HUMAN IMPACT on the BIOSPHERE - Chapter 6

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**HUMAN POPULATION**

- Current world population is just over **7 BILLION**
- Estimates predict it will reach 9 billion by 2050

**ECOSYSTEM SERVICES...THINGS THE PLANET DOES FOR US!**

- **SUPPORT SERVICES**
- **RESOURCES**
- **REGULATION**
- **AWESOMENESS**

- **SUPPORT SERVICES** - Recycle nutrients, purify water, form new soil, produce oxygen, clean pollution
- **PROVIDE RESOURCES** - Light, food, fuel, medicines building materials, paper, soil
- **REGULATION** of Earth's processes - Absorb carbon, filter water, natural pest control, moderate climate, prevent erosion, flood control, water storage
- **Just plain AWESOMENESS** - Homes for wildlife, recreation, inspiration

The ability of ecosystems to provide these services depends on **BIOLOGICAL DIVERSITY OR BIODIVERSITY** = a measure of the variety of organisms present in different ecosystems.

**Where can you find Biodiversity?**
- Tropical Regions of the world contain 2/3 of all land species on Earth
- Biodiversity increases as you move toward the Equator
- **BIODIVERSITY** makes ecosystems more **STABLE**
- Ecosystems with **MORE** biodiversity are better able to resist **DISTURBANCES** such as species loss, pollution, invasive species, urban development, climate change, etc.

**VOCAB**
- Species that has died out = **extinct**
- Species whose population size is rapidly declining and will become extinct if the trend continues = **endangered**
- Species that is at risk of becoming endangered in the near future = **threatened**
The declining population of one species can affect an entire ecosystem.

Question: What would happen to this ecosystem if kelp forest were destroyed?

A **RESOURCE** is anything an organism needs for life

**NATURAL RESOURCES** =

- **LAND**
- **AIR**
- **WATER**
- **FORESTS**

**NONRENEWABLE RESOURCES** - can NOT BE replenished by natural processes

EX: --> LAND --> Gasoline (fossil fuels) --> (What Else?)

**RENEWABLE RESOURCES** - can be replenished

- Living can **regrow**
- Non living replaced by **Biogeochemical cycles**
- **RENEWABLE** does **NOT** mean UNLIMITED!

Ex: **Fresh water** is a resource that is **RENEWABLE BUT LIMITED**

Drought or overuse makes water in short supply

**FRESH WATER RESOURCES**

Wetlands remove **pollutants** and **purify** the water passing through.

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**HUNTING AND GATHERING**

Throughout human history, people have **hunted** and **fished** in rivers, and **gathered** wild seeds, fruits, and nuts. We are still doing this today in many places.
WHEN IT BECOMES A PROBLEM?

OVERHUNTING & POACHING

Since the 1900's over-hunting has led to a severe overkill of whale populations, and to endangerment of many whale species. The Environmental Defense Fund (EDF) reports that 87% of the world's fish stocks are classified as overexploited or fully exploited.

North American Buffalo

Wild buffalo in America once numbered 30 – 60 million, ranging from Virginia to Alaska. By 1884, the buffalo was close to extinction due to overhunting.

WHY POACH? Many endangered big game animals today are threatened by Illegal poaching

EXAMPLE: Rhinos

All five rhino species are endangered. Just a few decades ago, the world’s rhino population exceeded 100,000, but today there are less than 11,000 due to habitat loss and poaching. Rhino horns are in demand in many countries where they can bring over $60,000/lb.

~ ground into medicine (China)

~ carved into ceremonial dagger handles (Yemen)

HOW DO WE HELP?

Preserves/Sanctuaries

Captive breeding programs

Laws/regulations

Support “GREEN” organizations

PRESERVES / SANCTUARIES

Preserving habitat

Establishing protected areas

Game ranger patrols to prevent poaching

Education

How do we help?

Captive breeding - Animals are raised and protected in zoos until population is stable, then returned to wild

Conservation efforts, private ownership, and reintroduction of buffalo have allowed the population to recover.

Today—total bison population in North America is estimated at 500,000. About 85 percent of these animals are privately owned.

LAWS/REGULATIONS

International Whaling Commission has placed a moratorium on whaling for certain species. Only works if nations voluntarily comply The Convention on International Trade in Endangered Species (CITES) bans international trade in products from endangered species.

Support “Green” organizations that work for laws to establish quotas and protect species. Scientists estimate there are 10-30 million plant and animal species on the planet. Most of these are unidentified. Some scientists estimate at the rate we are going 1/4 of the plants and animals will be committed to extinction by 2050
International Union for Conservation of Nature (IUCN) RED LIST = world’s main authority on the conservation status of species. 22,214 threatened species worldwide. In 2012, 3079 animals and 2655 plants classified as Endangered worldwide compared with 1102 animals and 1197 plants in 1998 AND NUMBERS ARE INCREASING!. It is believed that some 10,000 species have gone extinct in just the past 100 years. At current rate estimates predict between 200-2000 extinctions per year.

Species Extinctions Since 1800

**IMPACT OF AGRICULTURE**
By end of last ice age (about 11,000 years ago) humans began the practice of farming = AGRICULTURE
Soon people around the world were growing crops and raising animals for food

Agriculture
• one of most IMPORTANT developments in human history.
• Provided food in large quantities that could be stored for later.
• Allowed people to stay in one place
• Lead to: cities, governments, laws, and writing.

Importance of Agriculture
By middle of 20th century, despite agricultural advances there were food shortages in many parts of the world. Governments and scientists began a major effort to increase food production

GREEN REVOLUTION
1. New more productive plant strains
2. Modern farming techniques allowed planting larger areas
3. Chemical fertilizers & pesticides boosted crop production and controlled pests

WHY IS THIS A PROBLEM?
Best way to grow lots of food is by using MONOCULTURE. Large fields are planted with a single variety year after year. MONOCULTURE requires farmers to use pesticides to kill pests and fertilizers to help plants grow. Pesticides kill beneficial insects too and runoff from feedlots and fields can contaminate surface and ground water

Impact of Agriculture
Wearing away of topsoil = Soil erosion is caused by plowing land and removing plant roots. Desertification = changing of fertile land in dry climates into desert areas caused by farming, overgrazing, and drought.

WHY IS THIS A PROBLEM?
Farming often requires irrigation which uses freshwater resources

Challenges for Future
Many Midwest states rely on the OGALLALA aquifer for their water needs. We are using water faster than the water cycle can replenish it. Evidence indicates this aquifer may run dry within 20-40 years.
HOW DO WE HELP?
Modern technology is changing how farmers farm and lessening the impact on the environment.
EX: Satellite imaging, GPS technology - enable farmers to apply chemicals only where needed
EX: “No-till” - and other “green” farming methods can reduce soil erosion and protect ecosystems

Sustainable Agriculture
Ways to preserve the environment

Cover Crops
Legumes, grasses, and other cover crops recycle soil nutrients, reduce fertilizer need, and prevent weed growth.

Contour Plowing
Contour plowing reduces soil erosion from land runoff. On hilly areas, plowing is done across the hill rather than straight up and down.

Controlled Grazing
By managing graze periods and herd densities, farmers can improve nutrient cycling, increase the effectiveness of precipitation, and increase the carrying capacity of pastures.

Biological Pest Control
The use of predators and parasites to control destructive insects minimizes pesticide use as well as crop damage.

Crop Rotation
Different crops use and replenish different nutrients. By rotating crops, the loss of important plant nutrients is decreased.

INDUSTRIAL GROWTH and URBAN DEVELOPMENT
The impact of humans on the biosphere was transformed by the INDUSTRIAL REVOLUTION during the 1800’s. Industrial productivity and scientific advancements have provided us with the modern conveniences we enjoy today . . . but have had a serious impact on ecosystems

FOREST RESOURCES
Loss of forests = deforestation can result in erosion and loss of nutrients preventing regrowth. The tropical rainforests once covered more than 14% of the earth's total land surface, but now cover less than 6%.
Tropical rainforests are disappearing at a rate of about 80 acres per minute. Nearly half of the world’s species of plants, animals and microorganisms will be destroyed or severely threatened over the next quarter century due to rainforest deforestation

HOW DO WE HELP?
Sustainable development:
• Stop clear cutting of forests/jungles
• Selective harvest of mature trees
• Replanting of logged areas
• Tree farms
• Breeding new, faster growing species

BIODIVERSITY THREAT
Development of natural areas for cities or agriculture results in habitat destruction
Splitting a habitat into smaller disconnected pieces = Habitat fragmentation
It results in small “islands” of natural area isolated from each other by crop land, pasture, pavement, or even barren land. Habitat fragmentation brings wildlife in more frequent contact with humans. When it comes down to “us or them” . . . “they” usually lose.
One of most important threats to biodiversity come from apparently harmless plants or animals that humans transport into new habitats = INVASIVE SPECIES. New habitats don’t have PREDATORS and parasites that control the population so invasive species populations INCREASE rapidly when they move into a new area.
EXAMPLES OF INVASIVE SPECIES

24 rabbits turned loose for hunting in 1859 in Australia, reproduced at such a rapid rate they have taken over the continent. Within 10 years they had multiplied so rapidly, 2 million rabbits a year could be shot or trapped without any noticeable effect on population. They are believed to be responsible for the Extinction of 1/8 of the mammal species, unknown numbers of plant species, as well as serious soil erosion problems. It is still a major problem and rabbit diseases have been purposely introduced to try to control the population.

Zebra mussels - are native to the Caspian Sea region of Asia. They are believed to have been transported to the Great Lakes in the ballast water from a ship. They were first discovered in 1988, and have since spread rapidly to all of the Great Lakes and waterways in many states including SOUTH DAKOTA and into Canada.

PROBLEMS CAUSED BY ZEBRA MUSSELS

• Clog power plant and public water intakes and pipes, costing taxpayers millions of dollars
• Damage boat engines
• Blanket shorelines with their sharp shells and foul smell
• Consume available food for native species and smother native mussels
• Threaten water-based recreational activities

LEAFY SPURGE - is native to Europe and Asia and first appeared in Massachusetts in 1827. Across much of the Great Plains, leafy spurge is one of the most threatening invasive plants, crowding out native grassland and damaging grazing land. 302,000 acres in South Dakota are infested with LEAFY SPURGE.

According to the U.S. Department of Agriculture, leafy spurge infestations in the Dakotas, Montana and Wyoming alone cost agricultural producers and taxpayers at least $144 million annually in production losses, control expenses and other impacts to the economy.

BIODIVERSITY THREAT

Pollutant = any harmful material that can enter the biosphere through land, air, or water
(SMOG = Mixture of chemicals that appear as a gray-brown haze in the atmosphere.)

AIR RESOURCES

Burning fossil fuels releases pollutants that cause smog and other problems in atmosphere. Toxic chemicals like nitrates, sulfates, and particulates can cause breathing problems like asthma

Example:

DDT was first modern insecticide. It was cheap, stayed active for long time, and killed many different insects. Used to control agriculture pests and disease carrying MOSQUITOES. When DDT was sprayed, runoff carried it into rivers and streams in LOW concentrations. DDT then passes into organisms through the food chains, is stored in tissues, and doesn’t degrade.

BIOLOGICAL MAGNIFICATION = the concentration of a harmful substance. Increases as it passes to organisms at higher trophic levels in food chain or web.

Plants pick up DDT from water & store it → Herbivores eat plants and store some DDT → Carnivores eat herbivores and store more DDT
The widespread use of DDT threatened many species... especially fish eating birds like osprey, brown pelican, and bald eagles. DDT causes birds to lay eggs with fragile shells so eggs would break when sat on. American Bald Eagle was declared endangered in 1967. It has since been reclassified as “threatened.” In 1962, American biologist Rachel Carson published the book, *Silent Spring* which told of DDT’s harmful effects. The book led to a large public outcry and eventually resulted in DDT being banned in the United States in the 1970s. The book was one of the important events in the birth of the environmental movement.

**HOW DO WE HELP?**
- Smokestack “Scrubbers” can control emissions
- Auto emission standards
- Clean air regulations
- Reduce use of fossil fuels

**FRESH WATER RESOURCES**
Americans use BILLIONS of gallons of freshwater daily for drinking, washing and watering crops

**DON'T FORGET THE "INVISIBLE WATER"**
Water used to make products that we don’t think or know about The PRODUCTION OF:

- 1 kg wheat costs 1,300 L water
- kg rice costs 3,400 L water
- 1 kg eggs costs 3,300 L water
- 1 kg beef costs 15,000 L water
- 1 cotton shirt costs 2,500 L water
- 1000 g of blue jeans costs 10,850 liters water
- 1 ton passenger car costs 400,000 liters of water
- Building a house uses about 6 million liters of water

**HOW DO WE HELP?**
- Water conservation
- Protect wetlands and forests
- Water treatment plants
- Clean water regulations
WAYS TO CONSERVE WATER

THE BIG QUESTION?
Human activities affect renewable resources like land, forests, air, fresh water. How can we provide for our needs without using up all resources? = SUSTAINABLE DEVELOPMENT
~ Use natural resources without using them up
~ Provide for human needs WITHOUT causing long term environmental harm

CONSERVING BIODIVERSITY
Wise management of natural resources = conservation. Protecting endangered species requires detailed information about ecological relationships. We can’t protect a species without understanding how it interacts with the ecosystem. Today conservation efforts focus on protecting entire ecosystems not just individual species. HOT SPOTS = are places that are MOST endangered

WHAT CAN BE DONE?
• Urban planning so there is less “Sprawl”
• Set aside land for parks/preserves
• Research to understand species/ecosystem interactions
• Concentration of $ on “HOT SPOTS” to maximize results for $ spent

BIG ENVIRONMENTAL PROBLEMS
DEAD ZONES OZONE DEPLETION ACID RAIN GLOBAL CLIMATE CHANGE WASTE

DEAD ZONES - When an ecosystem receives a LARGE input of limiting nutrient (ie., fertilizer runoff) the population increases dramatically = ALGAL BLOOM
How do we HELP?

- Use modern technology and “green” farming methods to:
  - Prevent erosion
  - Decrease agricultural fertilizer use
  - Decrease runoff of agricultural waste

OZONE LAYER

Our atmosphere between 20-50 km contains high concentrations of OZONE \((O_3)\) which protect us from the sun’s harmful ultra-violet radiation.

EFFECTS OF UV RADIATION

| Skin cancer | Premature aging | Cataracts/blindness | Reduced crop yield | Disrupts food chains in oceans |

WHAT WE KNOW

Scientists have been monitoring the depletion of ozone in our atmosphere and have discovered a hole in the ozone layer over Antarctica. The annual ozone "hole" over Antarctica has occurred during the Antarctic Spring (October) since the early 1980s. Rather than being an actual hole through the layer, the ozone hole is a large area with extremely low amounts of ozone. Ozone levels fall by over 60% during the worst years. Ozone depletion is a global issue NOT just a problem at the South Pole. Research has shown that ozone depletion also occurs over North America, Europe, Asia, and much of Africa, Australia, and South America. Over the U.S., ozone levels have fallen 5-10%, depending on the season.

What's the cause of Ozone Depletion?

Chlorofluorocarbon molecules (CFC’s) released from air conditioners, aerosol spray cans, fire extinguishers, and industry destroy ozone

HOW DO WE HELP?

1987- the MONTREAL PROTOCOL committed signing nations (including USA) to a REDUCTION in the use of CFCs and other ozone-depleting substances. We can’t make enough ozone to replace what’s been destroyed, but provided that we stop producing ozone-depleting substances, computer models predict natural ozone production reactions should return the ozone layer to normal levels by about 2050. CFC production was banned after 1995 in the developed countries, and later in developing countries. Today, over 180 countries have ratified the treaty. This is the first example of different countries getting together on an environmental issue, agreeing on what to do, doing something, and seeing a positive effect.

THAT’S WHY …

AEROSOL spray cans no longer contain CFC propellants. Gases in AIR CONDITIONERS and refrigerators are collected and recycled.

ACID RAIN

What's the cause? BURNING FOSSIL FUELS

Releases Nitrogen oxides and Sulfur oxides into the atmosphere that react with water to produce ACID RAIN.
ACID RAIN EFFECTS
• damages buildings and statues
• damages forests
• kills fish
• reduces biodiversity
• causes illness & premature death from heart & lung disorders like asthma and bronchitis

HOW DO WE HELP?
Develop a National energy policy that emphasizes use of alternative renewable energy sources
Cut down on activities that use fossil fuels
   ~ conserve electricity
   ~ drive less
Drive automobiles with increased fuel efficiency OR run on alternative fuels
Recycle (uses less energy than starting from scratch)

GREENHOUSE EFFECT
Temperatures of Earth remain within a range suitable for life because the atmosphere acts as a natural insulating blanket.
Atmospheric gases such as Carbon dioxide (CO$_2$), methane, water vapor, CFC’s
NORMALLY trap heat energy from the sun like a greenhouse = Greenhouse effect

GLOBAL CLIMATE CHANGE - Is it real?
Some people say that the Earth has cycles of warmer/cooler climate change and that this is just part of that cycle. Most scientists believe that the increase in global temperatures is the result of human activities that have increased the amount of CO$_2$ and other greenhouse gases in the atmosphere. In 2007 in Paris a U.N.- backed panel of international scientists issued a major announcement on climate change stating that:
   1. "warming of the climate system is unequivocal"
   2. There is a 90% probability the cause "man- made".
Either way... our planet is getting warmer!

FACTS WE KNOW
Global mean surface temperatures have increased 0.5-1.0°F since the late 19th century. 14 of the planet’s warmest 15 years have all occurred since the year 2000. The snow cover in the Northern Hemisphere and floating ice in the Arctic Ocean have decreased.

Global Trends in Major Greenhouse Gases to 1/2003

Greenhouse gases in the atmosphere have increased steadily.

WHAT'S the CAUSE?
• Burning solid waste, fossil fuels (oil, natural gas, and coal), wood and wood products
• Production and transport of fossil fuels
• Decomposition of organic wastes in landfills
• Animal sources (methane)
• Deforestation (trees remove CO$_2$ from atmosphere)
What's so bad about warming up a little?

| Coastal flooding | Changes in Gulf Stream | More severe storms | Weather extremes; Heat waves and drought | Changing habitats...means loss of species |

What's so bad a little more CO2?

ACIDIFICATION OF OCEANS - Affects coral reefs and shelled sea animals

What's the Kyoto Accord?

- International agreement signed in 1997
- Aimed at reducing global warming
- Participants asked to REDUCE their GREENHOUSE GAS emissions to a percentage below 1990 emission levels
- Set binding targets for greenhouse gas (GHG) emissions for countries to reach by 2012
- 37 industrialized countries (includes US) which make almost 65% of greenhouse gases (GHG) were to decrease to ~5% less than 1990 levels (US target = 7%)

✓ The UNITED STATES is the only major industrial country that did NOT signed the Kyoto Accord. Standards set by Kyoto expired in 2012. Countries have been meeting since 2009 to decide what will happen next.

WHAT NEXT?

- Some developed countries have already declared that they will not continue to follow commitments to reduce emissions
- Developing countries have increased their carbon emissions by 130% or more
- Delegates from nearly 200 countries have met several times for major climate talks, but no new agreement has been reached.
- They have just agreed to “talk about it”
- Some countries say no deal will be in place until at least 2020.

What is a CARBON FOOTPRINT?

A CARBON FOOTPRINT = the total set of GHG (greenhouse gas) emissions caused directly and indirectly by an individual, organization, event or product. The US is no longer the #1 CO₂ emitter.

but . . . we contribute to the problem. Even if you don’t “believe” in global warming . . . Even if countries can’t agree on emission levels ... we should still work to reduce our emissions of global warming gases

BECAUSE . . .

THINGS WE DO TO "FIX CLIMATE CHANGE" make sense anyway!

REDUCE Fossil Fuel use -

- Fossil fuels are a limited resource...eventually they will be gone!
- Our supply of fossil fuels is dependent on countries that are not “friendly” to the U.S.
- Drilling for and transporting fossil fuels has negative environmental consequences

BP oil spill in Gulf 2011

HOW QUICKLY WE FORGET!

Look into innovate, alternative energy technologies! Innovation and alternative energy technologies for automobiles and power generation are good for our economy.
GLOBAL CLIMATE CHANGE - HOW DO WE HELP?

<table>
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<tr>
<th>Watch your own carbon footprint</th>
<th>Cut down on activities that use fossil fuels</th>
<th>Drive automobiles with increased fuel efficiency OR run on alternative fuels</th>
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<tbody>
<tr>
<td>Cut down on CO₂ emissions (with or without the Kyoto accord)</td>
<td>Recycle (uses less energy than starting from scratch)</td>
<td>Reduce deforestation (plants use CO₂)</td>
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<tr>
<td>Vote for leaders that support environmental issues</td>
<td>Write to your representatives and tell them what you think</td>
<td>Develop a National Energy Policy that emphasizes alternative energy and conservation</td>
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<td>Support funding for research on environmental issues and alternative energy production</td>
<td>Encourage innovation and creation of new ideas, technology, and solutions to environmental problems</td>
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WHAT DO WE DO WITH OUR TRASH?

According to the Environmental Protection Agency, the average American produces about 4.4 pounds of garbage a day. That adds up to approximately 220 million tons of garbage each year for all of us. This only takes into consideration the average household member and does not count industrial waste or commercial trash.

PACIFIC OCEAN GARBAGE GYRE

Covers an area twice the size of TEXAS. Estimated to contain over 100 million tons of debris. Two linked areas on either side Hawaiian islands. Western and Eastern Pacific Garbage Patches.

Why is the world’s biggest landfill in the Pacific Ocean?

We Can’t Just Keep Piling it up in Landfills

Recycling milk jugs into fence posts
Recycling plastic into clothing

We have to REDUCE, REUSE, RECYCLE