

ECOLOGY HANDOUT PART 3

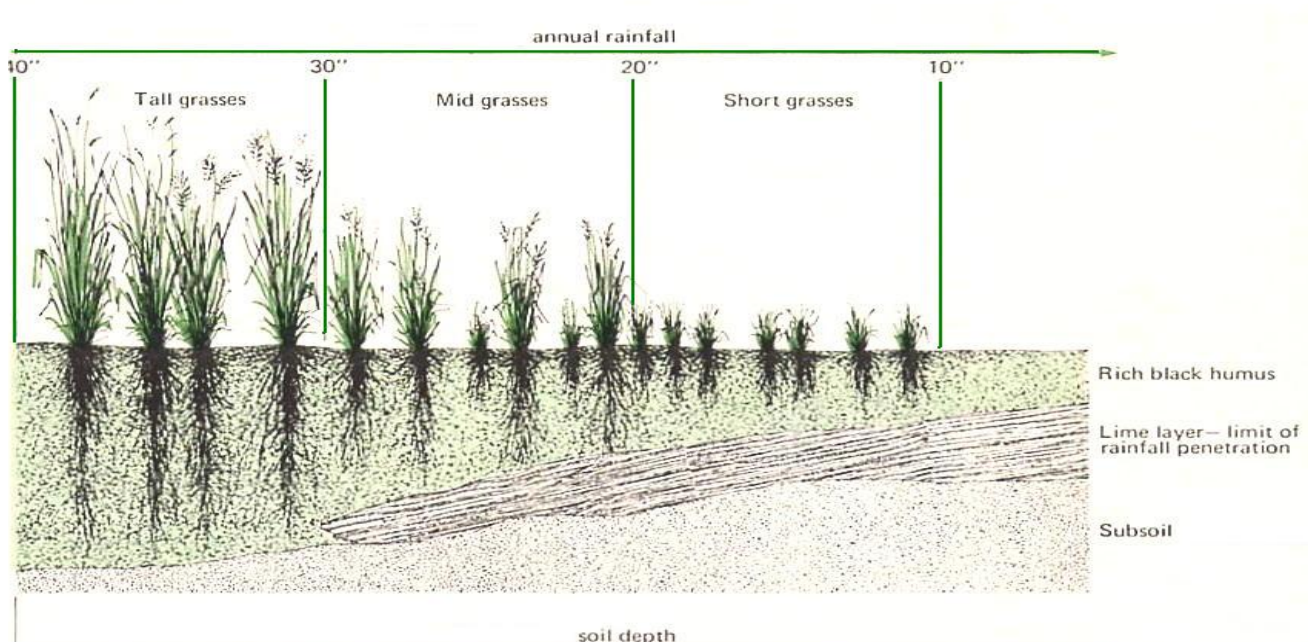
HUMAN IMPACT ON TERRESTRIAL ENVIRONMENTS – YEAR 2 (2018)

Training Handout

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Conservation Concerns for Grasslands (Prairies)

- Most disturbed biome – farming & domestic grazing with fences
- Majority of tall- and mid-grass prairie are now farmland
- Annuals replace perennials with annual soil disturbance by the plow
- Short-grass prairie is grazed, some areas are now overgrazed
- Overgrazing problems – “dust bowl”
- Biodiversity disturbed – extinct & endangered species
- Fire allowed vs. fire control
- Native grasslands being reintroduced

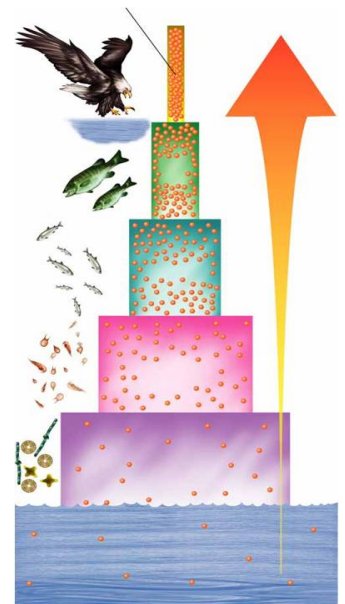
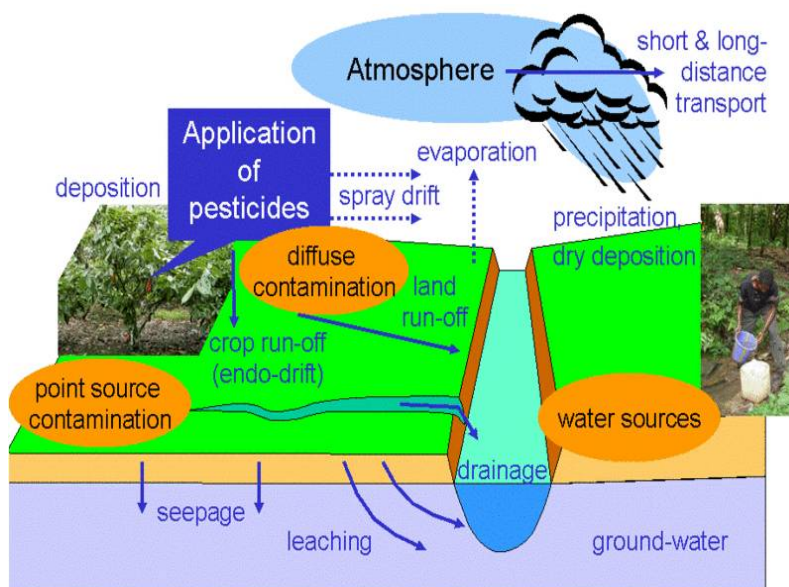


Farming Practices

Negative environmental impacts from unsustainable farming practices include:

- Land conversion & habitat loss
- Wasteful water consumption
- Soil erosion and degradation
- Pollution
- Climate change
- Genetic erosion

Fertilizers and Pesticides

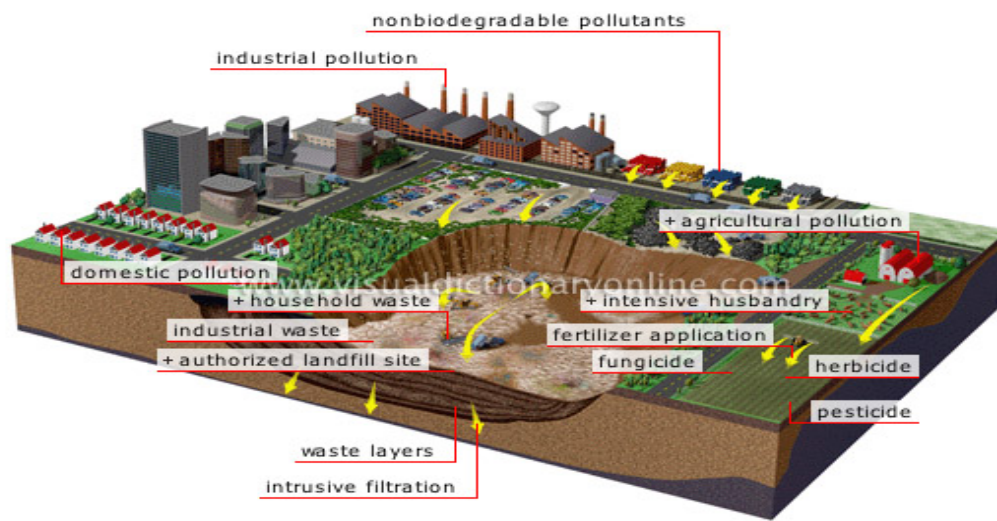


DDT

Magnification

- Insects, weeds, and plant diseases are serious threats that destroy crops
- Drainage of fertilizers and pesticides into water supplies has negative environmental effects
- Nitrogen fertilizers in lakes and oceans causes eutrophication and “dead zones”
- Use of artificial fertilizers can eventually deplete soil of organic matter reducing their ability to hold water and making them subject to erosion
- Pesticides can have negative effects on human health from over-exposure
- Effects of pesticides can be compounded as you go up the food chain as with DDT
- Herbicides used in agriculture can be highly toxic to wildlife
- Organic methods of farming do not use chemical pesticides and fertilizers
- There are plants which remove the pollutants from the soil
- There are organisms which can control pests

Soil Pollution



Ways that soil can become polluted, such as:

- Seepage from a landfill
- Discharge of industrial waste into the soil
- Percolation of contaminated water into the soil
- Rupture of underground storage tanks
- Excess application of pesticides, herbicides or fertilizer
- Solid waste seepage

Most common chemicals involved in causing soil pollution are:

- Petroleum hydrocarbons
- Heavy metals
- Pesticides
- Solvents

Effects of Soil Pollution

- Negative Effects on Human Health
- Effects on Growth of Plants
 - Ecological Balance is affected
 - Soil Chemistry changes
 - Fungi and bacteria found in soil decline
 - Nitrogen fixing bacteria decline
- Decreased soil fertility and decrease soil yield
- Toxic Dust from landfills pollute the environment
- Changes in Soil Structure – death of soil organisms as earthworms lead to alteration in soil structure

Environmental Concerns of Deserts

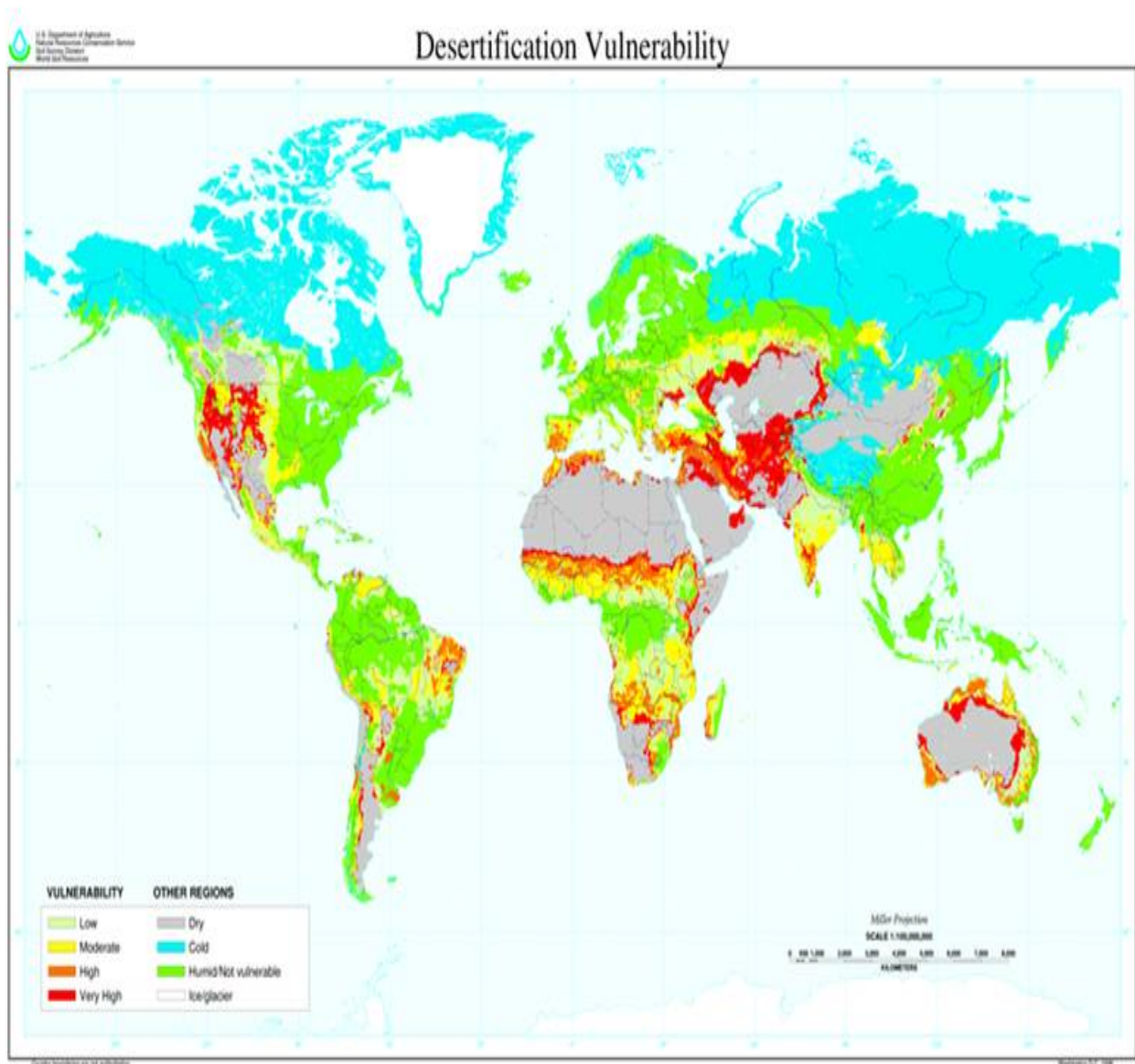
- Many endangered, rare and unusual plants and animals live in the desert.
- Slow to recover from habitat damage
- Desert expansion – growth of deserts in parts of the world
- Flooding problems during rains
- Competition of man for limited water supply



Desertification

- ***Desertification*** is an expansion of arid conditions into a non-arid environment.
- ***Major causes*** of desertification include
 - Overgrazing & poor grazing management
 - Cultivation of marginal lands
 - Deforestation
 - Destruction of vegetation in arid regions
 - Expanding human population
 - Urbanization
 - Incorrect irrigation practices leading to salinization
 - Environmental protection as a low priority

- ***Most endangered regions*** are near the world's five main deserts
 - Sonoran Desert which lies in Northwest Mexico and the Southwest United States
 - Atacama Desert in South America
 - Kalahari Desert in Southern Africa
 - most of Australia
 - the large desert mass made up by the Sahara, Arabian, Great Indian, Taklimakan, Gobi and the deserts of Iran and the former Soviet Union.



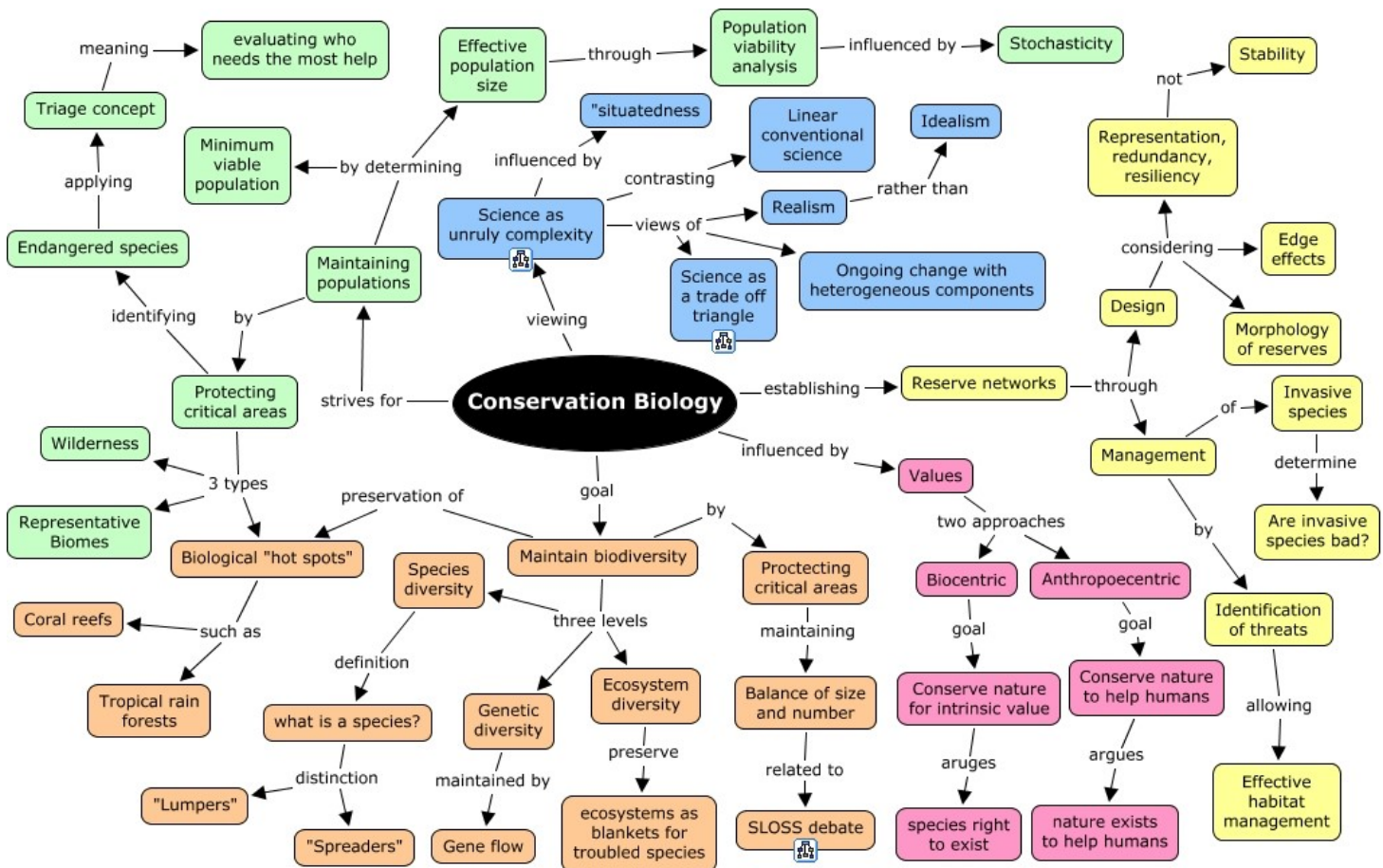
CONSERVATION BIOLOGY

Ecology is the study of the distribution and abundance of organisms, the interactions among organisms, and the interactions between organisms and the physical environment.

Conservation Biology is the scientific study of nature and of Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems from excessive rates of extinction and the erosion of biotic interactions. Conservation biologists investigate the impact of humans on Earth's biodiversity and develop practical approaches to prevent the extinction of species and promote the sustainable use of biological resources

Goals of Conservation Biology from Primack

- To document the full range of biological diversity on Earth – “taxonomy, natural history, ecology”
- To investigate human impact on species, genetic variation, and ecosystems – “ecology, genetics, biogeography, etc.”
- To develop practical approaches to prevent the extinction of species, maintain genetic diversity within species, and protect and restore biological communities and their associated ecosystem function – “conservation biology, communication, natural and social sciences, economics, politics, management, etc.”



Conservation Biology – Framework

Goals: Conservation biologists seek to maintain three important aspects of life on Earth: biological diversity, ecological integrity, and ecological health

- Biological diversity is a measure of the diversity of all life at all levels of organization.
- Ecological integrity is a measure of the composition, structure, and function of biological systems.
- Ecological health is a measure of a biological system's resiliency and ability to maintain itself over time

Threats: threats to biological diversity, ecological integrity, and ecological health

- Nature has faced and continues to face numerous threats from humans, including direct harvesting, habitat destruction, and introduction of non-native species.
- Principles of ecological economics correct oversights in neoclassical economic theory, which have contributed to conservation threats.
- Human societies have a long history of causing extinctions and making major changes to ecosystems.
- Human actions affect nature through their frequency, intensity, and spatial extent. Species are currently going extinct at a rate faster than at any time in human history and at a rate comparable to mass extinction events seen only in the fossil record.
- Humans cause extinction through habitat destruction and modification, overexploitation, and introduction of non-native species.
- Humans are currently causing the Earth's climate to warm, which will have severe consequences for natural systems.
- Extinction of a species can cause extinctions of other species.
- The present condition of most natural systems is changed from the past as a result of human actions. Ideas about the "normal" condition of nature are influenced by what a person experiences in his or her own lifetime.

Actions: protection and restoration of biological diversity, ecological integrity, and ecological health

- Conservation requires a combination of many different strategies.
- Protect species at risk of extinction.
- Designate ecological reserves.
- Lessen the magnitude of human impacts on natural systems.
- Restore ecosystems that have been degraded.
- Augment populations with individuals raised in cultivation or captivity.
- Control the number of individuals harvested in nature.
- Prevent the establishment of non-native species, and eliminate non-native species that have become established.
- Understand and participate in the policy-making process.
- Educate others about the importance of conservation.

Note: *from Conservation Biology, Pages 1180–1190 Volume 18, No. 5, October 2004*

Major Environmental Issues

- Pollution of Air, Water and Land
- Hazardous Chemicals and Wastes
- Land Degradation
- Loss of Biodiversity
- Ozone Depletion
- Climate Change
- Environmental Factors
- Loss of natural and cultural resources
- Habitat loss
- Overexploitation
- Exotic species and introductions
- Overpopulation



Major Causes of Environmental Issues

- Rapid population growth and the effects of urbanization, industry and harvesting practices on the ecosystem
- Rapid and wasteful use of resources
- Degradation of the earth's environmental systems

Evaluating Environmental Impact: The PAT Model.

Environmental Impact (I) (depends on three factors) - Paul Ehrlich

1. The number of people (population size, **P**)
2. The average number of units of resource each person uses (per capita consumption or affluence, **A**)
3. The amount of environmental degradation and pollution produced for each unit of resource used (destructiveness of the technologies used to provide and consume resources, **T**)

$$I = P \times A \times T \text{ (environmental impact)}$$

Sustaining the Earth– Learning as much as we can about how Earth sustains itself and adapts to ever-changing environmental conditions and integrating such lessons from nature into the ways we think and act

The basic **environmental** beliefs of the world:

- Nature exists for all of Earth's species, not just for people
- There is not always more
- Some forms of economic growth are environmentally beneficial and should be encouraged, but some are
- environmentally harmful and should be discouraged
- Our success depends on learning to cooperate with one another and with the rest of nature to learn how to work
- with the earth
- The key to creating a sustainable society:

Pollution - when harmful materials enter the environment

Sources of pollution usually fall into four main categories – industrial, residential, commercial, and environmental. Pollutants enter the environment through natural (volcanic eruption) or human activities

Sources of pollution may include

- **point source pollution** from a clearly identifiable location
- **nonpoint source pollution** that comes from many different places.

Sources of pollution may include

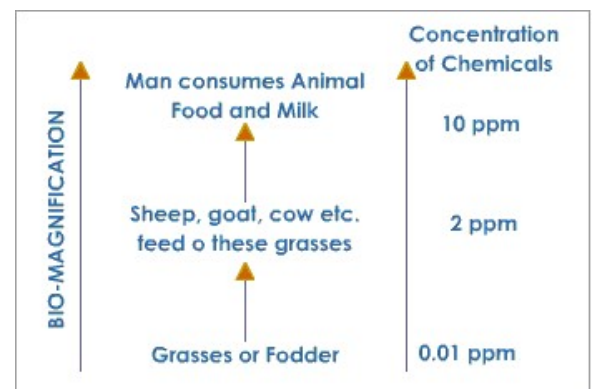
- **organic pollution** – decomposition of living organisms and their bi-products
- **inorganic pollution** – dissolved and suspended solids as silt, salts, and minerals
- **toxic pollution** – heavy metals and other chemical compounds that are lethal to organisms
- **thermal pollution** – waste heat from industrial and power generation processes
- **nuclear pollution** - radioactive materials

Harmful Impacts of Pollution – three factors determine the severity of the harmful effects

1. **Chemical nature** – how active and harmful the pollutant is to living organisms
2. **Concentration** – the amount of pollutant per unit of volume
3. **Persistence (degradability)** – how long the pollutant stays in the air, water, soil, or body of the organisms

Biomagnification

- Humans release thousands of chemicals into the environment, many of them did not exist in nature before. Organisms take in these toxins with nutrients and water. As we move up on the levels of a food web, toxins become more and more concentrated – **biological magnification**.



- As a result, top level carnivores tend to be most severely affected by toxic compounds in the environment.
 - Many toxins do not break down easily so they persist in the environment for decades or even longer.
- In some other instances, harmless substances can have toxic breakdown products or two or more chemicals can interact in the environment and can produce harmful effect together

Pollution can affect all areas of the environment and it is divided into the following:

- **Air Pollution** - the emission of any impurity into the air, such as smoke (including tobacco smoke), dust, cinders, solid particles, gases, mists, fumes, odors and radioactive substances.
- **Water Pollution** – pollutants being added to ground water, surface water environments and marine water environments
- **Thermal Pollution** – changes in water temperature due to additions of hot or cold water to a natural water system – often heated water from cooling at power plants
- **Soil Pollution** – pollutants being added to soil by agricultural runoffs, unclean technology, waste disposal
- **Noise Pollution** – excess noise from industrial and urbanization activities
- **Light Pollution** – excess night lighting around urban areas which can impact life cycles or organisms
- **Radioactive Pollution** – radioactive waste and nuclear accidents



Problems with Nutrient Enrichment:

- People can move nutrients from one area to another, enriching one and deplete another
- Farm soil may run off into streams
- When natural vegetation is cleared from an area, nutrients can easily run off

Loss of Biodiversity

- Loss of habitat of many living organisms because of the overpopulation by humans
- Biological magnification can poison organisms on the top of the food chain (top predators)
- Global climate change alters the pH, salinity, CO₂ concentration in the ocean, alter the temperature and precipitation in terrestrial ecosystems.

Causes of Biodiversity Loss:

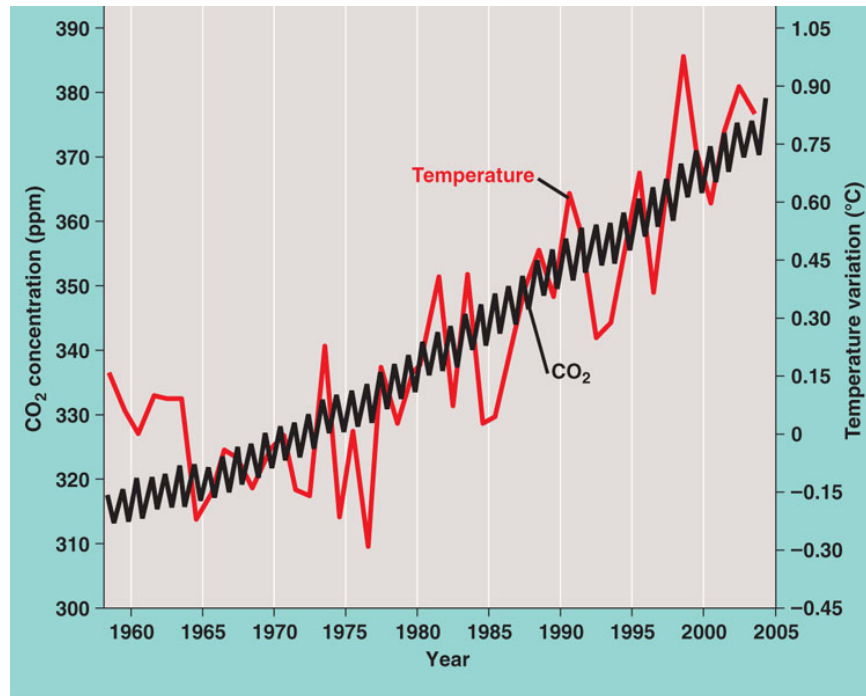
- **Habitat loss & Fragmentation**
- **Climate Change**
- **Over use and exploitation**
 - deforestation
 - non-sustainable agricultural practices: over-cultivation, etc.
 - overfishing
 - excessive hunting
 - illegal poaching
 - illegal exotic species trade
- **Construction, farming, etc.**
 - simplification—clearing and cleaning up land areas of natural debris; stream channelization, etc.
 - intrusion—interference with species: telecommunication lighted towers attracting migrating birds, casing collisions and entanglement in wires, etc.
- **Human population explosion**
- **Pollution**
 - land and water pollution: pesticides, toxic waste, oil spills, eutrophication of water, pathogens from human waste
 - air pollution and related issues: NO₂, SO₂, acid deposition; ozone depletion, GHG (Greenhouse gases)

Acid Precipitation (“Acid Rain”)

- **Acid precipitation** – rain, snow, sleet or fog that has the pH of 5.6 or lower.
- It forms when wood, coal or other fossil fuels are burned and produce sulfur and nitrogen oxides. These oxides react with water and form sulfuric and nitric acid that fall to the Earth with precipitation.
- Acid precipitation lowers the pH of aquatic ecosystems and affects the soil chemistry of terrestrial ecosystems. It leaches important minerals out of the soil and plants. It prevents the normal formation of shellfish shells and kills pH sensitive fish.
- In industrial countries, acid precipitation decreased in recent years.

Atmospheric CO₂

- Since the industrial revolution, the concentration of atmospheric CO₂ levels has been increasing as a result of burning fossil fuels with a higher rate and due to the increased deforestation.



- There are several consequences of this increase:
 - Increased vegetation but with more C₃ than C₄ plants
 - **Greenhouse effect** – water vapor and CO₂ traps the infrared radiation that is reflected back from the Earth's surface. As a result, more heat is trapped and global warming occurs.
 - Global warming has many effects on the earth's weather patterns, ocean currents and can cause flooding of the coastal areas.

Depletion of Atmospheric Ozone

- Ozone is necessary to prevent living organisms from harmful UV radiation coming from the sun. It is located on the lower part of the stratosphere.
- The ozone layer has been gradually thinning since the 1970's because of the introduction of CFC's (chlorofluorocarbons) that were widely used. Chlorine from CFC's moved up to the stratosphere and changed ozone into oxygen in a chain reaction where chlorine is gained back at the end. As a result, one chlorine atom can react with hundreds of ozone molecules.
- Low levels of ozone result in increased skin cancer rate and increased cataracts in humans, while other living organisms will also have seriously damaged DNA with unforeseen consequences.

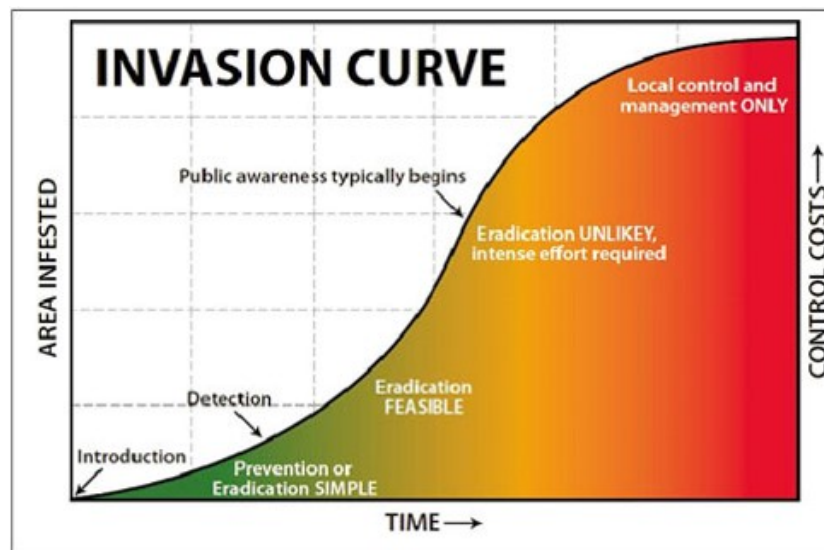
Invasive species introduction can be accidental or deliberate (ornamentation, horticulture, aquaculture) can take over an area, competing with native species for resources

Threats because of Invasive Species

- Causing disease
- Acting as predators or parasites
- Acting as competitors
- Altering habitats
- Hybridizing with local species - If an invasive species is much more abundant than a native relative, they may hybridize so often that the invaders genes "flood" the native species, such that no individuals contain the entire genotype of the native species, thus effectively driving the native species to extinction
- Major threat to biodiversity
 - Second only to habitat destruction as a threat to biodiversity
 - Almost half of the endangered species in the US are at risk because of invasive species
 - Introduced species are a greater threat to native biodiversity than pollution, harvest and disease combined
- Invasive predators may greatly reduce the population of native species or cause them to become endangered/extinct because the native prey have no defenses against the invasive predator.
- Invasive species can cause disease to other species as the Asian chestnut blight fungus the almost eliminated the American chestnut from the Eastern US forests in the first half of the 20th Century harming the ecosystem and the organisms dependent on the chestnut for survival.
- Invasive species can cause human disease as the AIDs virus and West Nile virus
- **Invasion Meltdown** - invading species interact with one another to generate a problem where either species alone would be harmless

Control of Invasive Species – Key factors for the success of the control

- Catching the infestation EARLY, before population numbers get out of hand.
- Whether or not the invasive organism is mobile within the environment.
- How rapidly the invasive can reproduce.
 - Does it reproduce in more than one way?
 - Does it need certain conditions?
- How vulnerable the invasive is to control.
 - IS it tolerant to pesticides?
 - Will it re-grow if burned?

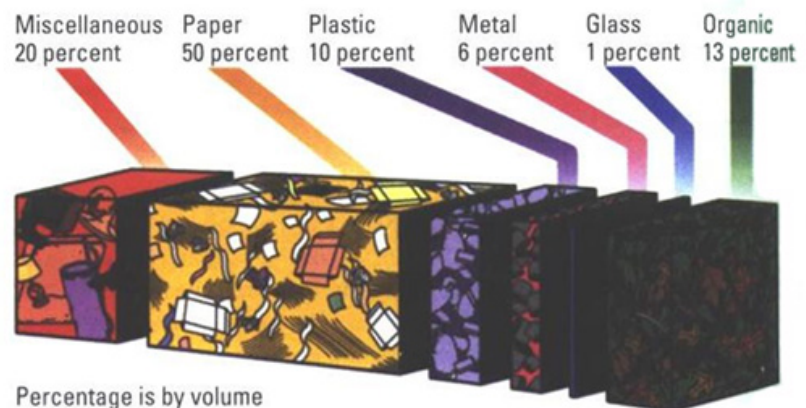


Waste Disposal

- Waste, or rubbish, trash, junk, garbage is an unwanted or undesired material or substance.
- It may consist of the unwanted materials left over from a manufacturing process (industrial, commercial, mining or agricultural operations,) or from community and household activities.
- The material may be discarded or accumulated, stored, or treated (physically, chemically, or biologically), prior to being discarded or recycled.
- **Waste Categories**
 - **Solid Waste or Municipal Waste** commonly known as trash
 - **Regulated Medical Waste (RMW)** – potentially infectious or biohazardous waste
 - **RCRA Hazardous Waste** - hazardous pharmaceuticals, bulk chemotherapeutic agents, mercury, xylene and other solvents, some paints, aerosol cans etc
 - **Nuclear Waste** – radioactive materials
 - **Universal Waste** – batteries, pesticides, mercury-containing equipment, bulbs or lamps
 - **Recyclables** - paper, cardboard, beverage and food containers, metal and glass
 - **Construction and Demolition Debris** as ceiling tiles, plumbing fixtures, carpeting, concrete, bricks, fill dirt, etc.
 - **Composting material** – as grass, weed clippings, tree limbs, branches, waste from vegetable produce, bread and grains, and paper products as napkins and paper plates
- **Methods of Waste Disposal**
 - Landfill
 - Incineration
 - Recycling Methods
 - Biological Processing
 - Energy Recovery
 - Avoidance and Reduction Methods



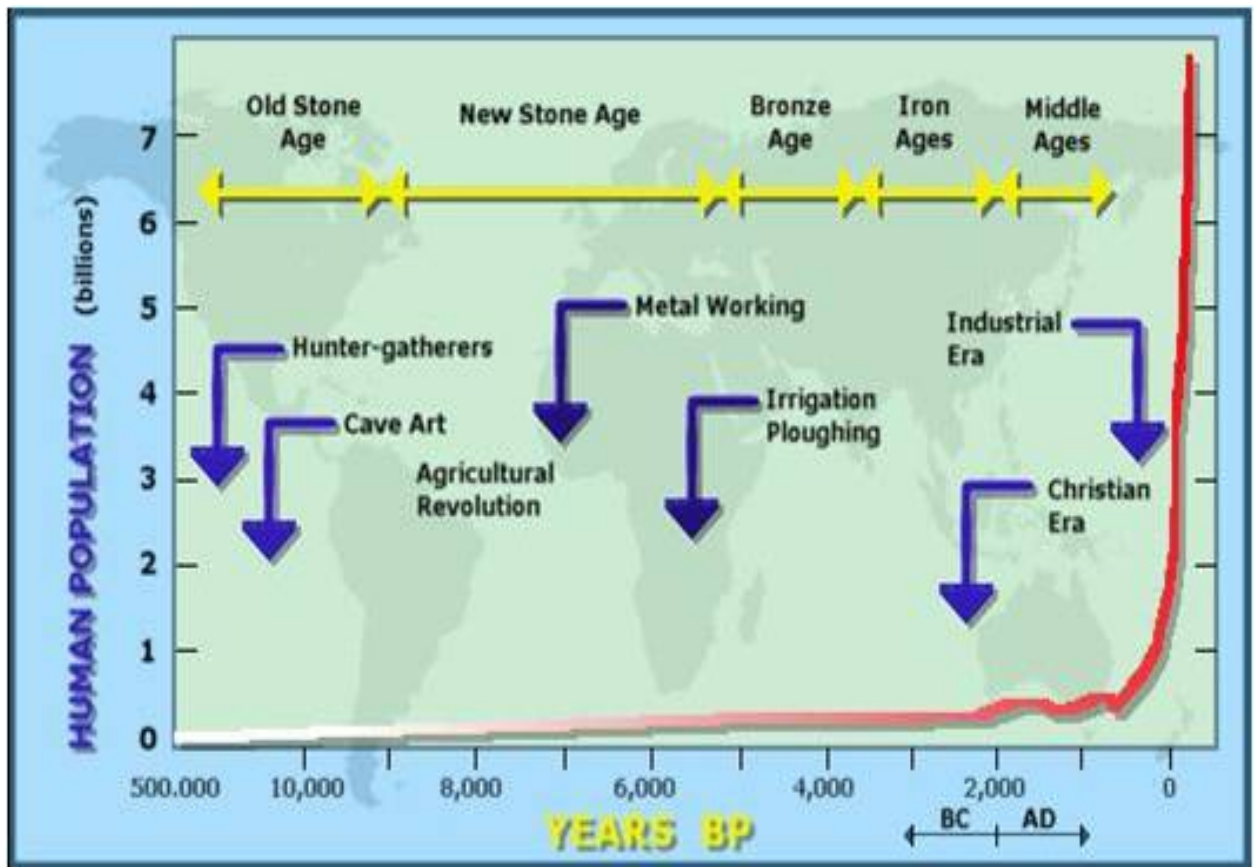
- Landfill makeup



Population Growth Issues

- Urbanization
- Habitat Destruction
- Farming Practices
- Fertilizers & Pesticides

Human Population Growth



Urbanization

Concerns:

- Public Health
- Food Supply
- Freshwater
- Coastlands and Oceans
- Forests
- Biodiversity and Habitat Destruction
- Global Climate Change



Habitat Fragmentation & Destruction

Habitat destruction and **fragmentation** is a process that describes the emergences of discontinuities (fragmentation) or the loss (destruction) of the environment inhabited by an organism.

Causes include:

- **conversion** to human-made uses: urbanization, deforestation, etc.
- **fragmentation**—natural geographic ranges are “cut up” due to construction, farming, etc.
- **simplification**—clearing and cleaning up land areas of natural debris; stream channelization, etc.
- **intrusion**—interference with species: telecommunication lighted towers attracting migrating birds, casing collisions and entanglement in wires, etc.

It results in

- Loss of resident species
- Loss of food sources
- Loss of ecosystem functions provided by the habitat

