# Conservation of the Biosphere

Chapter 18

## Conservation efforts often center around…

- Protecting **biodiversity**: the sum total of all living things on Earth
- Biodiversity has been steadily decreasing
- Source of…
  - Intrinsic beauty
  - Knowledge
  - Potential technology and innovation

## Why Conserve?

***Figure 25: Ecosystem services*** *Provisioning services are the products obtained from ecosystems, regulating services are the benefits obtained from the regulation of ecosystem processes, cultural services are the nonmaterial benefits people obtain from ecosystems and supporting services are those services that are necessary for the production of all other ecosystem services. Adapted from the Millennium Ecosystem Assessment, 2005.*

## Global Declines in Biodiversity

- Currently in sixth mass extinction
- Wild and domesticated species
- Ecosystem functions down

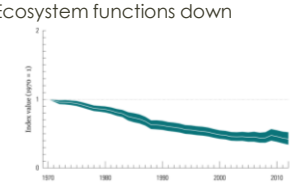
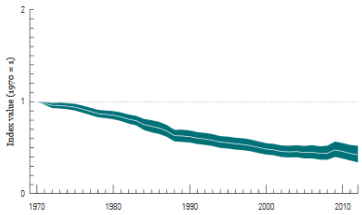
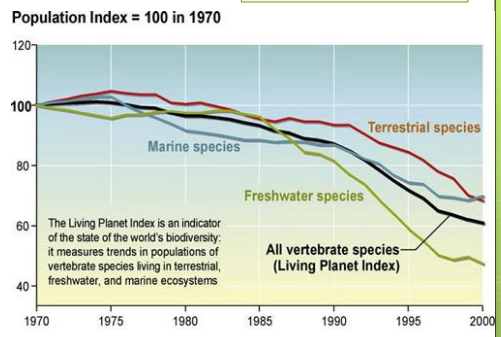
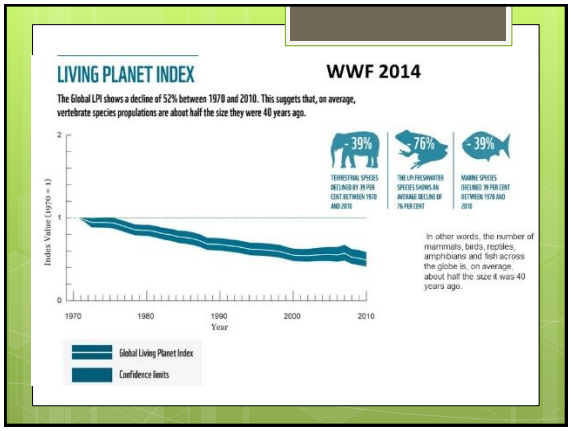
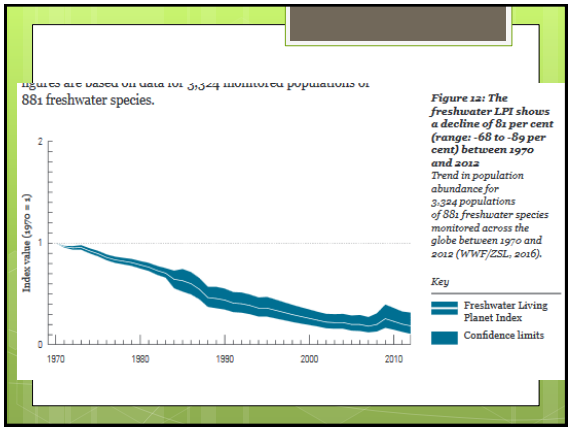


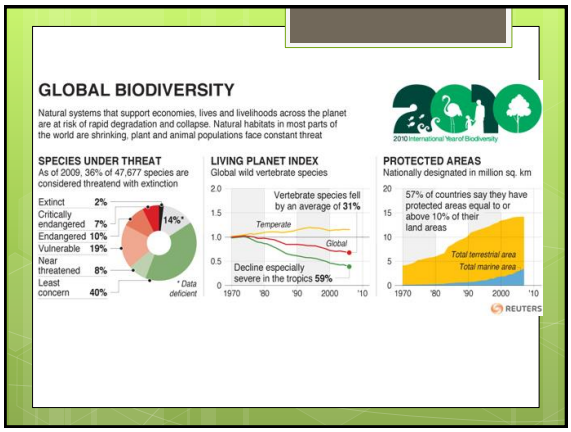

***Figure 2: The Global Living Planet Index shows a decline of 58 per cent (range: -48 to -66 per cent) between 1970 and 2012*** *Trend in population abundance for 14,152 populations of 3,706 species monitored across the globe between 1970 and 2012. The white line shows the index values and the shaded areas represent the 95 per cent confidence limits surrounding the trend (WWF/ZSL, 2016).*




LIVING PLANET INDEX
WWF 2014
The Global LPI shows a decline of 52% between 1970 and 2010. This suggests that, on average, vertebrate species populations are about half the size they were 40 years ago.
- 39%
TERRESTRIAL SPECIES DECLINED BY 39 PER CENT BETWEEN 1970 AND 2010
- 76%
THE LPI FRESHWATER SPECIES SHOWS AN AVERAGE DECLINE OF 76 PER CENT
- 39%
MARINE SPECIES DECLINED 39 PER CENT BETWEEN 1970 AND 2010
Index Value (1970 = 1)
Year
In other words, the number of mammals, birds, reptiles, amphibians and fish across the globe is, on average, about half the size it was 40 years ago.
Global Living Planet Index
Confidence limits


881 freshwater species.
Index value (1970 = 1)
Figure 12: The freshwater LPI shows a decline of 81 per cent (range: -68 to -89 per cent) between 1970 and 2012
Trend in population abundance for 3,324 populations of 881 freshwater species monitored across the globe between 1970 and 2012 (WWF/ZSL, 2016).
Key
Freshwater Living Planet Index
Confidence limits


GLOBAL BIODIVERSITY
Natural systems that support economies, lives and livelihoods across the planet are at risk of rapid degradation and collapse. Natural habitats in most parts of the world are shrinking, plant and animal populations face constant threat
2010 International Year of Biodiversity
SPECIES UNDER THREAT
As of 2009, 36% of 47,677 species are considered threatend with extinction
Extinct 2%
Critically endangered 7%
Endangered 10%
Vulnerable 19%
Near threatened 8%
Least concern 40%
14%*
* Data deficient
LIVING PLANET INDEX
Global wild vertebrate species
Vertebrate species fell by an average of 31%
Temperate
Global
Decline especially severe in the tropics 59%
PROTECTED AREAS
Nationally designated in million sq. km
57% of countries say they have protected areas equal to or above 10% of their land areas
Total terrestrial area
Total marine area
REUTERS

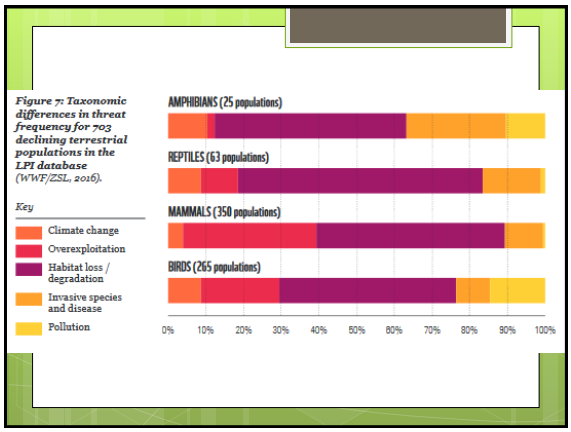
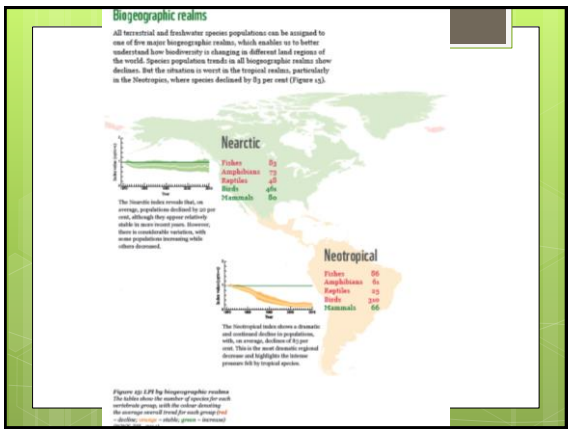


Figure 7: Taxonomic differences in threat frequency for 703 declining terrestrial populations in the LPI database (WWF/ZSL, 2016).
Key
Climate change
Overexploitation
Habitat loss / degradation
Invasive species and disease
Pollution
AMPHIBIANS (25 populations)
REPTILES (63 populations)
MAMMALS (350 populations)
BIRDS (265 populations)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Biogeographic realms
All terrestrial and freshwater species populations can be assigned to one of five major biogeographic realms, which enables us to better understand how biodiversity is changing in different land regions of the world. Species population trends in all biogeographic realms show declines. But the situation is worst in the tropical realms, particularly in the Neotropics, where species declined by 83 per cent (Figure 13).
Nearctic
Fishes 83
Amphibians 73
Reptiles 48
Birds 46
Mammals 60
The Nearctic index reveals that, on average, populations declined by 40 per cent, although they appear relatively stable in more recent years. However, there is considerable variation, with some populations increasing while others decreased.
Neotropical
Fishes 66
Amphibians 61
Reptiles 23
Birds 310
Mammals 66
The Neotropical index shows a dramatic and continued decline in populations, with, on average, declines of 83 per cent. This is the most dramatic regional decrease and highlights the intense pressure felt by tropical species.
Figure 13: LPI by biogeographic realms
The tables show the number of species for each vertebrate group, with the colour denoting the average overall trend for each group (red = decline; orange = stable; green = increase)

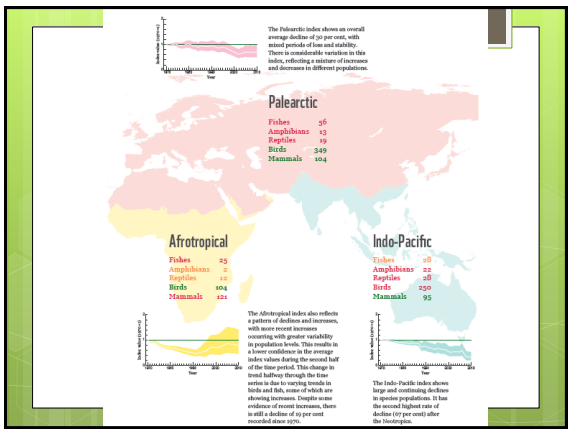

The Palearctic index shows an overall average decline of 30 per cent, with mixed periods of loss and stability. There is considerable variation in this index, reflecting a mixture of increases and decreases in different populations.
Palearctic
Fishes 56
Amphibians 13
Reptiles 19
Birds 349
Mammals 104
Afrotropical
Fishes 25
Amphibians 2
Reptiles 12
Birds 104
Mammals 121
The Afrotropical index also reflects a pattern of declines and increases, with more recent increases occurring with greater variability in population levels. This results in a lower confidence in the average index values during the second half of the time period. This change in trend halfway through the time series is due to varying trends in birds and fish, some of which are showing increases. Despite some evidence of recent increases, there is still a decline of 19 per cent recorded since 1970.
Indo-Pacific
Fishes 28
Amphibians 22
Reptiles 48
Birds 250
Mammals 95
The Indo-Pacific index shows large and continuing declines in species populations. It has the second highest rate of decline (67 per cent) after the Neotropics.

*Figure 3: Humanity's Ecological Footprint*
*1.5 Earths would be required to meet the demands humanity currently makes on nature. For more than 40 years, humanity's demand has exceeded the planet's biocapacity – the amount of biologically productive land and sea area that is available to regenerate these resources (Global Footprint Network, 2014).*

## THREATS

### Habitat loss and degradation

This refers to the modification of the environment where a species lives, by either complete removal, fragmentation or reduction in quality of key habitat characteristics. Common causes are unsustainable agriculture, logging, transportation, residential or commercial development, energy production and mining. For freshwater habitats, fragmentation of rivers and streams and abstraction of water are common threats.

### Species overexploitation

There are both direct and indirect forms of overexploitation. Direct overexploitation refers to unsustainable hunting and poaching or harvesting, whether for subsistence or for trade. Indirect overexploitation occurs when non-target species are killed unintentionally, for example as bycatch in fisheries.

### Pollution

Pollution can directly affect a species by making the environment unsuitable for its survival (this is what happens, for example, in the case of an oil spill). It can also affect a species indirectly, by affecting food availability or reproductive performance, thus reducing population numbers over time.

### Invasive species and disease

Invasive species can compete with native species for space, food and other resources, can turn out to be a predator for native species, or spread diseases that were not previously present in the environment. Humans also transport new diseases from one area of the globe to another.

### Climate change

As temperatures change, some species will need to adapt by shifting their range to track suitable climate. The effects of climate change on species are often indirect. Changes in temperature can confound the signals that trigger seasonal events such as migration and reproduction, causing these events to happen at the wrong time (for example misaligning reproduction and the period of greater food availability in a specific habitat).

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## Habitat loss intense

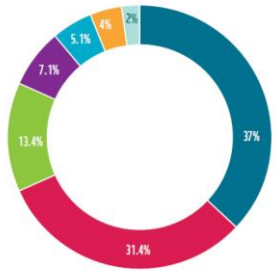


*Figure 11: Primary threats to LPI populations*
*Information on threats has been identified for 3,430 populations in the LPI assigned to seven categories. Other populations are either not threatened or lack threat information (WWF, ZSL, 2014).*

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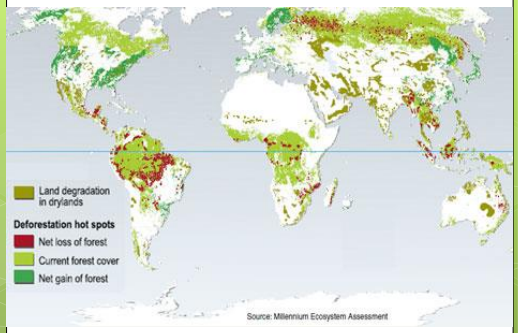
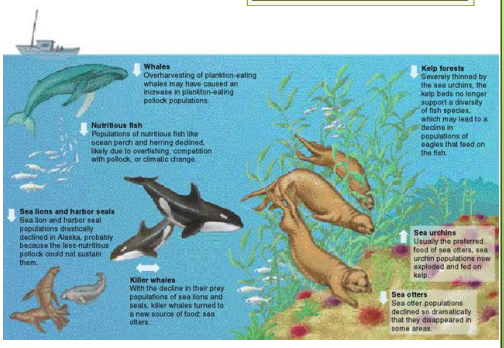



## Invasive Species

## Overharvesting

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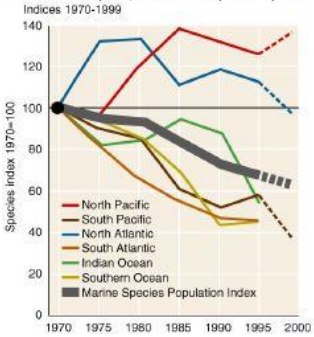
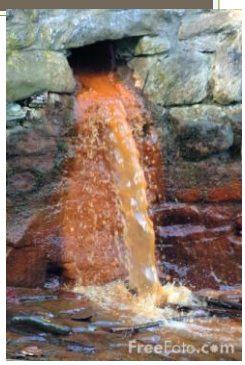
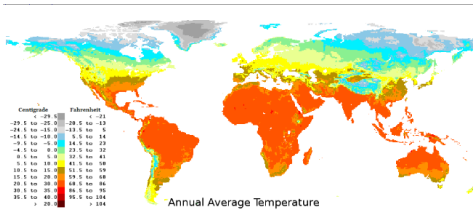
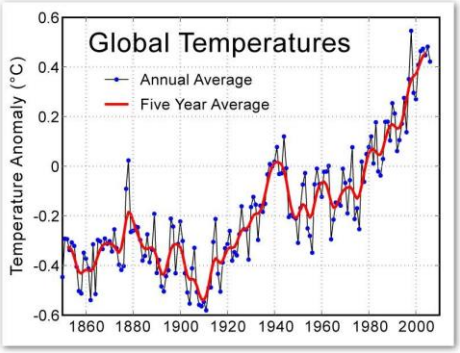



## Pollution




## Climate change



## What's been done?

- US Legislation:
  - Marine Mammal Protection Act – 1972: cannot kill ANY marine mammals in US or import body parts or products
- Global agreements

## CITES

- Convention on International Trade in Endangered Species of Wild Fauna and Flora
- 1973 to control international trade
- Signed by 175 countries
- **Red list**: list of organisms with either strict limitations or some limitations on trade

## Endangered Species Act – 1973

- Implemented CITES
- US Fish and Wildlife determine what's endangered, threatened, at risk
- Government can purchase habitat for these organisms
- Restricts certain human activities in places where endangered organisms live

## Umbrella Species

- Organism that when protected, ends up providing protection for many others
- "High-profile"

## Protecting Regions

- Protecting resources, tracts of land, etc.
- National Parks, preserves, etc.

## Biosphere Reserves

- Protected land that allows some permissible human activity
- Range from no activity to recreation to sustainable harvesting