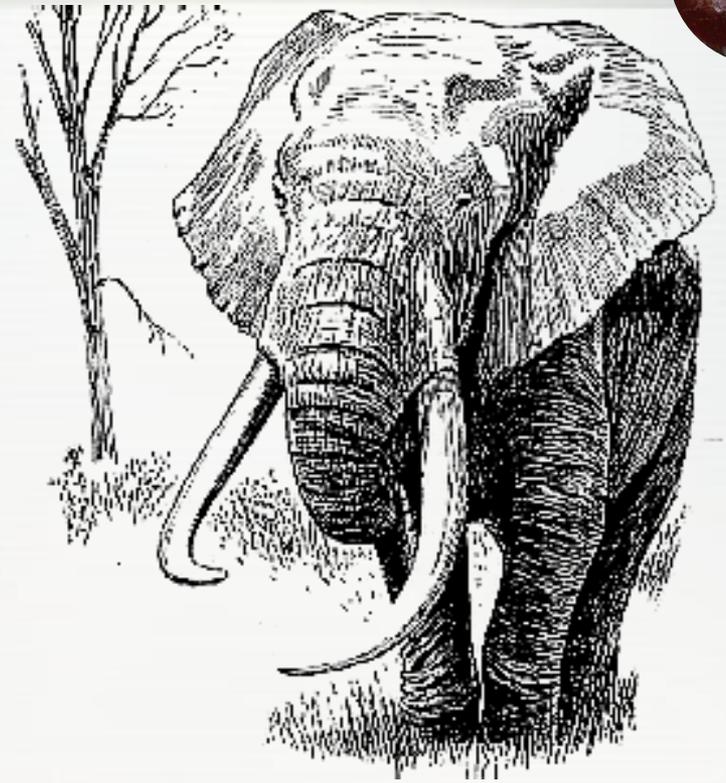


Human Impact on the Environment: Part III



The late Alan Gregg pointed out that human population growth within the ecosystem was closely analogous to the growth of malignant tumor cells, that man was acting like a cancer on the biosphere. The growth of human numbers certainly seems wild and uncontrolled. Four million a month -- the equivalent of the population of Chicago. We seem to be doing all right at the moment; but if you could ask cancer cells, I suspect they would think they were doing fine. But when the organism dies, so do they; and for our own, selfish, practical, utilitarian reasons, I think we should be careful about how we influence the rest of the ecosystem.

Marston Bates



6. BIODIVERSITY LOSS

Biodiversity Loss



Biodiversity: the HUGE variety of animals and plants on our planet, together with the habitats where they're found.

Scientists were startled in 1980 by the discovery of a tremendous diversity of insects in tropical forests. In one study of just 19 trees in Panama, 80% of the 1,200 beetle species discovered were previously unknown to science ... Surprisingly, scientists have a better understanding of how many stars there are in the galaxy than how many species there are on earth.

Biodiversity Loss



- If we don't know how much there is to begin with, we don't know *exactly* how much we're losing.
- But we do have lots of facts and figures that indicate that the news isn't good.
 - The rapid loss of species we are seeing today is estimated by experts to be between 1,000 and 10,000 times higher than the **natural (background) extinction rate**.
 - Experts calculate that between 0.01 and 0.1% of all species will become extinct each year.
 - If the low estimate of the number of species is true (app. 2 million species), between 200 and 2,000 extinctions occur every year.
 - If the upper estimate of species numbers is true (app. 100 million species), between 10,000 and 100,000 species become extinct each year.

Biodiversity Loss



The five mass extinctions in history

Geological time
(millions of years ago)

Era

Effects on biodiversity:
reduction in the
number of species

1

430

late Ordovician

84-85%

2

360

late Devonian

79-83%

3

250

Permian

95%

4

200

Triassic

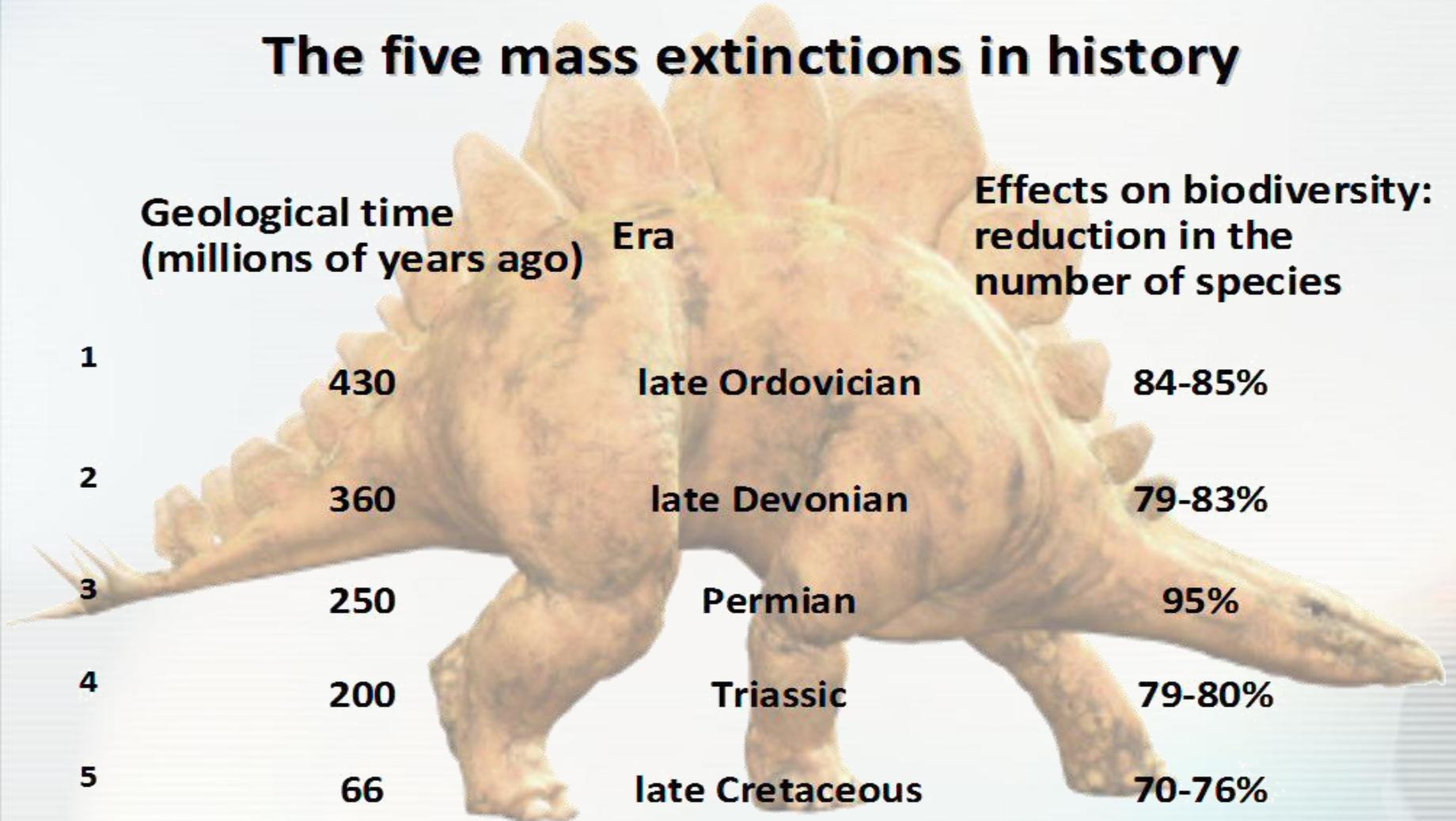
79-80%

5

66

late Cretaceous

70-76%



Biodiversity Loss



The **Living Planet Index** (LPI), which tracks nearly 4,000 populations of wildlife, shows an overall fall in population trends of 52% between 1970 and 2010. (See next slide.)

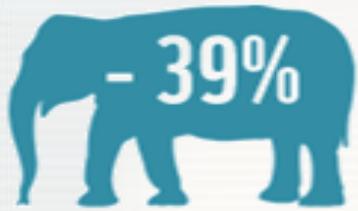
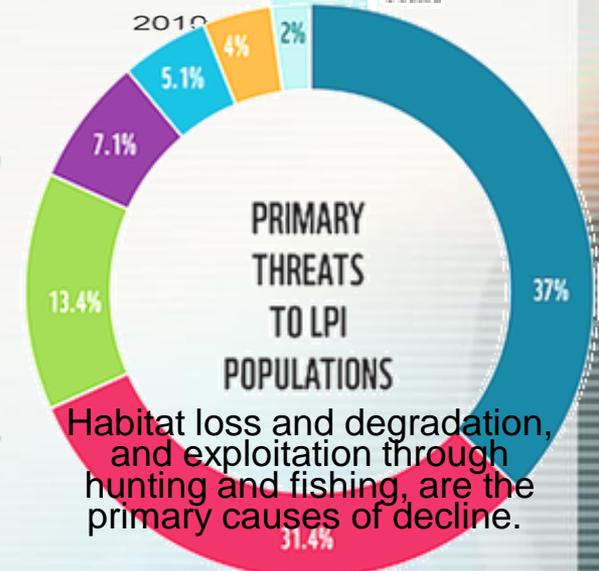
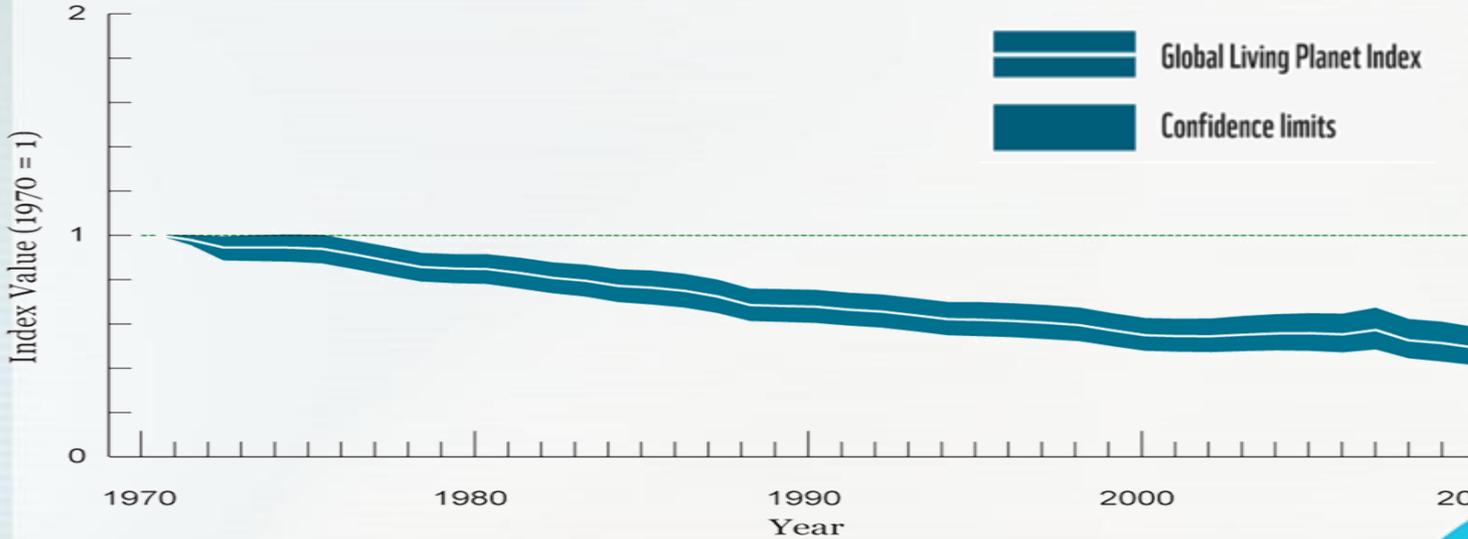
And, unlike the mass extinction events of geological history (previous slide), the current extinction challenge is one for which a single species -- ours -- appears to be almost wholly responsible.

Biodiversity Loss



LIVING PLANET INDEX

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.



TERRESTRIAL SPECIES DECLINED BY 39 PER CENT BETWEEN 1970 AND 2010



THE LPI FRESHWATER SPECIES SHOWS AN AVERAGE DECLINE OF 76 PER CENT



MARINE SPECIES DECLINED 39 PER CENT BETWEEN 1970 AND 2010

Biodiversity Loss Example



The world's great marine predators are being wiped out. Populations of marlin, swordfish, tuna, cod and rays have crashed by more than 90% since the advent of industrial-scale fishing (around 1950). 80% depletion occurred in just the first 15 years of industrial fishing.

Moreover, fish are on average roughly 50% or less of the size they once were. For example, harpooned swordfish in the 1930s averaged 300 lbs. By the mid-1990s they averaged barely 90 lbs.

Biodiversity Loss Example



- **overfishing** -- the amount of fish caught exceeds the amount of fish needed to sustain fish stocks (repopulate) in a given region
- Global fisheries are the largest source of protein on earth, exceeding even all animal husbandry sources. Of those...
 - 52% are exploited at maximum sustainable level
 - 16% are over-exploited
 - 7% are completely depleted
 - 23% can sustain some expansion

Biodiversity Loss Example



Marine environments recover very quickly if left unmolested. After just two years...

- 91% increase in density of organisms
- 192% increase in biomass of organisms
- 31% increase in average size of organisms
- 23% increase in species diversity

But ... To picture how many fish can be caught at one time by one **factory trawler**, imagine a net as large as four football fields, with a circumference at the mouth of the net big enough to encompass three Statues of Liberty standing head-to-toe.

Biodiversity Loss

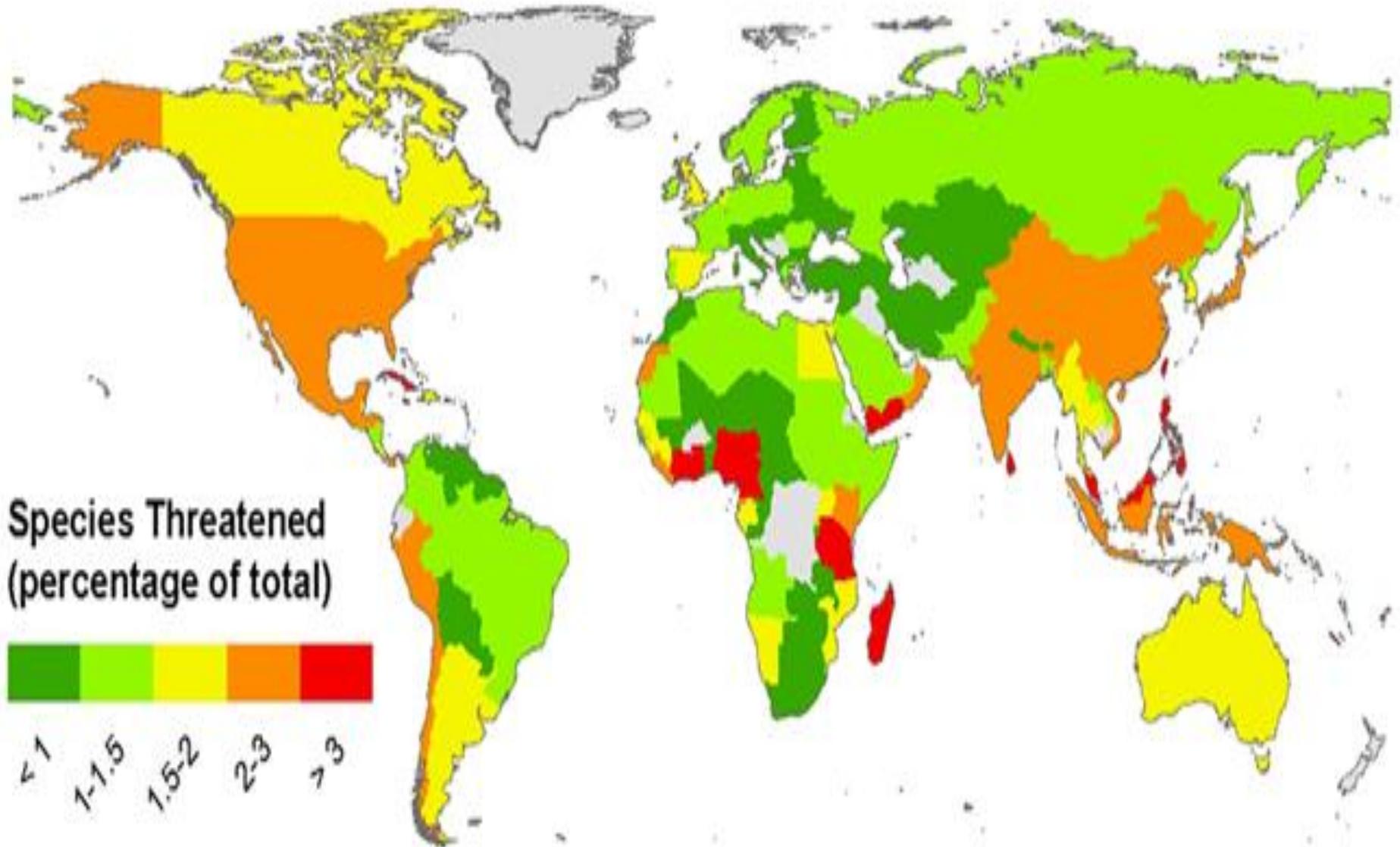


Species threatened with extinction for some classes of vertebrates

	Estimated number of species	Endangered Species	Examples
Mammals	4500	505	black rhino, tiger (and other cats), African elephant, giant panda, Javan gibbon, various canids and deer, porcupines and other rodents, marsupials
Birds	9500	1029	Mauritius kestrel, Philippine eagle and other raptors, Spix macaw and other parrots, American cranes, ducks, geese, swans, swallows
Reptiles	6000	167	lizards, boas, monitor lizards, tortoises, iguanas

The Dodo (*Didus* sp.)

Biodiversity Loss



Biodiversity Loss



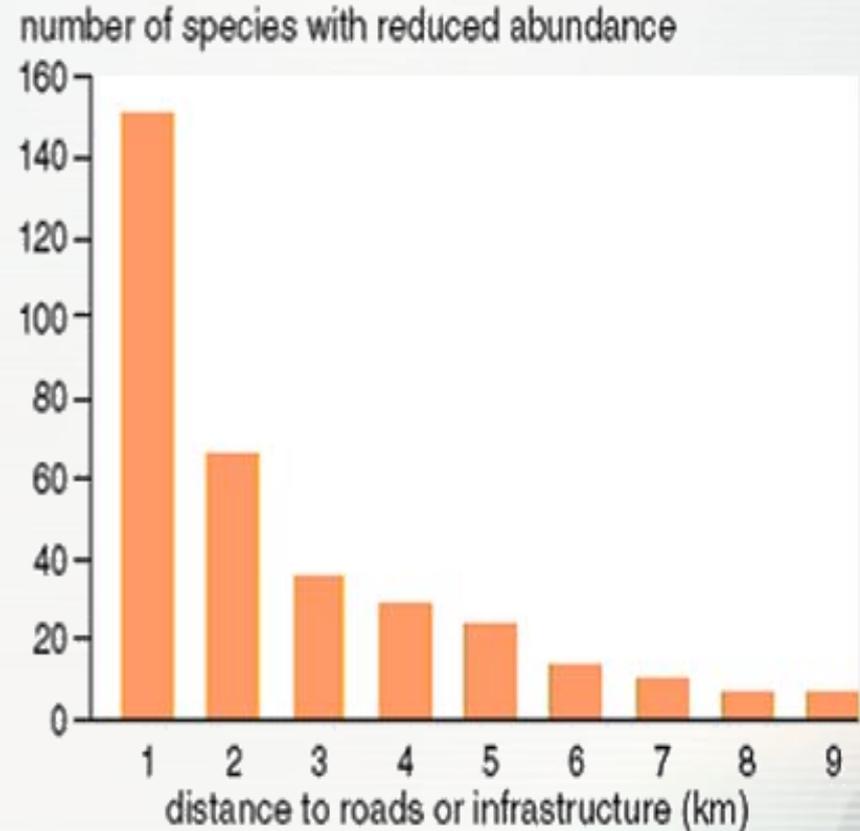
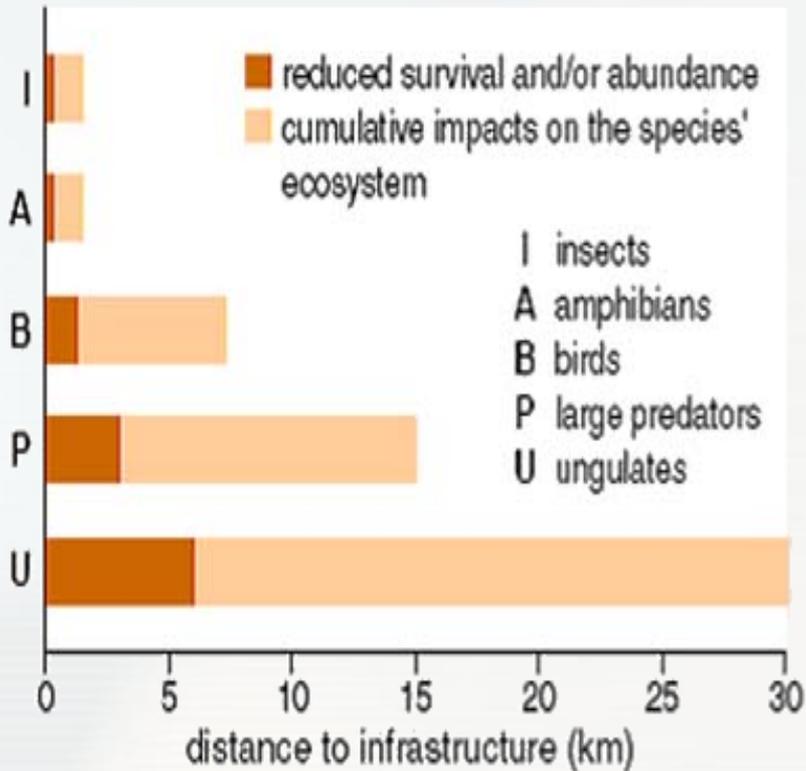
The main cause of the loss of biodiversity can be attributed to the influence of human beings on the world's ecosystems.

Humans have altered the environment, modified the territory, exploited species directly (for example by fishing and hunting), changed the biogeochemical cycles and transferred species from one area of the planet to another.

Biodiversity Loss



How can simply building a road affect all species in an area, including humans?



Distances from roads and other infrastructure within which reduced survival or reduced abundance of wildlife was observed

Synthesized from >100 studies and 151 species

Biodiversity Loss



The threats to biodiversity include:

- **Alteration and loss of habitats:** The transformation of natural areas determines not only the loss of vegetation species, but also a decrease in the animal species associated with them.
- **Introduction of exotic species and genetically modified organisms:** Species originating from a particular area, introduced into new natural environments can lead to different forms of imbalance in the ecological equilibrium.
- **Pollution:** Human activity influences the natural environment producing negative direct or indirect effects that alter the flow of energy, the chemical and physical makeup of the environment and the abundance of species.

Biodiversity Loss



The threats to biodiversity include (continued):

- **Climate change:** Heating of the earth's surface affects biodiversity because it endangers all species adapted to the cold due to latitude (polar species) or altitude (mountain species).
- **Overexploitation of resources:** When activities connected with capturing and harvesting (hunting, fishing, farming) a renewable natural resource in a particular area is excessively intense without leaving enough time for organisms to reproduce, the resource itself may become exhausted ... for example, sardines, herrings, cod, tuna, etc.

Biodiversity Loss



The threats to biodiversity include (continued):

- **Agriculture:** The dramatic increase in the number of humans has instigated a concomitant growth in agriculture, and has led to conversion of wild lands to croplands, massive diversions of water from lakes, rivers and underground aquifers, and has polluted water and land resources with pesticides, fertilizers and animal wastes. The result has been the destruction, disturbance or disabling of terrestrial ecosystems, and polluted, oxygen-depleted and atrophied water resources.
- **Human population growth:** The geometric rise in human population levels exacerbates every other factor having an impact on biodiversity.

Biodiversity Loss



As a result of human activities, plants and animals are becoming extinct at a faster rate than the planet has ever previously experienced.

If they were to survive, scientists believe many of the disappearing plants could become useful to humans as medicines, foods and industrial products.

Biodiversity Loss



Biodiversity Loss



- The effects of biodiversity loss include:
- decreases in...

stabilization and moderation of the earth's climate	generation and renewal of soil fertility, including nutrient cycling	moderation of floods, droughts, temperature extremes and wind
provision of shelter and building materials	provision of food, fuel and fiber	purification of air and water
control of pests and diseases	detoxification and decomposition of wastes	pollination of plants, including many crops
food security	cultural and aesthetic benefits	ability to adapt to change
- decreased ability to maintain genetic resources key to crop varieties, livestock breeds, medicines and other products
- decline in plant production

Biodiversity Loss



STATE OF GLOBAL BIODIVERSITY

Terrestrial



Freshwater



Marine



The benefits that people obtain from ecosystems

ECOSYSTEM SERVICES

Provisioning services

- food
- medicine
- timber
- fibre
- bioenergy



Regulating services

- water filtration
- waste decomposition
- climate regulation
- crop pollination
- regulation of some human diseases



Supporting services

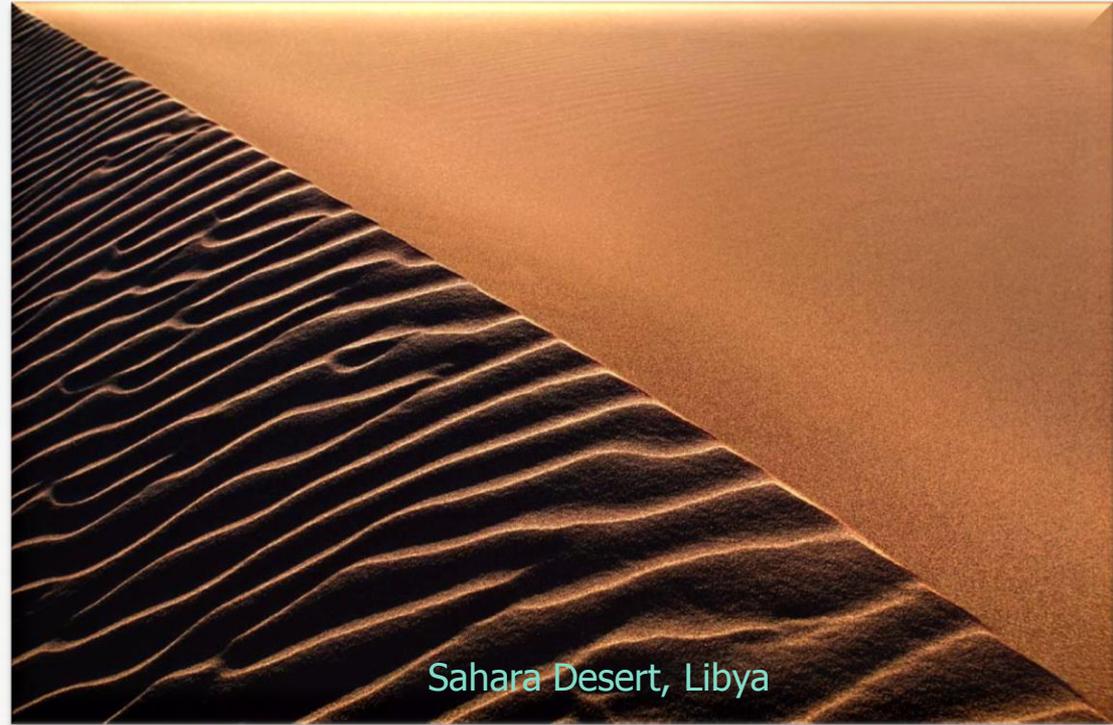
- nutrient cycling
- photosynthesis
- soil formation



Cultural services

- enriching
- recreational
- aesthetic
- spiritual





Sahara Desert, Libya

7. DESERTIFICATION

Desertification



Desertification is the process by which environments become more like desert.

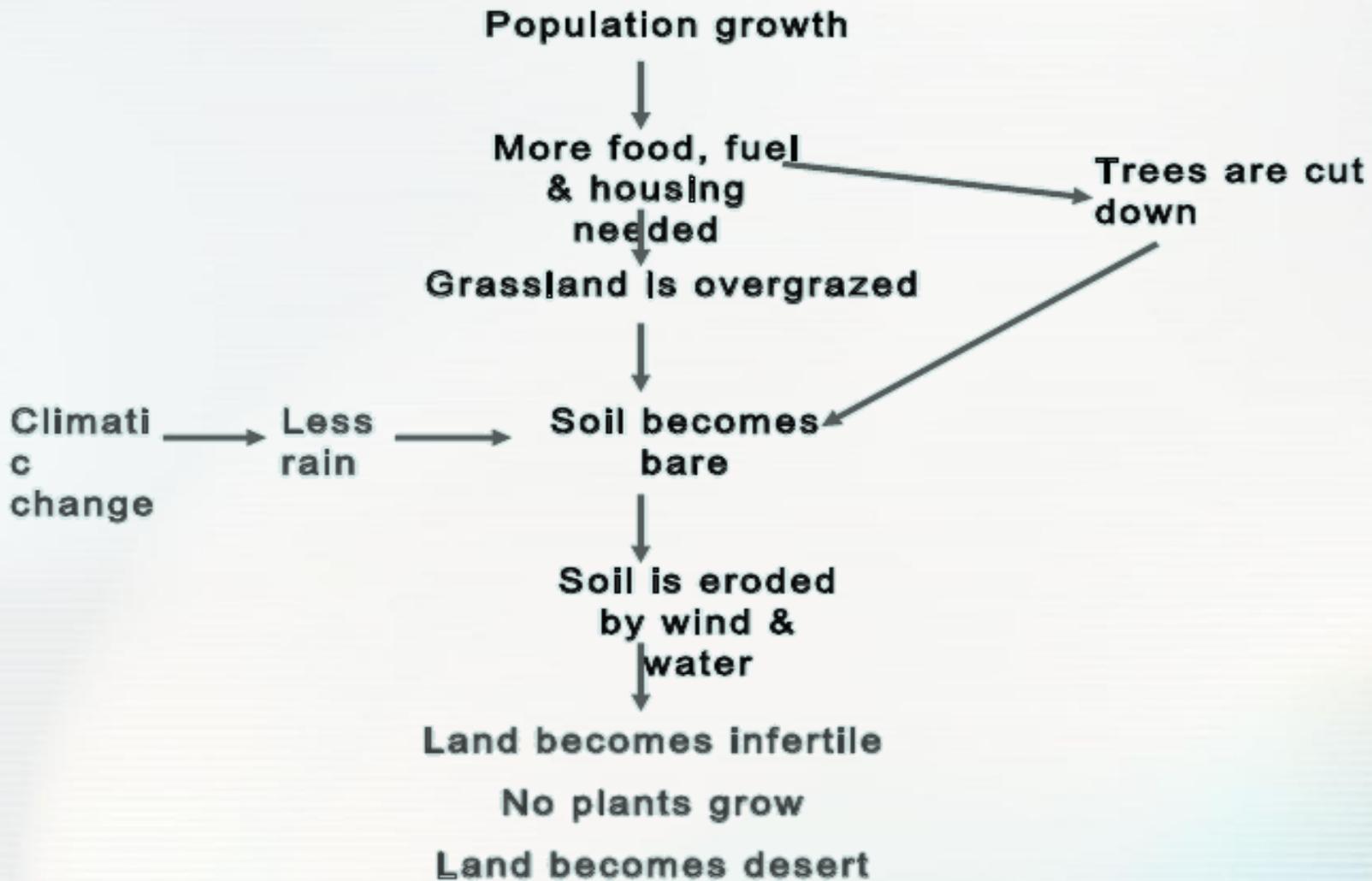
It is a land degradation process that involves a continuum of change, from slight to very severe degradation of the plant and soil resources.



Desertification



Desertification ~ the process

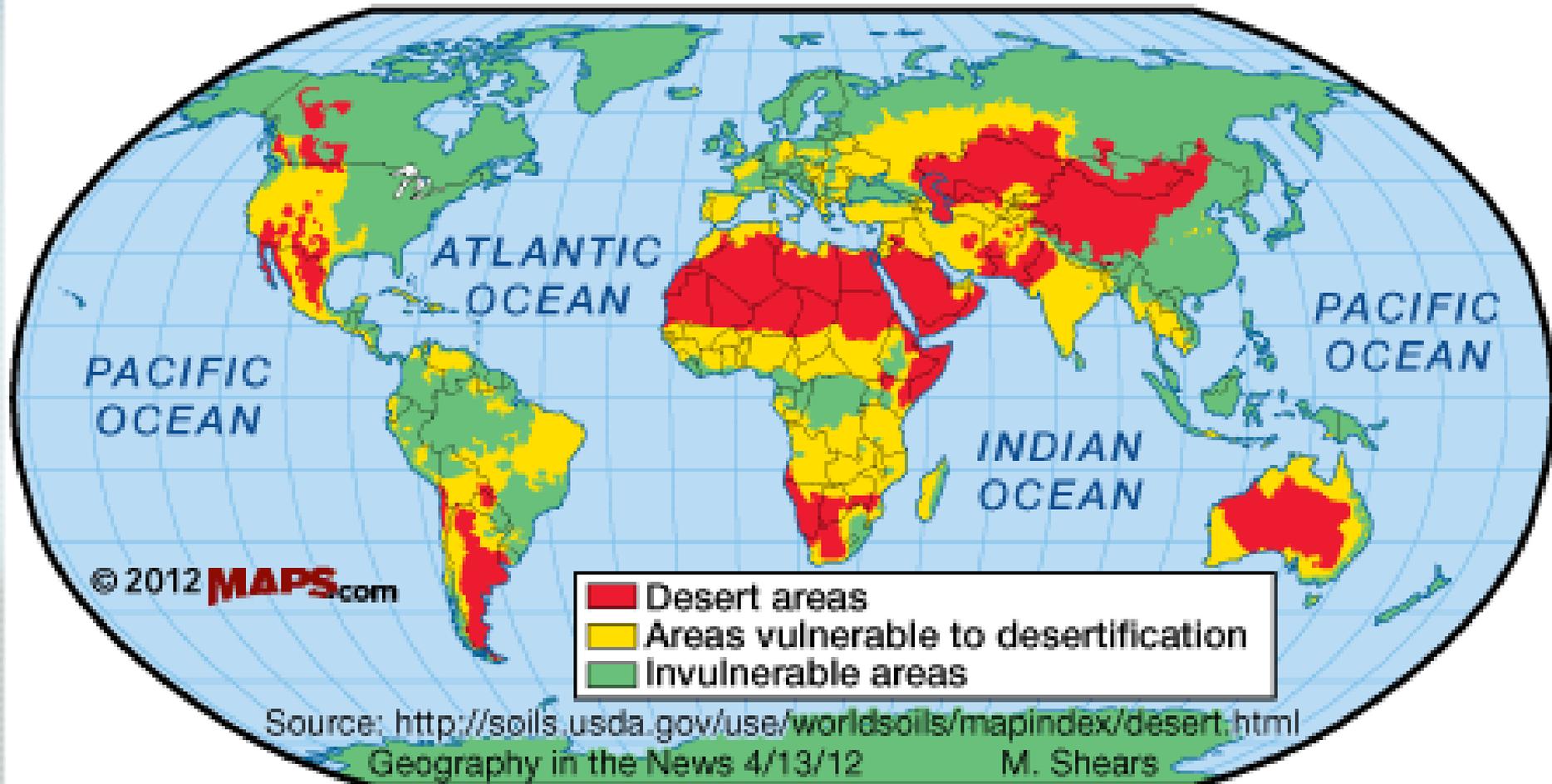


Desertification



- Almost 25 million acres of arable land are lost annually.
- Earth loses 24 billion tons of topsoil annually.
- Asia contains the largest amount affected of land – just under 3,459.4 million acres.
- Occurring in 70% of all dry lands, or $\frac{1}{4}$ of earth's total land area.
- By 2020, 135 million risk losing their land to desertification already in progress, of whom 60 million live in Sub-Saharan Africa.
- Costs more than \$40 billion annually in lost productivity.
- Dust storms originating on China's affected land have reached as far as North America.

Desertification



Desertification



- A combination of overcultivation, overgrazing, deforestation and climate change transform marginal land into a desert area.
- As a result, agricultural output decreases and/or the habitats available to native species are lost.

Desertification



Practices such as the following can reverse desertification in some cases.

- tethering live stock to limit their grazing area
- diversifying the types of crops and trees grown to enhance soil binding, preventing erosion
- reducing deforestation by cutting back branches on trees allowing them to grow back rather than cutting down whole trees
- limiting grass burning to small areas to prevent wildfires

Desertification



Desertification's most serious effects are on those people who already live in poverty because it makes it even harder for them to make a living from the land.

It is estimated that 90% of the people who are affected by desertification live in the world's poorer countries.

Desertification



The effects of desertification include:

- decreased crop yields
- famine
- increased irrigation demands
- decreased supply and quality of fresh water
- increased competition for water
- Soil becomes less usable, can be blown away by wind or washed away by rain.

Desertification



The effects of desertification include (continued):

- Salt can build up in the soil.
- Vegetation damaged, loosened soil may bury plants or leave roots exposed.
- Plant species may be lost to overgrazing.
- Soil no longer suited for growing food.
- flooding, poor water quality, dust storms, pollution
- Water cycle breaks down.



Continued in
Human Impact on the Environment
Part IV