LIFE SUPPORT ENVIRONMENT

Text book:
Ecology, Eugene P. Odum, Sinauer Associates, Inc., Rev. Ed. of 2nd Ed. 1993

Problems:

1. Oxygen level drops
2. Power failure

Immediate action can not be taken
because of the limited information about the “consumables”

time is wasted

To survive with limited oxygen and power

CO_2 starts to accumulate
Disposal of the human waste starts to become a problem
There is nuclear material in the vehicle

Are there any similarities to our current global problems?

What is the difference between the spacecraft and the earth?

Life support systems on the spacecrafts are
mechanically controlled storage systems.

No naturally occuring recycling (urine, CO_2)

the earth is bio-regenarative

plants, animals, especially microorganisms
regenerate, recycle and control life's necessities

We need to learn

*how *the current life support systems of the earth* function

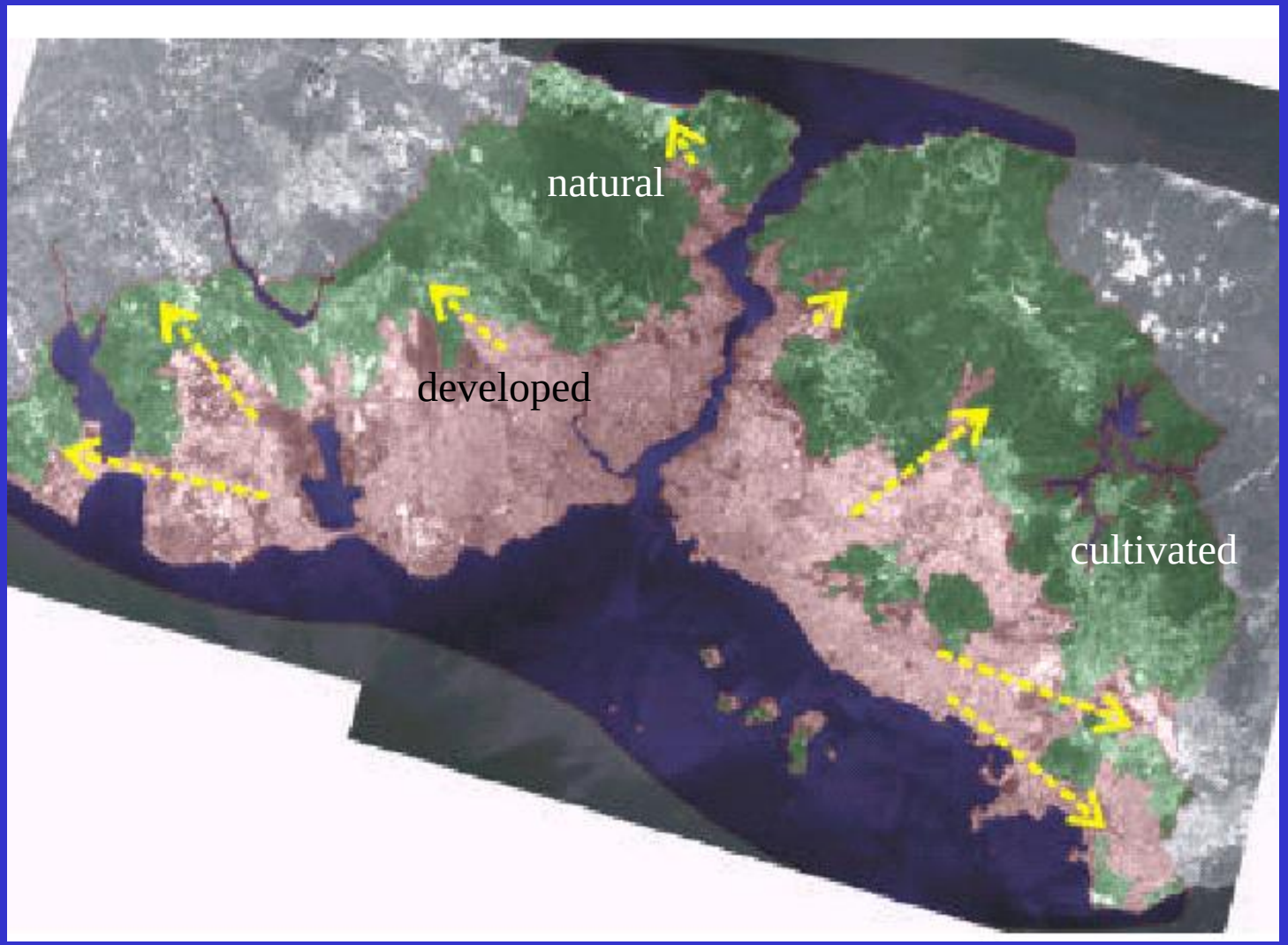
*how the earth support systems get affected by human activities.

* We can preserve and maintain the quality of these systems

* Someday build self-maintaining spacecraft or colonize other planets

If we take an aereal view

We will see three major environments:



Developed: fuel powered systems
cities, industrial parks, roads, railways, airports

Cultivated : subsidized solar powered
agricultural lands, managed forests,
artificial ponds and lakes

Natural : basic solar powered
Forests, lakes and rivers,
mauntains, oceans

Life support environment: Part of the earth that provides food and energy

Life support systems: agricultural systems + natural systems

oikos: the household
logy: the study of

Ecology: the study of the household
Animals, microbes, people – living together on the Earth as interdependent beings.

The study of how organisms interact with each other and their environment.

LEVELS OF ORGANIZATION

For better understanding the complex world it is helpful to think "levels of organizational hierarchies"

Hierarchy: an arrangement into a graded series of compartments

EXAMPLES:

Geographic
Biological hierarchy (nested: made up a group of low
Ecological level units)

Goverments
Corporations non nested
Universities
Military

Ecological Hierarchy

Population: groups of individuals of any species that live together in some designated area.

* group of organisms of the same, interbreeding species
* group of organisms of different species linked

plant populations
bird populations
plankton populations

Community: all of the populations living in a designated area

Ecological system or ecosystem: the community + the nonliving environment

Landscape: groups of ecosystems + human artifact

Biomes: large regional units (ocean, grassland region)

Biogeographic regions: major continents and oceans

Biosphere: all of the Earth's ecosystems functioning together

Ecosphere = biosphere
Biosphere = all of the life on earth
Ecosphere = all of the life + nonliving materials

Litosphere: rocks, sediments, mantle and core of the earth
Hydrosphere: surface and ground water
Atmosphere:

ORDER OUT OF CHAOS

Large ecosystems as a whole (oceans, forests) are less variable over time than their individual components.

Hierarchial constraint

IMPORTANCE OF TIME AND SCALE

Parasite and host:

to get better of other (short term)

balanced coexistance, co-evoluation: (long term) chp.7

Population in a small track of a forest depends on the large scale landscape (source-sink energetics chp.4)

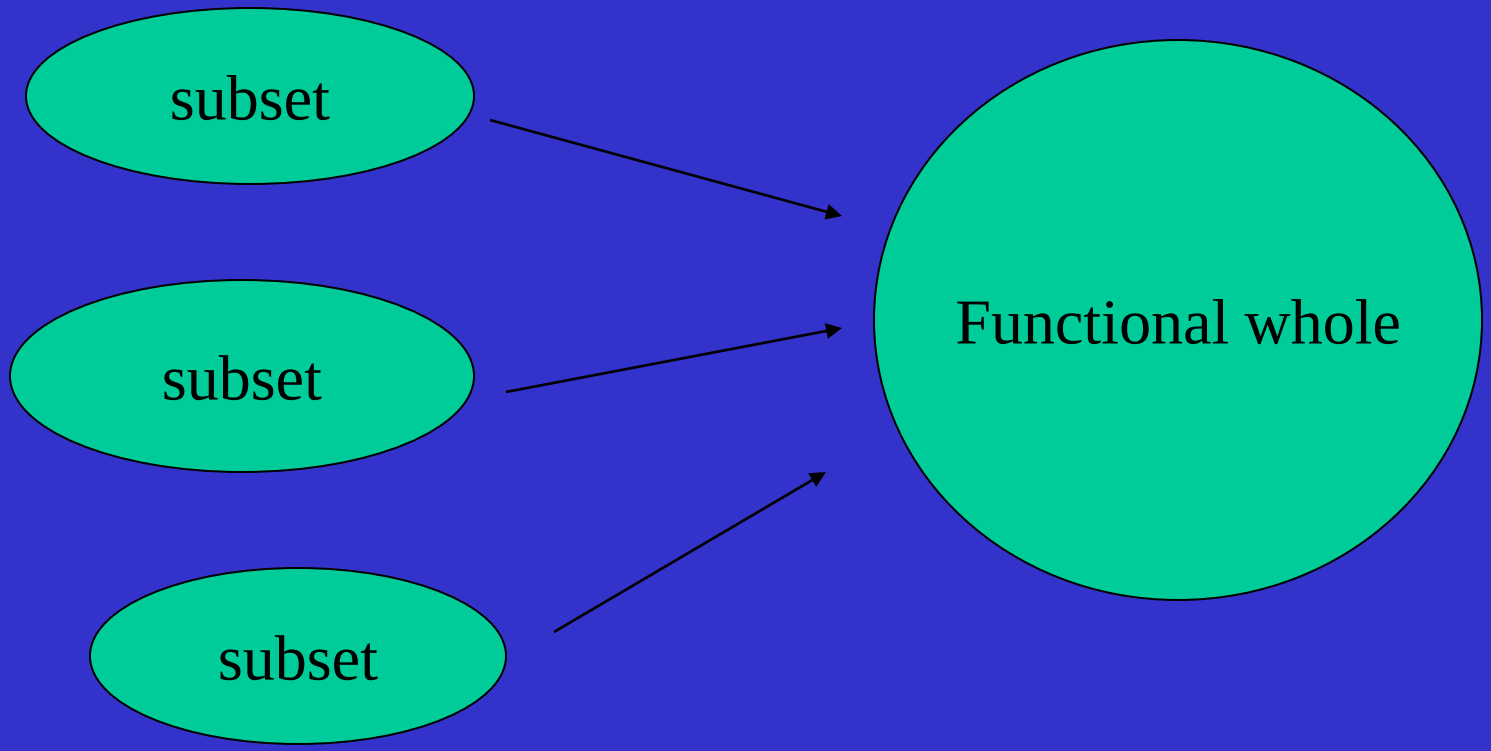
INTERFACES
Ecology-economics
Oikos: the household
Mics : management

Economist: human works, market goods and services

Ecologist: natural environment, non market but vital goods
air purification, water recycling, soil enrichment

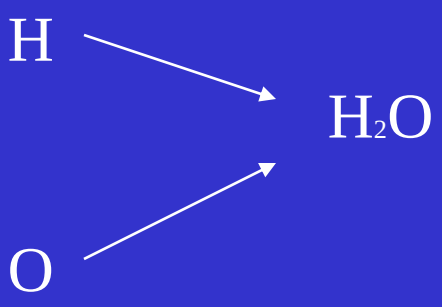
Environmental health
engineering
law
Conservation biology
Landscape ecology
Restoration ecology

Emergent property



New properties emerge that were not present or evident at the level below

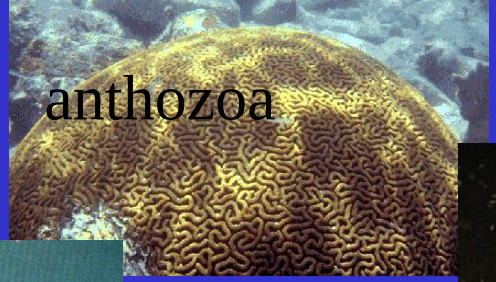
Examples:



For certain fungi
Fungus + root = mycorrhizae
able to extract mineral nutrients more efficiently than roots alone

Algae and coelenterate animals evolve together to form coral.
Coral reef maintains high rate of productivity in low nutrient waters

Coelenterate:
Anthozoa (corals and sea anemones)
Scyphoza (jellyfish)
Hydrozoa (hydra)



Stony Corals are similar to sea anemones but with smaller coral polips (10 mm in diameter). Stony corals extrete a calcium carbonate shell around their bodies. When the polip dies, this shell does not decay and new polips grow over it. Over years, coral reef is formed by this repeading process.

photos:
www.oneocean.org/overseas/200011/where_have_all_our_coral_reefs_gone.html

Dinoflagellate algae : zooxanthellae

www.seaslugforum.net/zoox2.htm

www.seaslugforum.net/zoox2.htm

The algae live in the digestive cavity of the coral polip, and corals with algae grow much faster than those without the algae. The algae stimulate the calcification, supply the animal O_2, carbon and nitrogen compounds. The host obtain vitamins, trace elements from the algae. Pigments produced by the corals protect both the host and algae from UV radiation.

The algae cause the beautiful color of that coral.

NOAA Photo Library
www.photolib.noaa.gov/reef/index.html

Outside differences may result different effects at different levels

Example:
Forest fires

Chaparral

Adapted to the fire and can not survive without it. Otherwise other species overtake and grow at the expense of the chaparral.

Mediterranean Chaparral

Resources:

Web Sites:

www.sc.edu/union/Sears/270.2.Ecol.htm

www.ucmp.berkeley.edu/chromista/chromista.html

www.teaching-biomed.man.ac.uk/bs1999/bs146/biodiversity/cnidpic.htm

www.ucmp.berkeley.edu/cnidaria/anthozoa.html

www.seaslugforum.net/zoox2.htm

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Insect Pests and Exotic Species
Integration and lack of integration of species within their community:

Insects become pests when they are displaced from their native ecosystem.
Examples:

North America:
Mediterranian fruit fly
Japanese beetle
European corn borer

In their natural environment, these species function as parts of well ordered ecosystem. Any excesses are controlled as a result of long periods of evolutionary adjustment; in new situations that lack of such controls their population increases enormously and destroy the whole system before controls set.

Aphids

Aphids are small soft-bodied insects. They are one of the most common pest groups of ornamental plants.

Japanese beetle:

Japanese beetles (JB) were introduced into New Jersey on nursery stock from Japan in 1913.

Tomato Hornworm: Manduca Quinquemaculata Sphingidae

European Corn Borer:

Introduced new species can demage the natural system

Examples:
Rapana venosa
Invasion: Black Sea
First apperance: 1947
Origine: Chinese coast
Impact: :Bivalvian species
Black Sea scallop *Flexopecten ponticus*,
edible oyster *Ostrea edulis*

Mnemiopsis
Invasion: Black Sea
First apperance: 1980s
Origine: Chinese coast
Impact: : Populations fed on plankton sharply decreased. (Black Sea anchovy, scad and sprat).

•In the early 1980s, *Mnemiopsis leidyi* was accidentally introduced to the Black Sea, where it flourished and expanded into the Azov, Marmara, Mediterranean, and Caspian Seas.

•In November 1982 *M. leidyi* for the first time was found in Sudak Bay of the Black Sea.

•In 1986 *M. leidyi* was recorded again in the coastal area of north-western Black Sea.

•In 1987 *Mnemiopsis* appeared in the north-eastern, north-western coastal waters and in the Bosporus area.

•June-September 1988 *M. leidyi* was found everywhere, at an average biomass of 1 kg WW m-2 (40 g WW m-3) and average abundance of c. 310 m-2 (12.4 m-3).

•In autumn 1989, the greatest mean biomass ever in the open sea 4.6 kg WW m-2 (184 g m-3) and greatest abundance, 7,600 ind. m-2 (304 ind. m-3) were measured.

Experts suggested a predator named “beroe”
But nobody dared to take a step.

In 1997, they appeared by themselves in the Black Sea.

Another example:

Zebra Mussel from the Caspian Sea was introduced into the Great Lakes.

Zebra mussel feed on plankton, the other species fed on plankton were affected

Solution??????

Another species from the Caspian Sea;

Gobies
Their main food is bivalves (such as Zebra Mussel)

But :
Very aggresive fish
Capable of rapid population growth

Massive invasion of the lakes by Gobies
Compete with native fishes for food and space
Contamination of the food chain (mussels filter out toxins in the water)

Applying Hierarchy Theory

We can start to study ecology at any level without knowing everything at the other levels.

Challange: to recognize the unique charasteristic of that level
And then devise appropriate methods.