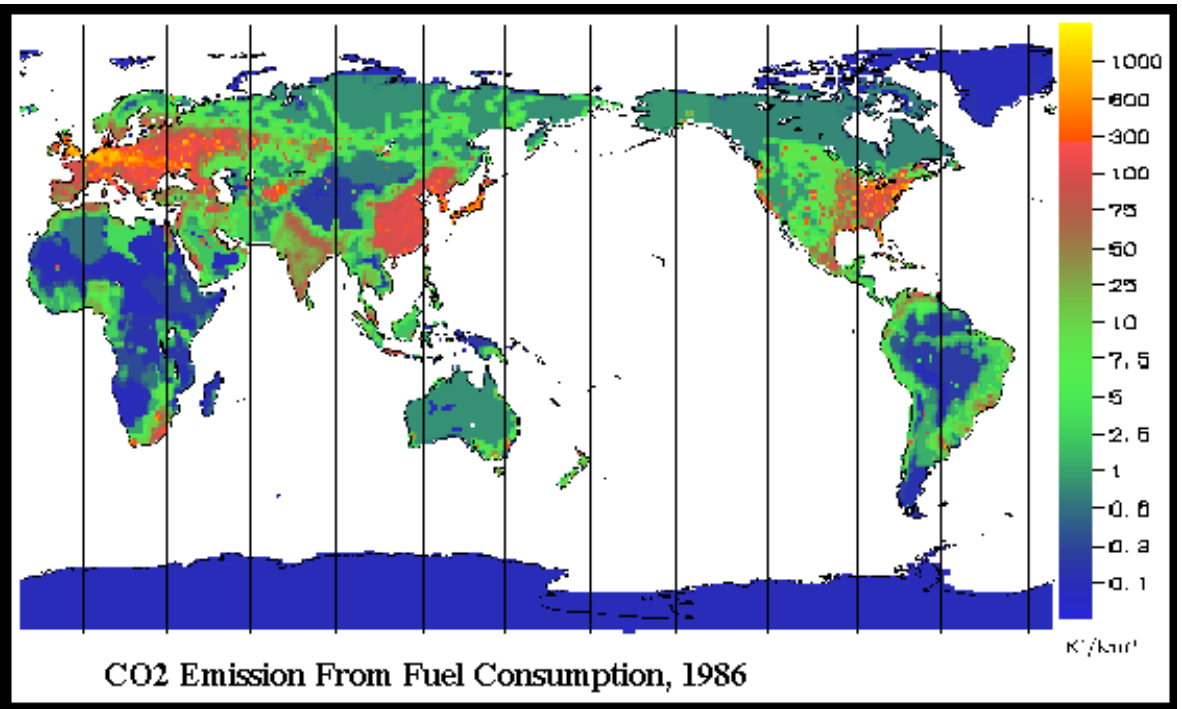


# Inquinamento

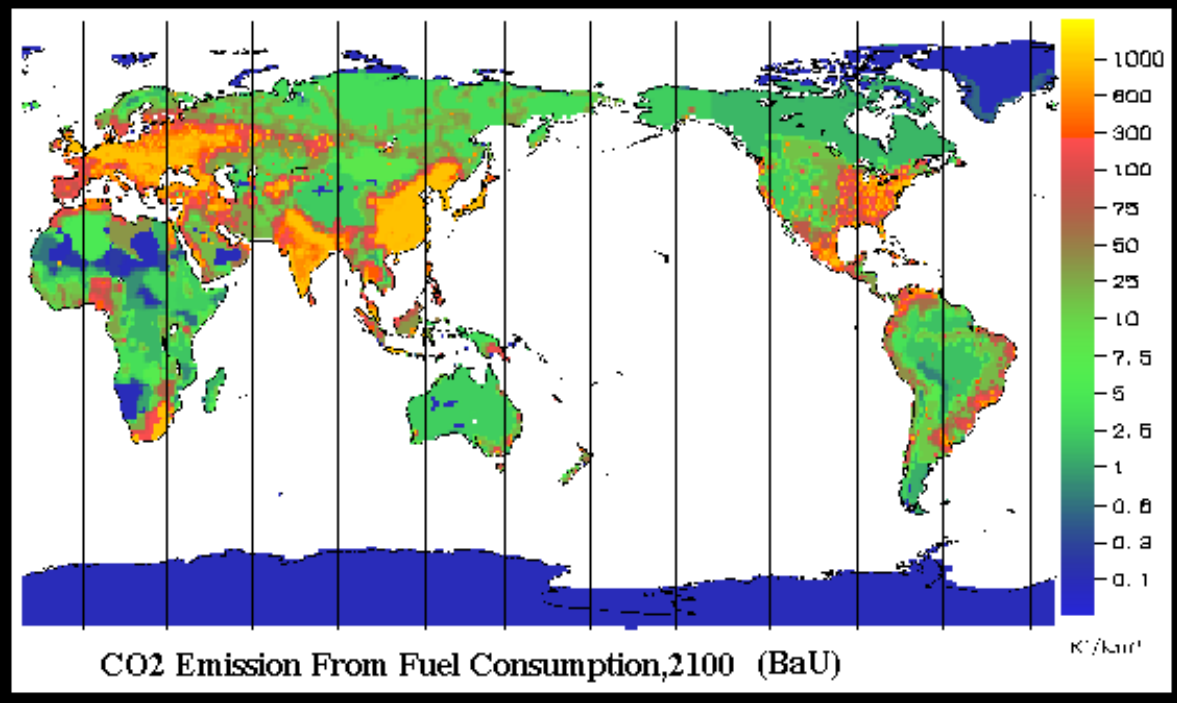
## gli ambienti acquatici sono spesso utilizzati come discarica di rifiuti



**La “moria delle foreste” causata dalle piogge acide oltre a deteriorare direttamente la vegetazione la rende più vulnerabile agli attacchi degli insetti nocivi.**

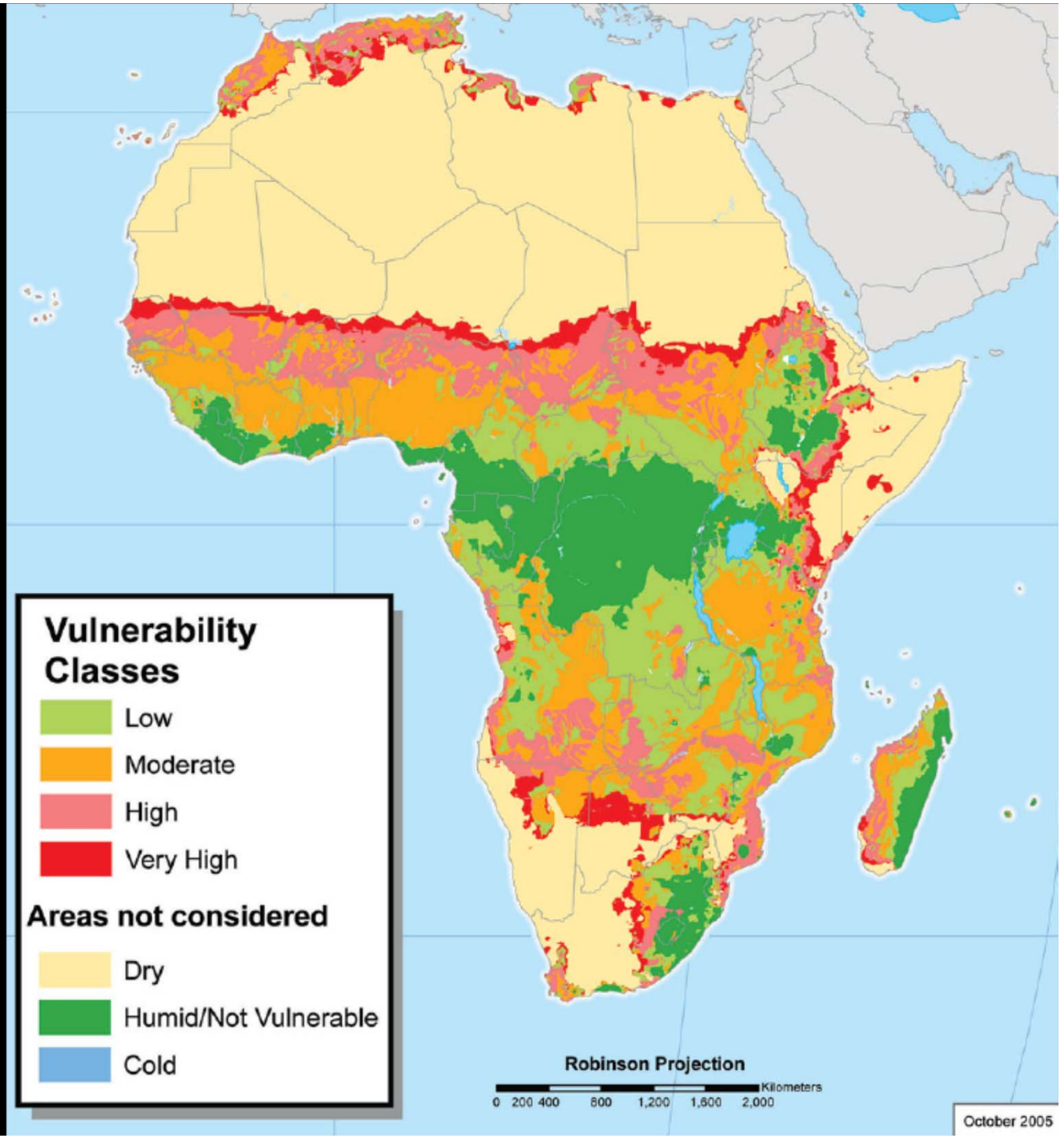



CO2 Emission From Fuel Consumption, 1986



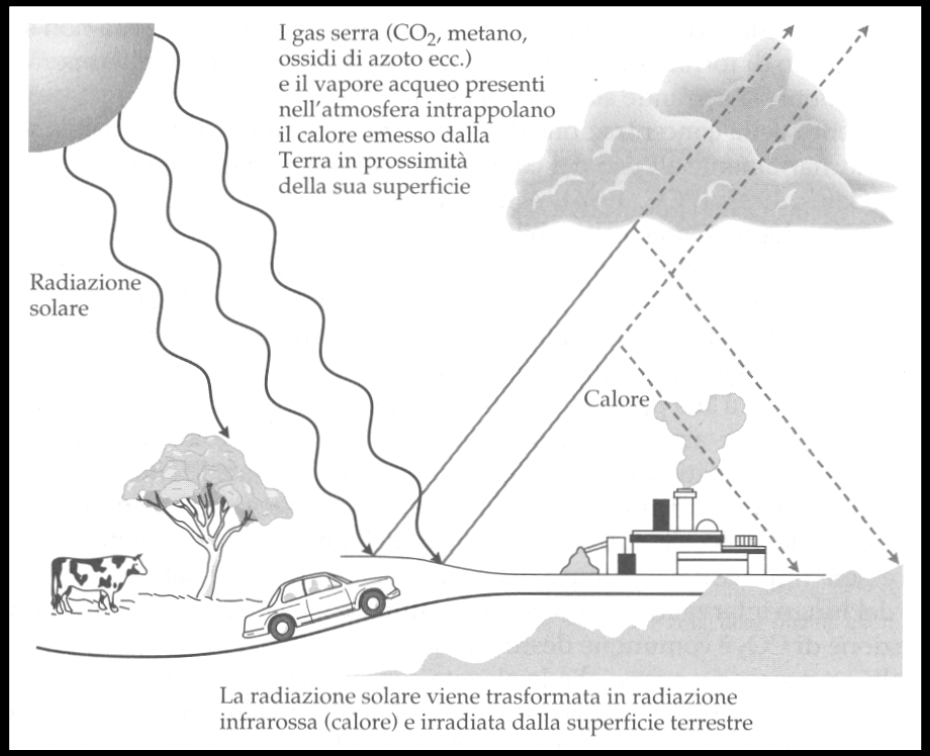

CO2 Emission From Fuel Consumption,2100 (BaU)

CAMBIAMENTI CLIMATICI E DESERTIFICAZIONE

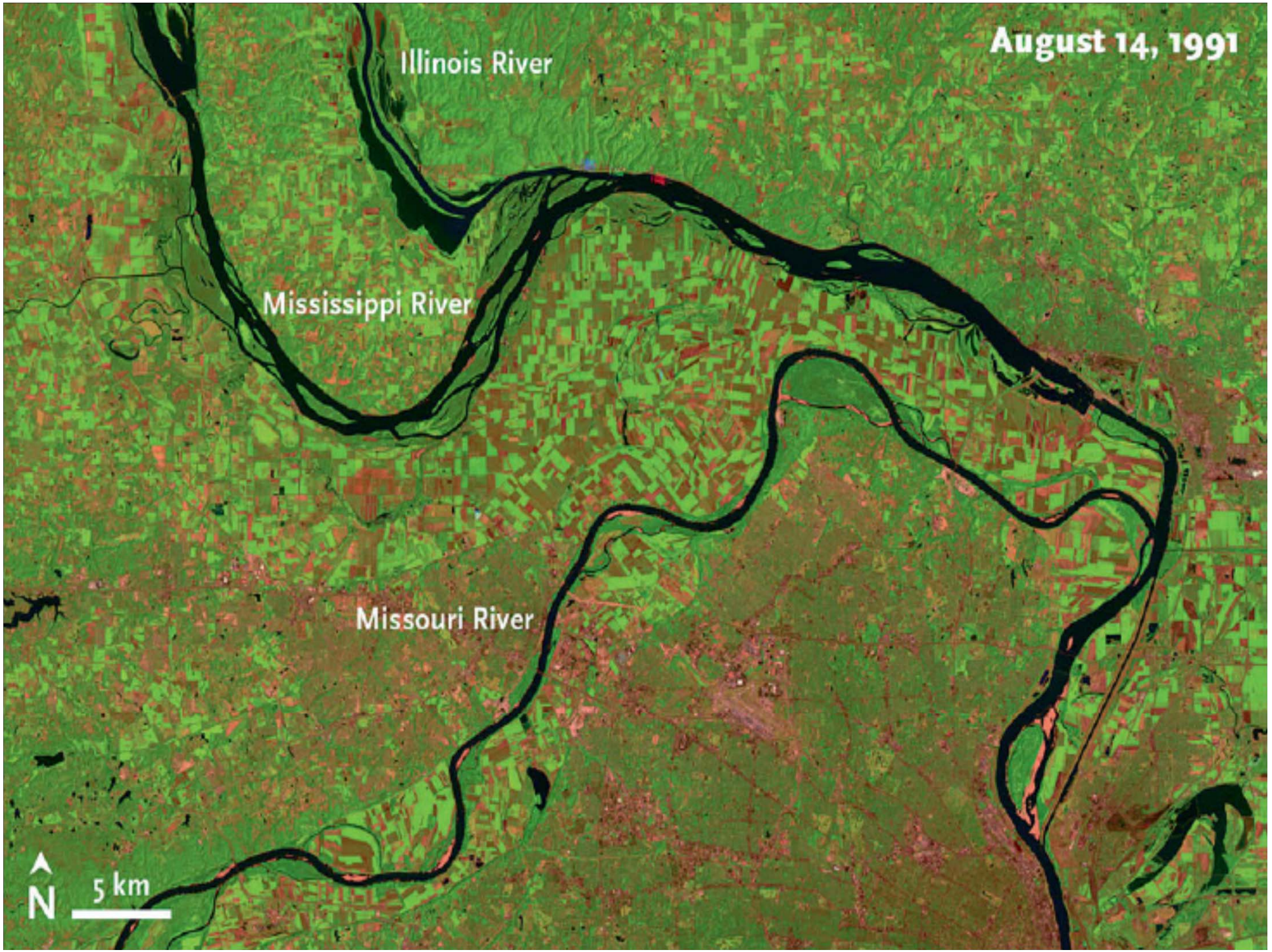


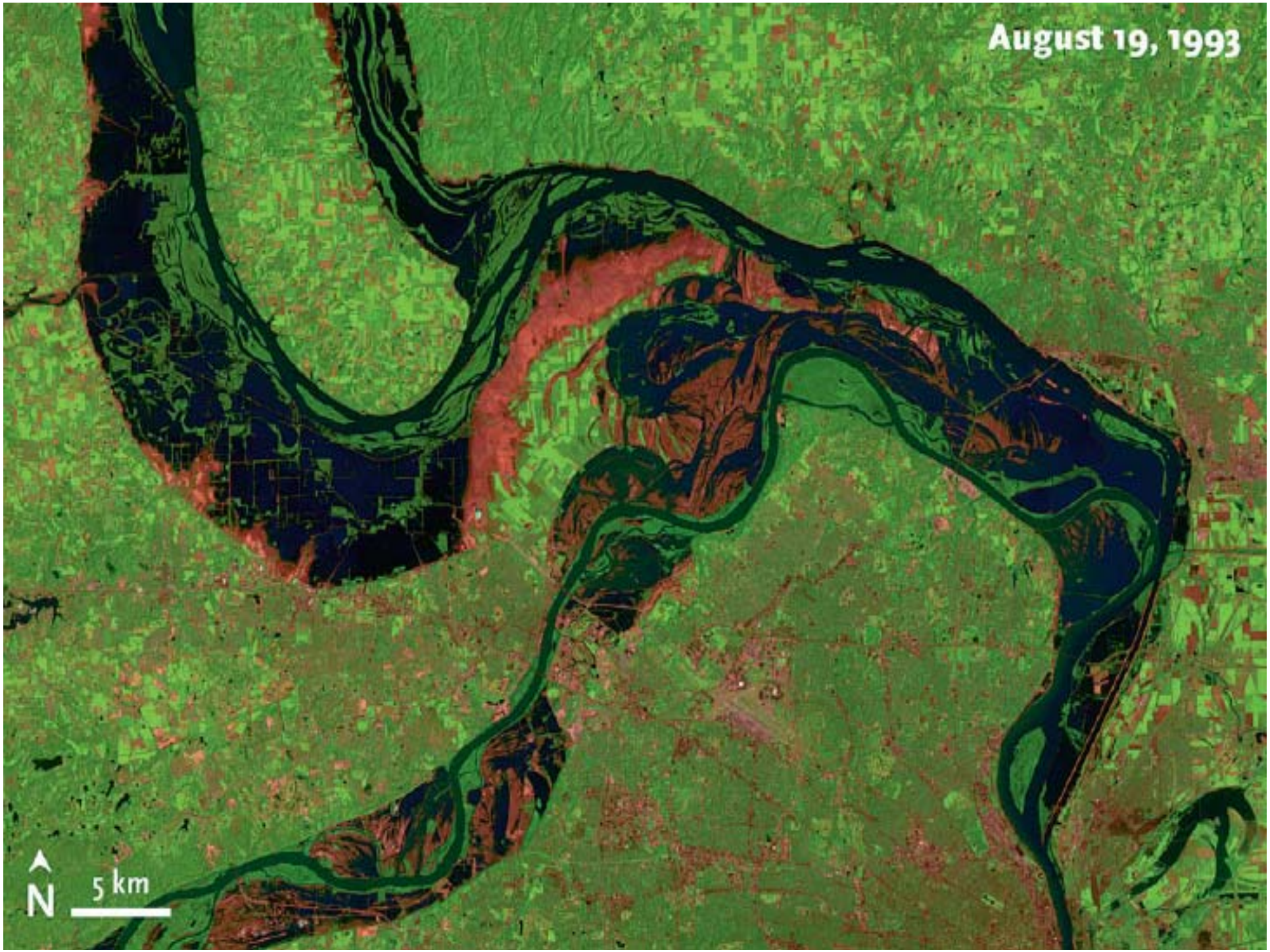
# Cambiamenti climatici globali:

## i gas serra ($CO_2$, $CH_4$, ossidi di N)
## → surriscaldamento, desertificazione



La radiazione solare viene trasformata in radiazione infrarossa (calore) e irradiata dalla superficie terrestre


August 14, 1991
Illinois River
Mississippi River
Missouri River
N
5 km


August 19, 1993
N
5 km

# Effetto sinergico di cambiamenti climatici e ambientali

**Conseguenze dell'uragano Katrina**

**USA**
**Anno 2005**

*The draining and development of coastal wetlands that previously protected the Gulf Coast contributed to severe flooding in New Orleans, Louisiana in the aftermath of Hurricane Katrina*

# ILLEGAL TRADE








# IL VALORE DELLA BIODIVERSITÀ

## Valore strumentale o utilitaristico

| | |
|---|---|
| 1) Beni | cibo<br>fonti di energia<br>fibre<br>medicinali |
| 2) Servizi | impollinazione<br>riciclo dei nutrienti<br>fissazione dell'azoto<br>regolazioni omeostatiche |
| 3) Conoscenza | ingegneria genetica<br>biologia applicata<br>scienza di base |
| 4) Psico-spirituale | bellezza estetica<br>conoscenza scientifica<br>ispirazione religiosa |

# EXOTIC FRUIT FROM THE BIG ISLAND OF HAWAII

**Abiu**
*(Pouteria caimito)*
August – January
アビト

**Acerola / Barbados Cherry**
*(Malpighia punicifolia)*
March – December
アセロラ

**Aglaia**
*(Aglaia spp.)*
September – December
アグライア

**Akee**
*(Blighia sapida)*
November – December
アキー

**Alupag**
*(Dimocarpus didyma)*
June – July
アルパグ

**Amazon Tree-Grape**
*(Pourouma cecropiaefolia)*
August – November
ポウロウマ

**Atemoya**
*(Annona cherimola x A. squamosa)*
August – February
アチモヤ

**Avocado - Yamane**
*(Persea americana)*
*Monthly varieties
アボカド

**Bael Fruit**
*(Aegle marmelos)*
October – January
マルメロ

**Bakupari / Madrono**
*(Garcinia madruno)*
October – May
バクパリ

**Banana - Brazilian**
*(Musa)*
*Monthly varieties
バナナ

**Banana - Cuban Red**
*(Musa)*
*Monthly varieties
バナナ

**Banana Poka**
*(Passiflora mollissima)*
July – January
バナナ ポカ

**Blackberry Jam Fruit**
*(Randia formosa)*
May – August
ブラックベリージャムフルーツ

**Black Sapote**
*(Diospyros digyna)*
November – March
ブラックサポテ

**Breadfruit / Ulu**
*(Artocarpus altilis)*
November – June
パンノキ

**Bignay**
*(Antidesma bunius)*
September – December
ブニノキ

**Bilimbi**
*(Averrhoa bilimbi)*
May – December
ビリンビ

**Buddha's Hand**
*(Citrus medica sarcodactylus)*
August – January
ふしゅかん

**Burmese Grape / Rambai**
*(Baccaurea sapida)*
July – August
マファイ

**Cacao**
*(Theobroma cacao)*
*Monthly varieties
カカオ

**Calabash Tree**
*(Crescentia cujete)*
May – September
瓢箪の木

**Calamondin**
*(Citrus microcarpa)*
May – December
カラモジン

**Cannonball Tree**
*(Couroupita guianensis)*
August – March
ホウガンノキ

**Cashew Apple**
*(Anacardium occidentale)*
September – December
カシュー

**Champedak**
*(Artocarpus integer)*
June – September
コパラミツ

**Charichuela**
*(Garcinia macrophylla)*
September – December
チャリクエラ

**Cherimoya**
*(Annona cherimola)*
July – January
チェリモヤ

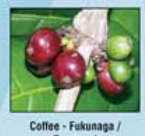
**Chico Sapodilla**
*(Manilkara zapota)*
April – January
チコ

**Chupa-Chupa**
*(Matisia cordata)*
September – October
チュッパチュッパ

**Coconut**
*(Cocos nucifera)*
*Monthly varieties
ココナツ

**Coffee - Kona Typica**
*(Coffea arabica)*
August – March
コーヒー

**Coffee - Yellow Caturra**
*(Coffea arabica)*
August – March
コーヒー カツーラ



**Coffee - Fukunaga / Dewevrei**
*(Coffea liberica)*
August – March
コーヒー リベリカ / デベブレイ

**Cupuacu**
*(Theobroma grandiflorum)*
August – January
クプアス

**Custard Apple**
*(Annona reticulata)*
October – April
カスタードアップル
ギュウシンリ(牛心梨)

**Date Palm**
*(Phoenix dactylifera)*
September – December
ナツメヤシ

**Dragon Fruit**
*(Hylocereus undatus)*
May – August
ドラゴンフルーツ

**Dragon Fruit / Yellow Pitaya**
*(Selenicereus megalanthus)*
May – December
ヒロケレウリ ウン

**Durian**
*(Durio zibethinus)*
September – March
ドリアン



**Egg Fruit / Canistel**
*(Pouteria campechiana)*
June – November
クダモノタマゴ



**Emblic**
*(Phyllanthus emblica L.)*
September – November
アムラビリー



**Feijoa / Pineapple Guava**
*(Feijoa sellowiana)*
June – September
フェイジョア



**Fig**
*(Ficus carica)*
July – March
イチジク



**Fijian Longan**
*(Pometia pinnata)*
August – November
タイトウリウゴン



**Gnetum**
*(Gnetum gnemon)*
Several Times Per Year
グネモン



**Gourka**
*(Garcinia dulcis)*
April – January
ガルシニア / ゴウルカ



**Governor's Plum**
*(Flacourtia indica)*
May – January
オオミイヌカンコ



**Grapefruit**
*(Citrus x paradisi)*
October – February
グレープフルーツ



**Green Sapote**
*(Pouteria viride)*
August – February
ミドリ サポテ



**Grumichama**
*(Eugenia brazilliensis)*
May – July
グリミチャマ



**Guajilote / Cuachilote**
*(Parmentiera edulis)*
September – February
グアジローテ



**Guarana**
*(Paullinia cupena)*
August – October
グワラナ



**Guava - White**
*(Psidium guajava)*
October – January
グアヴィ白



**Strawberry Guava**
*(Psidium cattleianum)*
July – December
テリハバンジロウ / イチゴグァバ



**Guava - Yellow Strawberry**
*(Psidium cattleianum lucidum)*
July – December
イチゴグァバ黄



**Ice Cream Bean**
*(Inga sp.)*
Septermber – January
アイスクリーム ビーン



**Ice Cream Bean**
*(Inga fastuosa)*
September – January
アイスクリーム ビーン



**Ichant Papeda**
*(Citrus ichangensis)*
August – October
イーチャンゼンシス



**Indian Jujube**
*(Ziziphus mauritiana)*
August – September
インドナツメ



**Jaboticaba**
*(Myrciaria cauliflora)*
August – February
ラフレモン



**Jackfruit**
*(Artocarpus heterophyllus)*
May – February
パラミツ / ジャックフルーツ



**Jamberi Lemon**
*(Citrus jambhiri)*
August – February
ラフレモン



**White Java Plum / Jambolan / Duhat**
*(Syzygium cumini)*
September – October
ムラサキフトモモ



**Kaffir Lime**
*(Citrus hystrix)*
Yearround
カファーライム / スワンギ



**Kitembilla**
*(Dovyalis herbecarpa)*
*2 or 3 times a year
ケテンピラ



**Kumquat**
*(Citrus fortunella)*
October – December
キンカン



**Kusiae Lime**
*(Citrus x limonia)*
August – January
ミカン科



**Lalijiwa**
*(Mangifera lalijiwa)*
January – February
ラリジワフ



**Langsat**
*(Lansium domesticum)*
November – January
ランシャト



**Lem Wai**
*(Passiflora ligularis)*
July – January
甘実果物時計



**Lemon**
*(Citrus limon)*
July – February
レモン



**Lime - Tahiti or Bearss**
*(Citrus latifolia)*
June – February
ライム



**Lime - Mexican / Key**
*(Citrus aurantifolia)*
July – February
メキシコ ライム



**Lime - Sweet**
*(Citrus limettioides)*
Yearround
甘果レモン



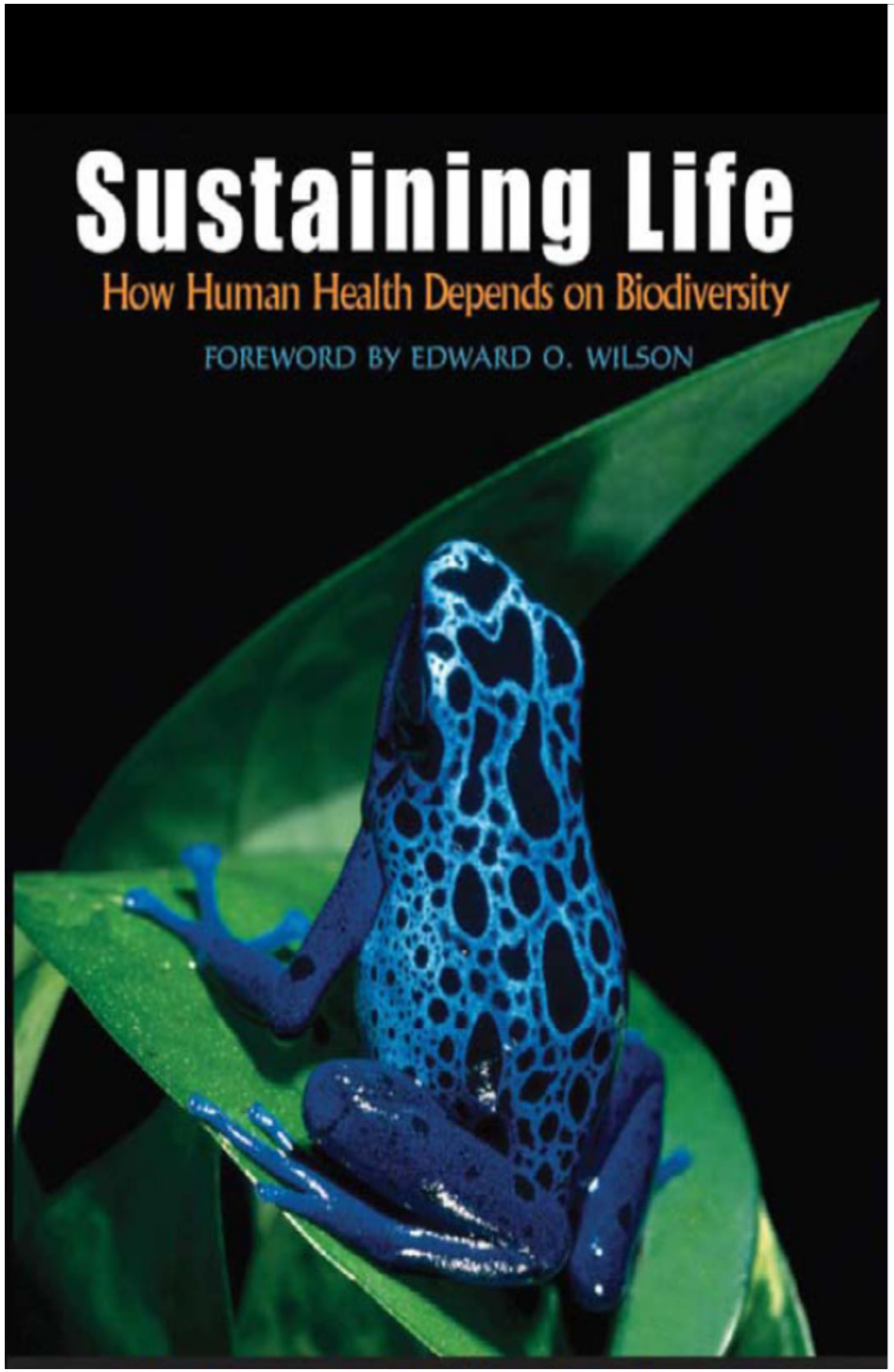
**Lime - Abhayapuri Kaghzi**
*(Citrus aurantifolia)*
Yearround
インドライム



**Lime - Kona Ranggur**
*(Citrus x limonia Osbeck)*
October – March
ラフレモンとライム



**Longan**
*(Dimocarpus longan)*
Yearround
ロンガン




*(left)*
**Various Beetle Species Mostly from the Genus *Lebia*.** There are some 350,000 described beetle species (comprising about 40 percent of all known insects), a number that is six times greater than all the vertebrate species that have been identified. (From C.G. Champion, *Biologia Centrali-Americana; or Contributions to the Knowledge of the Fauna of Mexico and Central America*, Vol. 1, Part 1, Insecta. Coleoptera, table 10 (Frederick Du Cane Godman and Osbert Salvin, editors), R.H. Porter and Dulau and Company, London, 1881–1884. From the collections of the Ernst Mayr Library, Museum of Comparative Zoology, Harvard University.)

CHAPTER 1

# WHAT IS BIODIVERSITY?

*Stuart L. Pimm, Maria Alice S. Alves, Eric Chivian, and Aaron Bernstein*

*Although there is substantial controversy about the circumstances in which it was said and about the exact wording of the original remark, J.B.S. Haldane, one of the most prominent and brilliant evolutionary biologists of his time, when asked what one could conclude about the Creator from studying His work, is reputed to have said, "He had an inordinate fondness for beetles."*

Biological diversity, or biodiversity for short, is the variety of life on Earth—its genes, species, populations, and ecosystems. Human actions that have degraded land, bodies of fresh water, and the oceans have already caused biodiversity to decline sharply, and even greater losses are expected if humanity continues its current unsustainable use of natural resources. Although such activities as the release of greenhouse gases have exacted heavy, and in some cases potentially catastrophic, tolls on the global environment, the loss of biodiversity is the only truly irreversible consequence of environmental degradation. When a gene, a species, a population, or an ecosystem is lost, it is gone forever.

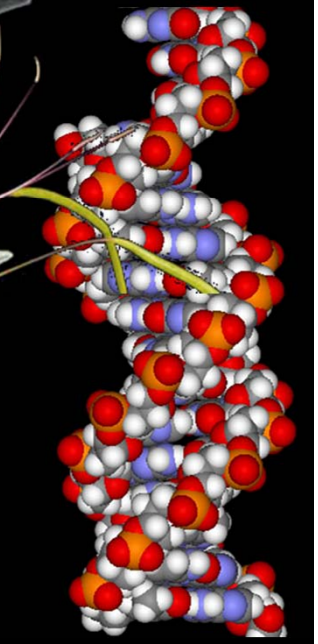
When considering the loss of biodiversity, species loss has become the most widely used measure. The subject of biodiversity loss is, however, broader and more complex than this, because there is diversity at other levels of organization as well. For example, genetic diversity exists among members of an individual species, and a species can lose some of this diversity when local populations are lost even though the species itself has not gone extinct. There is also diversity at higher levels, above the species level, in the genera (the plural of genus), families, orders, classes, phyla, and kingdoms to which species belong, and in the types of ecological communities, or ecosystems, they are a part of. A loss of diversity, or in function, at any one of these levels may be independent of such losses at another level. For example, an ecosystem may shrink dramatically in area and lose many of its functions, even though all of its constituent species may manage to survive.

This chapter provides an overview of the current status of the world's biodiversity. It is intended to provide a baseline for the chapters that follow that will, in turn, examine some of the threats to biodiversity, the ways we depend on it, and how our health and our lives may be endangered by its loss.

# BIODIVERSITÀ

## Valore strumentale (o utilitaristico)

| | |
|---|---|
| 1) Beni | cibo<br>fonti di energia<br>fibre<br>medicinali |
| 2) Servizi | impollinazione<br>riciclo dei nutrienti<br>fissazione dell'azoto<br>regolazioni omeostatiche |
| 3) Conoscenza | ingegneria genetica<br>biologia applicata<br>scienza di base |
| 4) Psico-spirituale | bellezza estetica<br>conoscenza scientifica<br>ispirazione religiosa |



# BIODIVERSITÀ

## Valore intrinseco

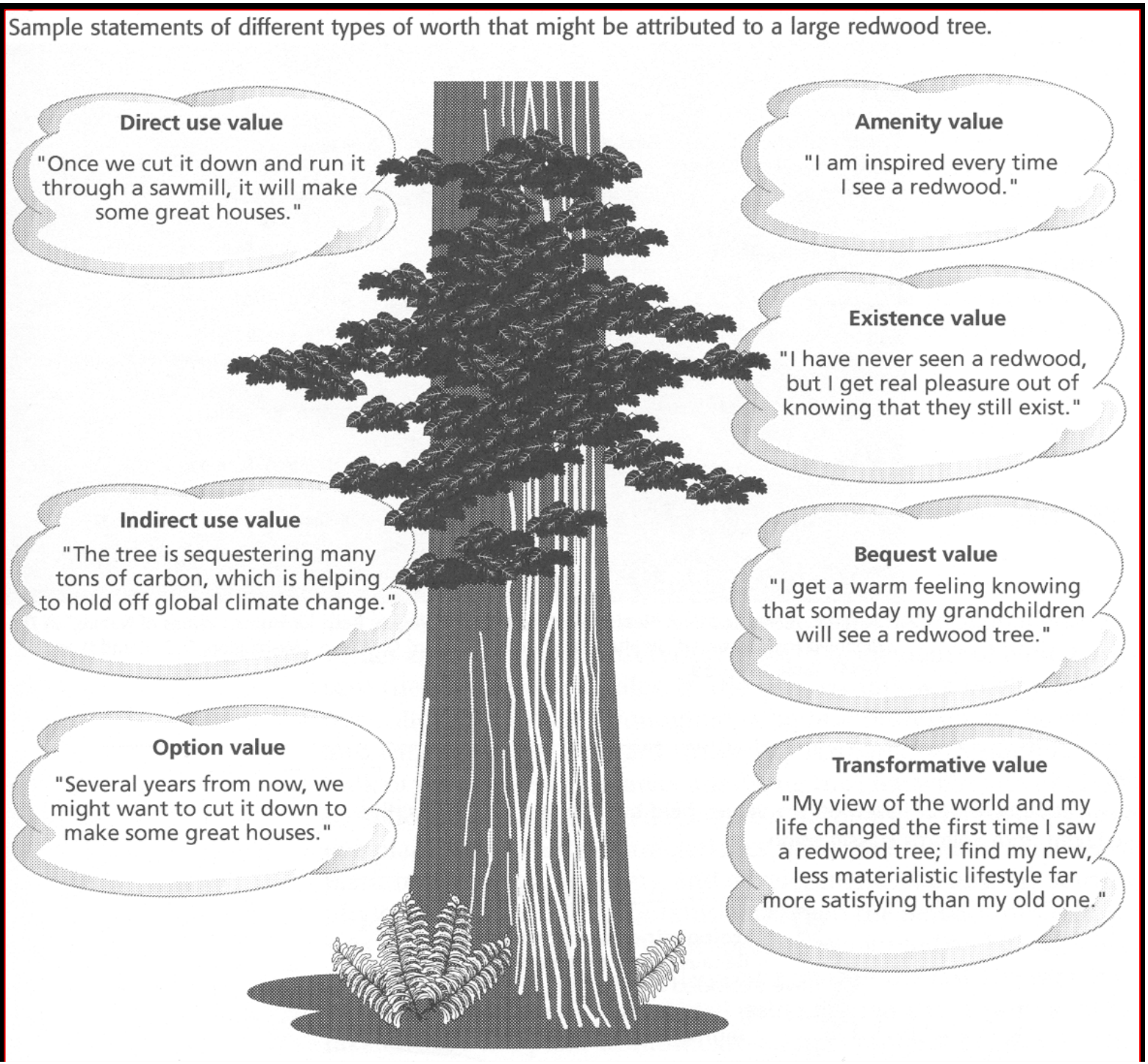
Che cosa significa “valore intrinseco”?

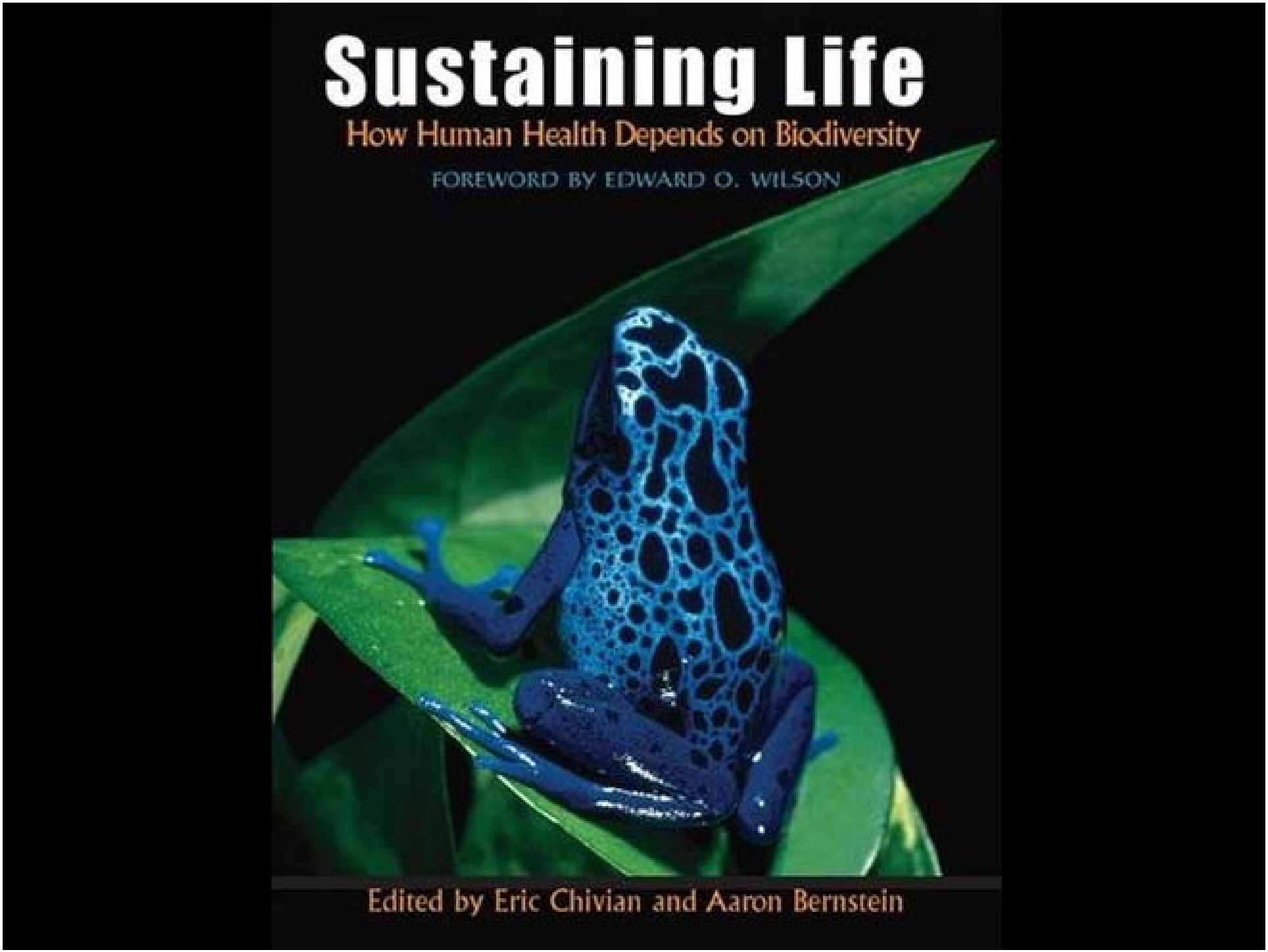
Ogni tentativo di risposta ci porterebbe necessariamente al di fuori del campo della scienza.

Ogni forma di vita è unica, e ne va garantito il rispetto a prescindere dal suo valore per l'uomo (valore strumentale).

*Chelonia mydas* in barriera corallina

Valore strumentale o utilitaristico delle risorse naturali e della biodiversità




Sustaining Life
How Human Health Depends on Biodiversity
FOREWORD BY EDWARD O. WILSON
Edited by Eric Chivian and Aaron Bernstein

# Sustaining Life

## How Human Health Depends on Biodiversity

FOREWORD BY EDWARD O. WILSON

| PROVISIONING SERVICES | REGULATING SERVICES | CULTURAL SERVICES |
|---|---|---|
| Products obtained from ecosystems | Benefits obtained from environmental regulation of ecosystem processes | Nonmaterial benefits obtained from ecosystems |
| • food<br>• fuel wood<br>• fiber<br>• medicines | • cleaning air<br>• purifying water<br>• mitigating floods<br>• controlling erosion<br>• detoxifying soils<br>• modifying climate | • aesthetics<br>• intellectual stimulation<br>• a sense of place |

### SUPPORTING SERVICES

Services necessary for the production of all other ecosystem services

- primary productivity
- nutrient cycling
- pollination

Figure 3.1. A Sampling of Ecosystem Services.

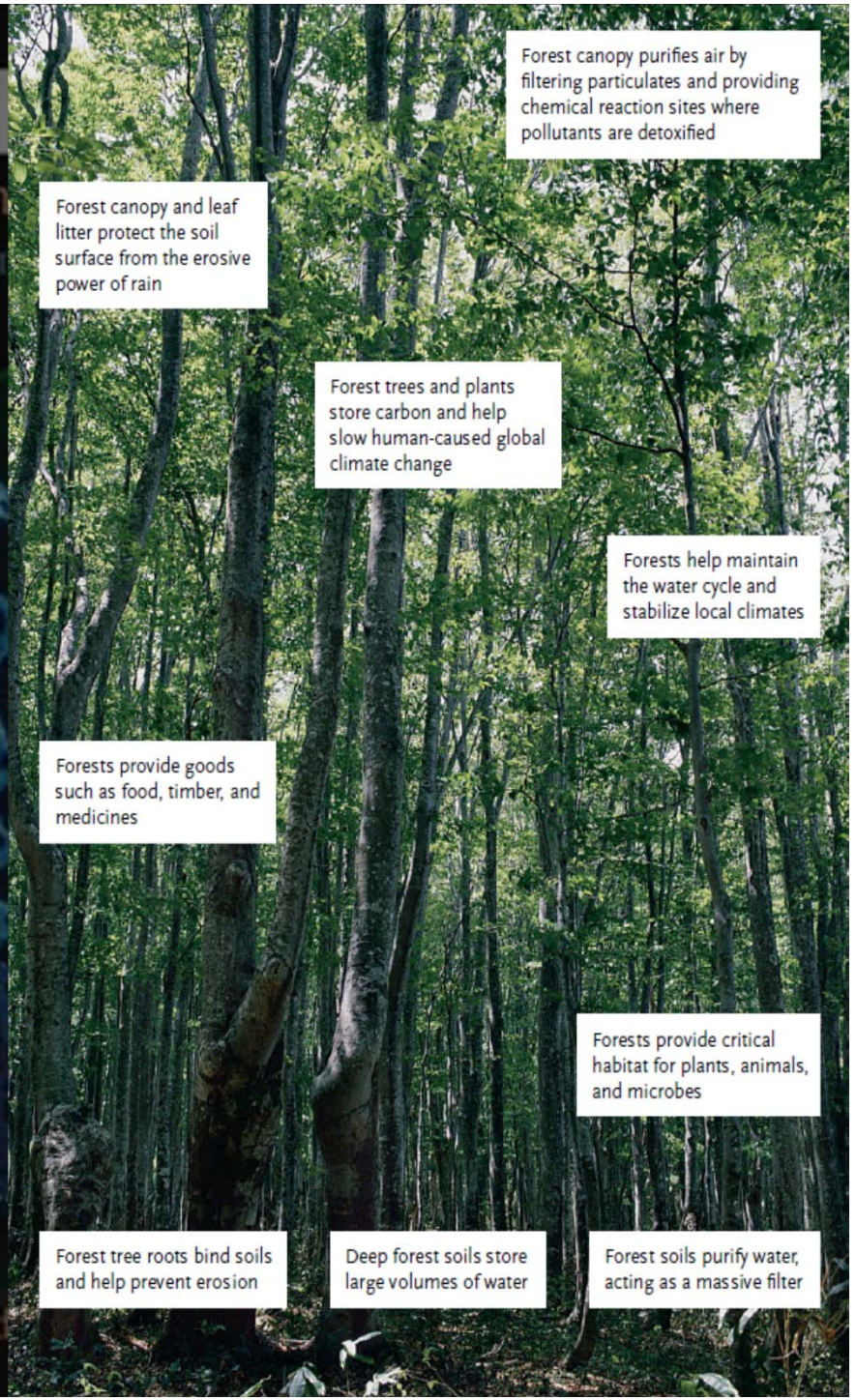
**Esempio: ECOSISTEMI FORESTALI**

A. Parti aeree

1. Protezione nei confronti dell'erosione da pioggia battente
2. Purificazione dell'aria
3. Sequestro di carbonio
4. Mantenimento del ciclo dell'acqua
5. Beni (cibo, legni, medicinali)
6. Habitat

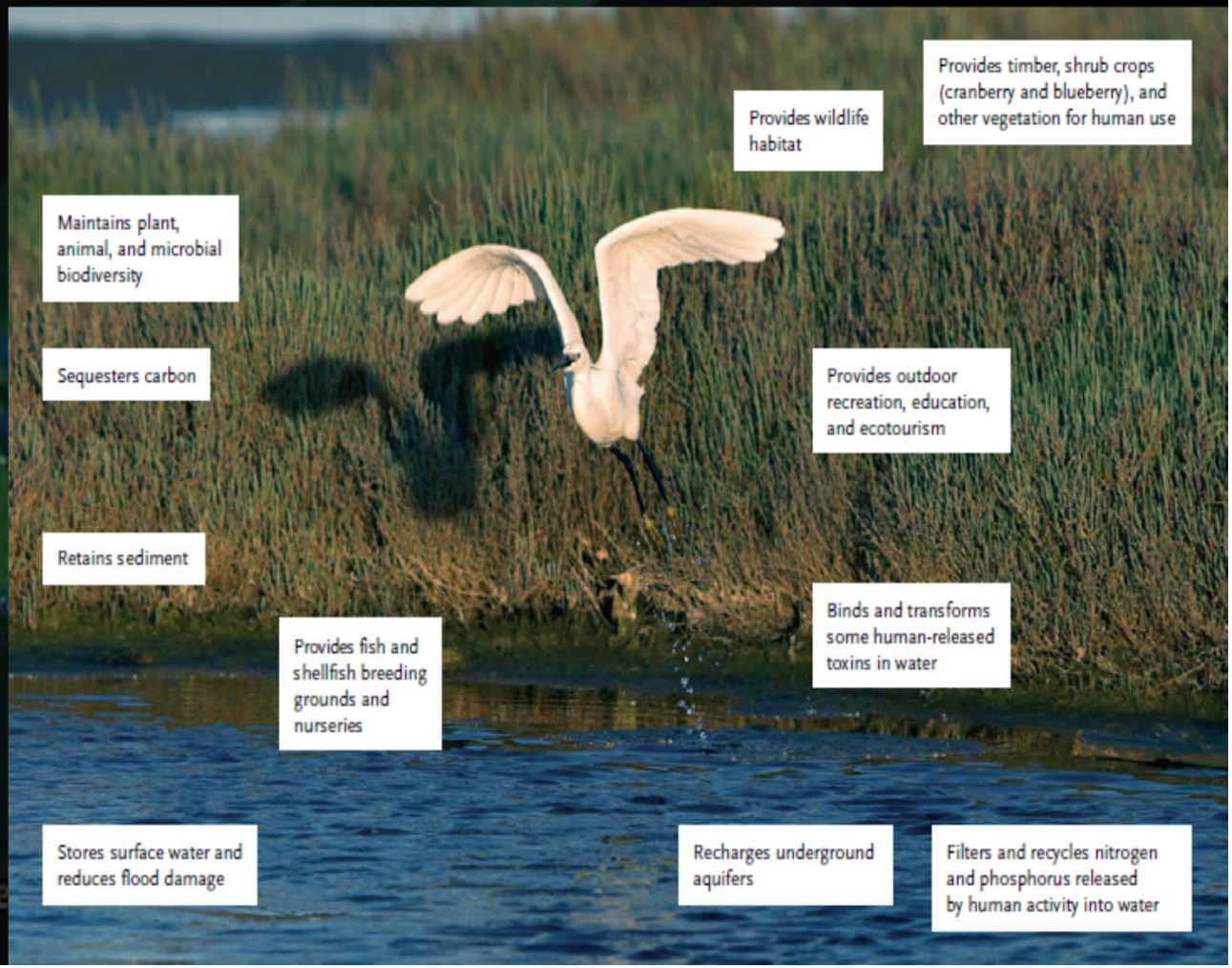
B. Parti sub-aeree

7. Protezione nei confronti dell'erosione da dilavamento
8. Riserva di acqua nel suolo forestale
9. Filtraggio dell'acqua da parte del suolo



**Esempio: AREE UMIDE**

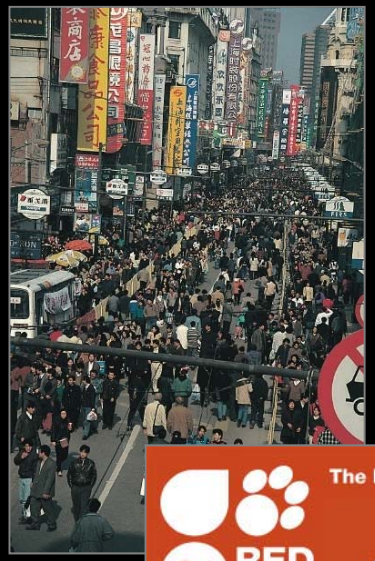
1. Mantenimento delle biodiversità vegetale, animale e microbica
2. Sequestro di carbonio
3. Ritenzione dei sedimenti
4. Habitat per pesci e invertebrati
5. Riduzione della minaccia di straripamento
6. Habitat per la fauna selvatica terrestre
7. Sfruttamento economico dei prodotti vegetali
8. Turismo e ricreazione
9. Chelazione e trasformazione di alcune tossine rilasciate dall'uomo
10. Ricarica degli acquiferi
11. Filtraggio e riciclaggio dei nutrienti (N, P) rilasciati dall'uomo
12. Protezione dalle mareggiate



# Biologia della conservazione

Scopi:

- Studiare l'impatto umano sulla biodiversità
- Sviluppare metodi di azione per impedire l'estinzione delle specie
- Cercare nuove modalità di compromessi fra priorità di conservazione e bisogni umani




# Biologia della conservazione

*The field of conservation biology is a response by the scientific community to the biodiversity crisis.*

*It is a new, synthetic field that applies the principles of*

- *Ecology*
- *Biogeography*
- *Population genetics*
- *Economics*
- *Sociology*
- *Anthropology*
- *Philosophy*
- *and other theoretically based disciplines to the maintenance of biological diversity throughout the world*

*Meffe & Carroll 1994*

# Biologia della conservazione

*... synthetic field that applies the principles of*

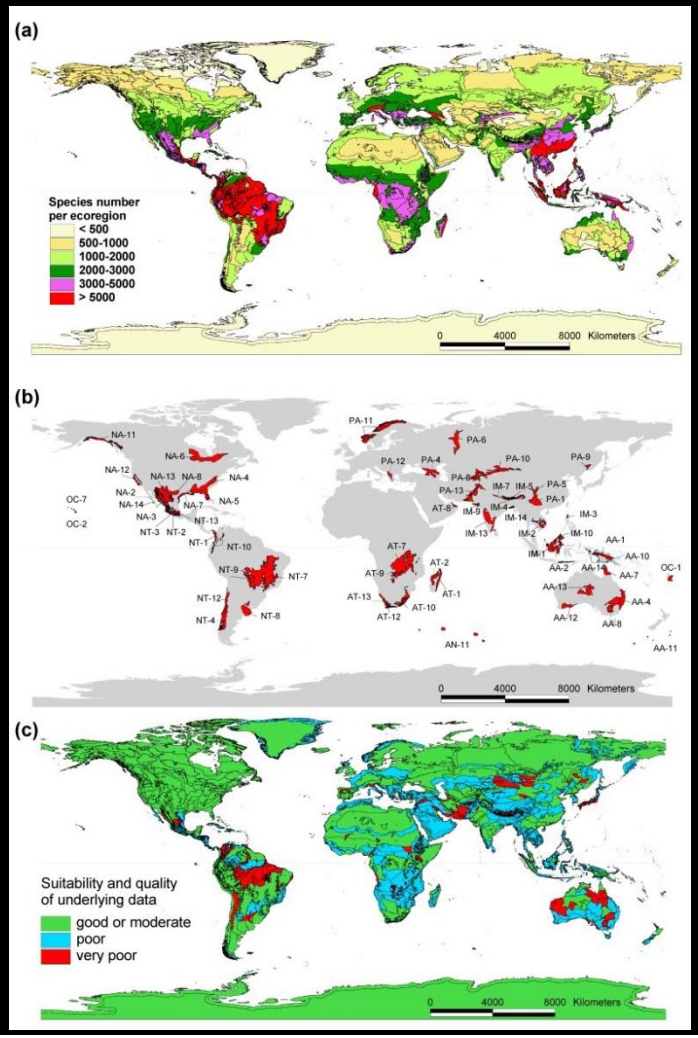
- *Ecology*

Ecologia: disciplina che studia le interazioni che determinano la distribuzione e l'abbondanza degli organismi

# Biologia della conservazione

*... synthetic field that applies the principles of*

- *Biogeography*

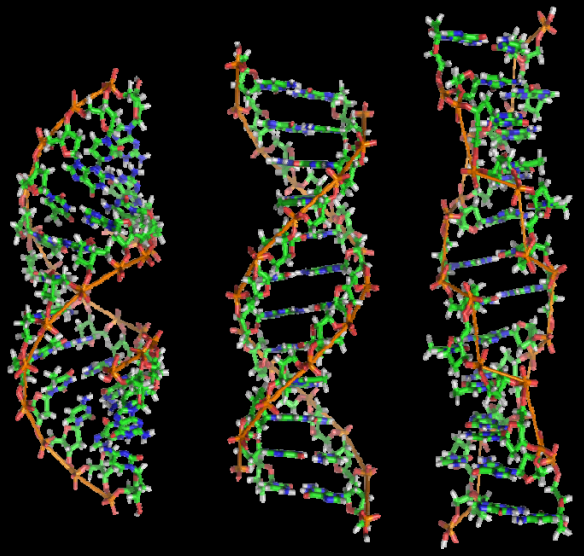



Biogeografia: disciplina che studia la distribuzione nello spazio e nel tempo degli organismi viventi e delle cause che la determinano. Si occupa di indagare estensione, sviluppo, avvicendamento nel tempo e sovrapposizione degli areali delle specie.

# Biologia della conservazione

*... synthetic field that applies the principles of*

- *Population genetics*

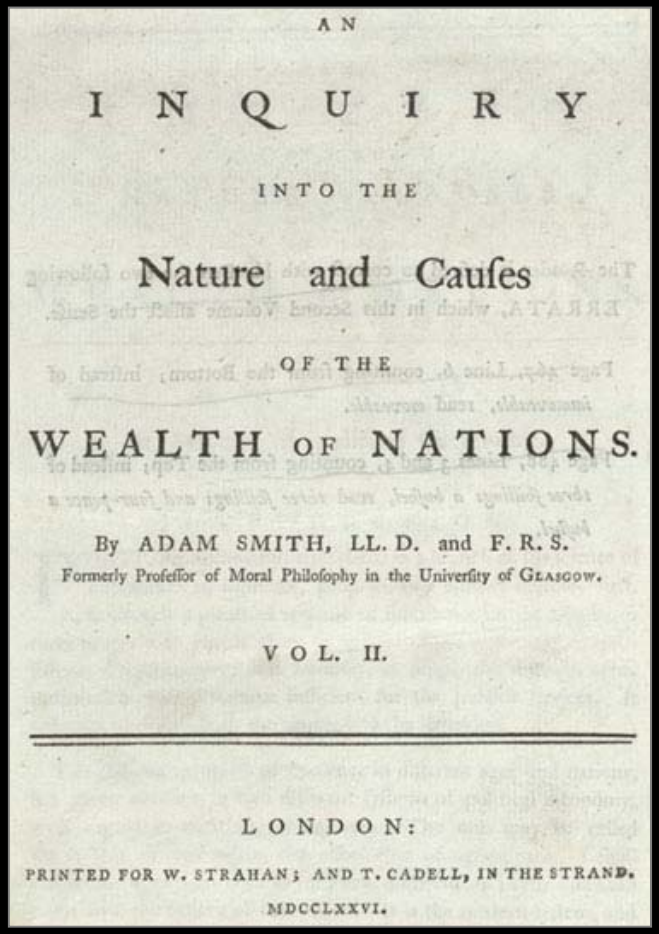


Genetica di popolazione: branca della genetica che analizza la costituzione genetica delle popolazioni mendeliane in termini qualitativi (varianti alleliche presenti all'interno di una popolazione) e quantitativi (frequenze alleliche e genotipiche). La genetica delle popolazioni valuta le modalità con le quali le caratteristiche genetiche sono trasmesse alla progenie evoluzione temporale) ed il variare delle stesse in relazione al territorio (distribuzione spaziale).

# Biologia della conservazione

*... synthetic field that applies the principles of*

- *Economics*



AN

INQUIRY

INTO THE

Nature and Cauſes

OF THE

WEALTH OF NATIONS.

By ADAM SMITH, LL. D. and F. R. S.

Formerly Profeſſor of Moral Philoſophy in the Univerſity of GLASGOW.

VOL. II.

LONDON:

PRINTED FOR W. STRAHAN; AND T. CADELL, IN THE STRAND.

MDCCLXXVI.

Economia [politica]: disciplina che studia il comportamento umano come relazione tra fini e mezzi scarsi suscettibili di usi alternativi; è quindi la disciplina che studia il funzionamento dei sistemi economici.

*Adam Smith, 1776. Wealth of Nations*
*[La ricchezza delle Nazioni]*

# Biologia della conservazione

*... synthetic field that applies the principles of*

- *Sociology*

Sociologia: disciplina che studia le strutture sociali, le loro organizzazioni, le norme ed i processi che uniscono (e separano) le persone non solo come individui ma come componenti di associazioni, gruppi ed istituzioni.

# Biologia della conservazione

*... synthetic field that applies the principles of*

- *Anthropology*

Antropologia: disciplina che studia l'uomo dal punto di vista sociale, culturale, fisico e dei suoi comportamenti nella società.

# Biologia della conservazione

*... synthetic field that applies the principles of*

- *Philosophy*

  Filosofia: disciplina che si pone domande e cerca di dare risposte sul senso del mondo e dell'esistenza umana, e, più specificatamente, il tentativo di studiare e definire le possibilità e i limiti della conoscenza.

*Da dove veniamo? Chi siamo? Dove andiamo?* Paul Gauguin 1848 1903

# Postulati della “Biologia della Conservazione” *(Soulé 1985)*

***POSTULATO: proposizione non dimostrata, ma ammessa ugualmente come vera in quanto necessaria per fondare un procedimento o una dimostrazione.***

1. La diversità biologica è bene che deve essere preservato
2. L’estinzione prematura degli organismi deve essere prevenuta
3. La complessità ecologica è un bene
4. L’evoluzione deve continuare
5. La biodiversità ha un valore intrinseco

# Postulati della “Biologia della Conservazione” *(Soulé 1985)*

## 1. LA DIVERSITÀ BIOLOGICA È BENE CHE DEVE ESSERE PRESERVATO

Alcuni scienziati sostengono che l’uomo abbia una predisposizione genetica, una tendenza innata ad apprezzare la diversità delle forme di vita (*biofilia*)

Fenomeno probabilmente molto importante quando l’uomo cacciatore-raccoglitore visse per migliaia di anni prima della nascita dell’agricoltura

# Postulati della “Biologia della Conservazione” *(Soulé 1985)*

## 2. L’ESTINZIONE PREMATURA DEGLI ORGANISMI DEVE ESSERE PREVENUTA

Le attività umane dell’ultimo secolo hanno determinato un’accelerazione abnorme del tasso di estinzione, che potrebbe essere almeno 1.000 volte superiore a quello normale

# Postulati della "Biologia della Conservazione" *(Soulé 1985)*

## 3. LA COMPLESSITÀ ECOLOGICA È UN BENE

Il funzionamento e il mantenimento dei sistemi ecologici spesso si realizza soltanto in condizioni naturali o comunque poco modificate dall'uomo

# Postulati della “Biologia della Conservazione” *(Soulé 1985)*

## 4. L’EVOLUZIONE DEVE CONTINUARE

I processi evolutivi naturali sono fenomeni che portano all’estinzione delle specie e alla formazione di nuove, determinando in genere in complessivo aumento di biodiversità

Le attività umane che limitano questi fenomeno sono distruttive per la biodiversità

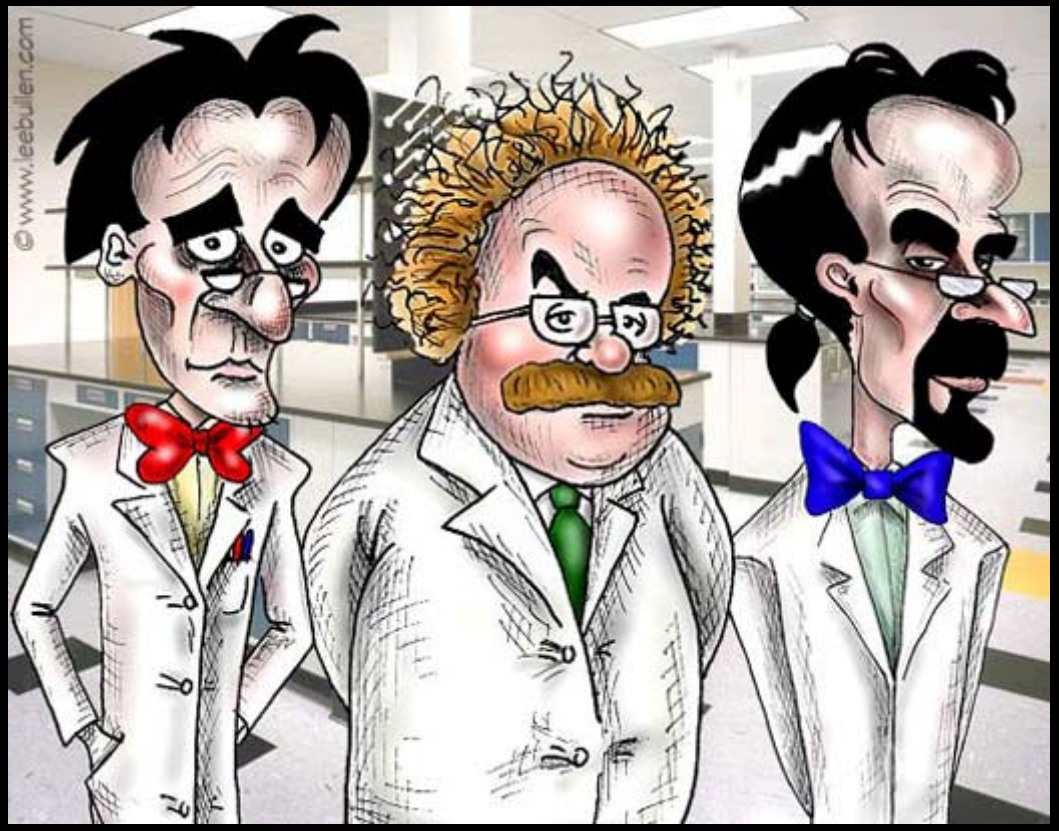
# Postulati della “Biologia della Conservazione” *(Soulé 1985)*

## 5. LA BIODIVERSITÀ HA UN VALORE INTRINSECO

La proprietà intrinseca di esistere, derivata dalla storia evolutiva dei viventi, va rispettata come tale, indipendentemente dal valore che ha per l’uomo

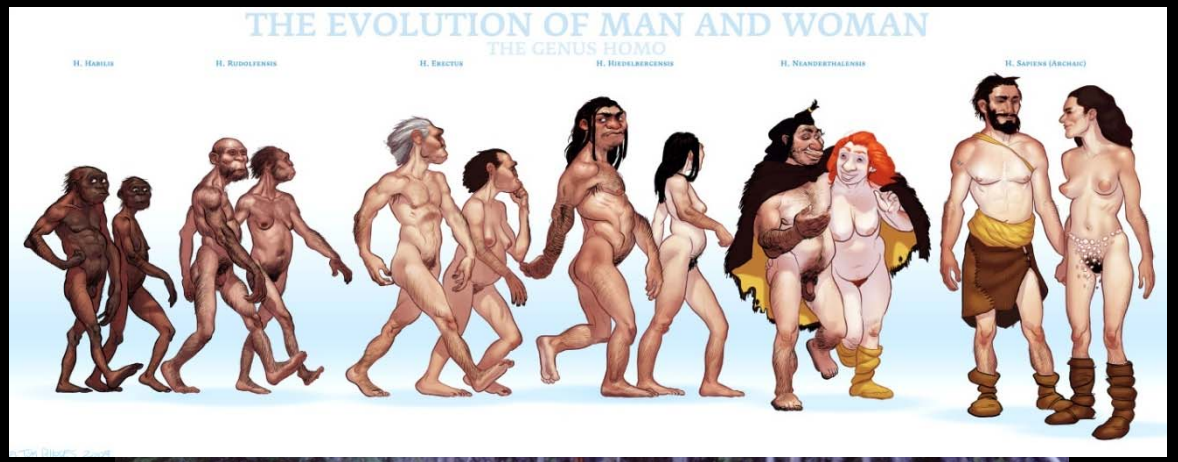
# PARADIGMA

Il punto di vista mondiale condiviso nell'ambito di una comunità scientifica (Kuhn 1972)



# Paradigmi della conservazione biologica

- Evoluzione
- Dinamica
- Presenza umana




- Evoluzione
  - Dinamica
  - Presenza umana

"Nulla ha senso in biologia al di fuori della teoria dell'evoluzione"

*Theodosius Dobzhansky*

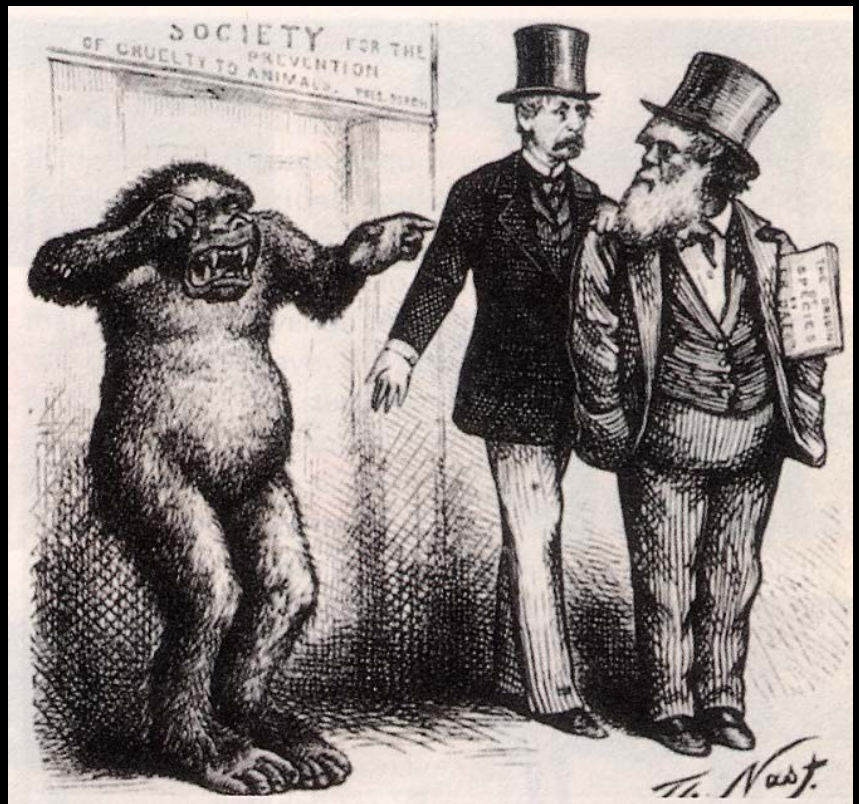
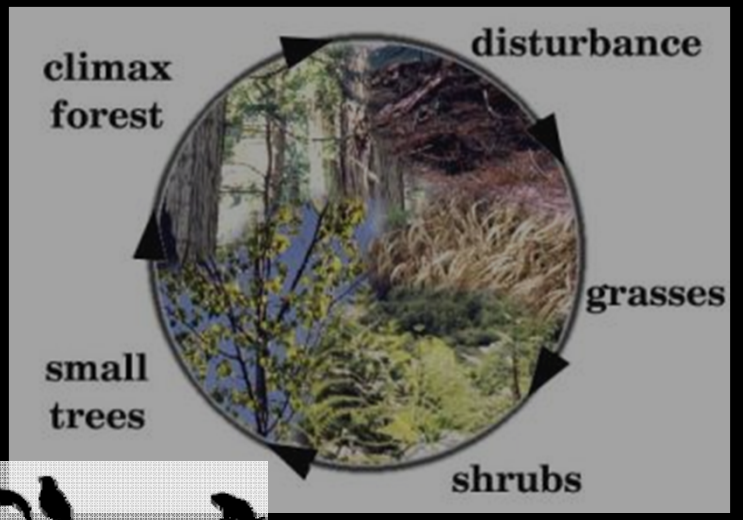



**Figura 2.19** Una delle numerose vignette politiche che comparvero dopo la pubblicazione di *On the Origin of Species*. Questa mostra Darwin e Bergh, il fondatore della Società per la prevenzione delle crudeltà sugli animali. La didascalia così recitava: "Il gorilla defraudato: 'Quell'uomo pretende di rivendicare il mio pedigree. Dice di essere uno dei miei discendenti.' Ed il Sig. Bergh: 'Ora, Signor Darwin, come potete insultarlo?' ".

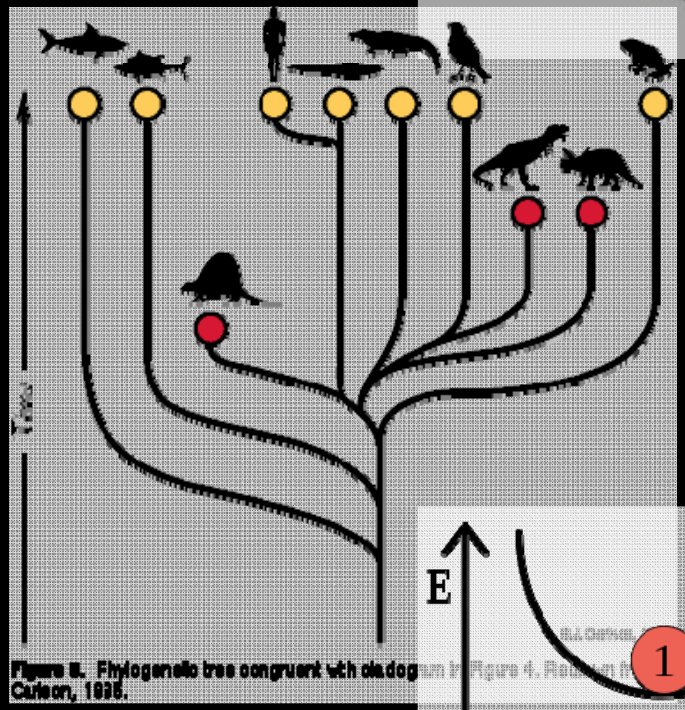
- Evoluzione
- **Dinamica**
- Presenza umana

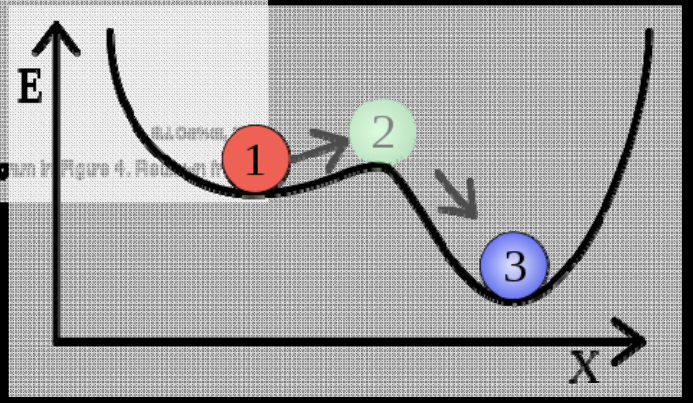



- Il concetto di equilibrio ecologico è fuorviante

- Gli equilibri sono *dinamici e irripetibili*

- I sistemi ecologici sono *meta-stabili*





- Evoluzione
- Dinamica
- Presenza umana

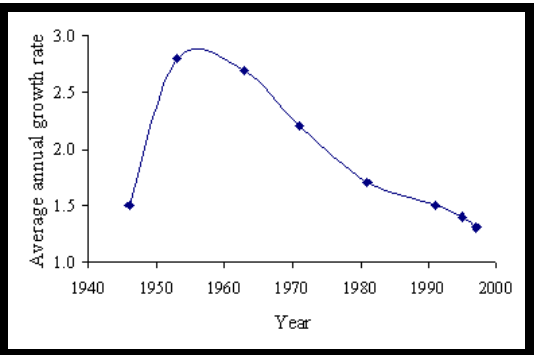
Il concetto di sostenibilità
è relativo e convenzionale



# UN’ULTIMA OPPORTUNITA’ PER IL PIANETA?

# MOTIVI DI SPERANZA

- Vari paesi hanno notevolmente abbassato la propria natalità in un tempo breve
- La distruzione della biodiversità non è dovuta soltanto al numero totale di persone viventi sul pianeta ma anche ai modi in cui costoro vivono e consumano
- Istruzione e sviluppo economico possono notevolmente ridurre la natalità



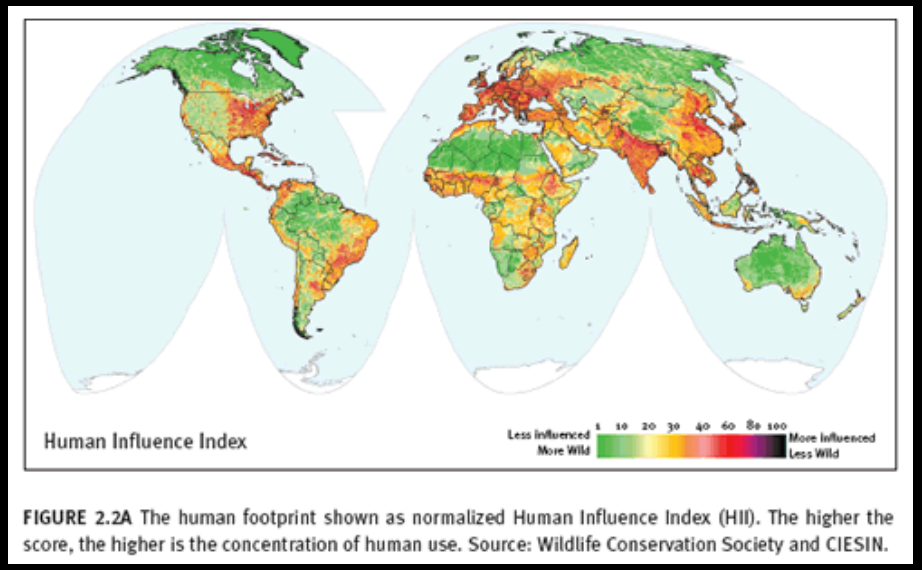
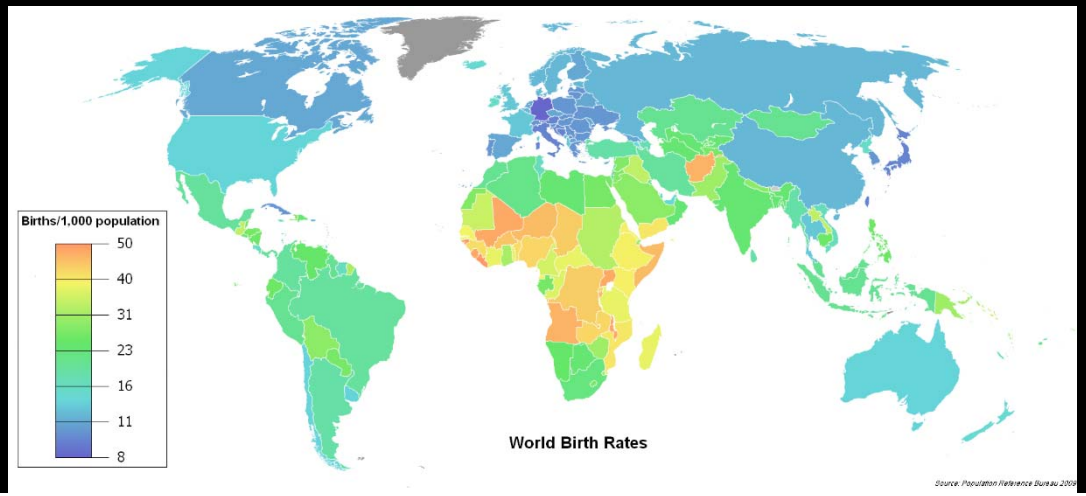
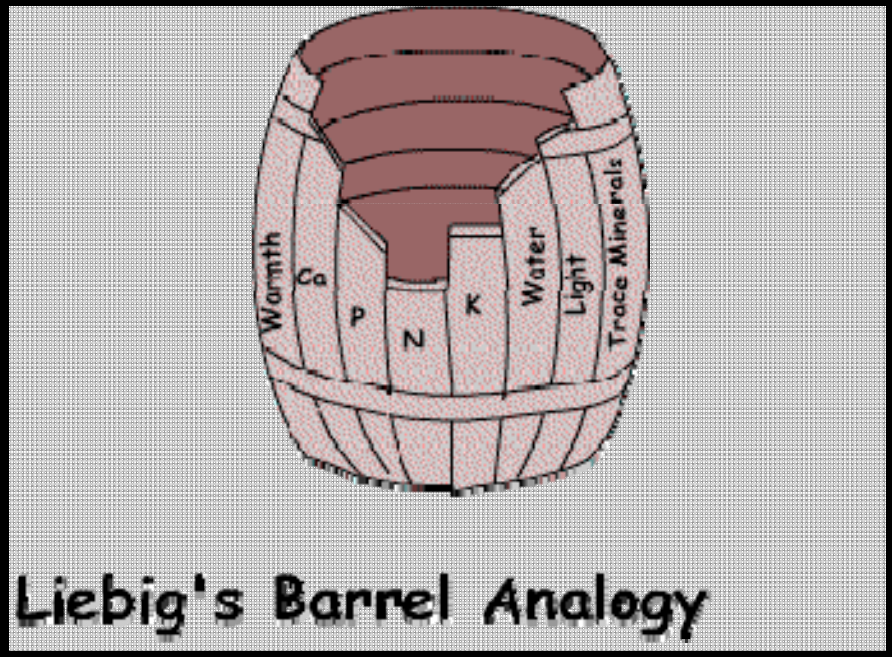




**FIGURE 2.2A** The human footprint shown as normalized Human Influence Index (HII). The higher the score, the higher is the concentration of human use. Source: Wildlife Conservation Society and CIESIN.



# MOTIVI DI PESSIMISMO

Il funzionamento di qualsiasi sistema complesso è condizionato da quello dei suoi componenti meno efficienti



*Non è necessario sperare per intraprendere né aver successo per perseverare*

Guglielmo d’Orange detto il Silenzioso