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Notes on an introductory course on Ecology

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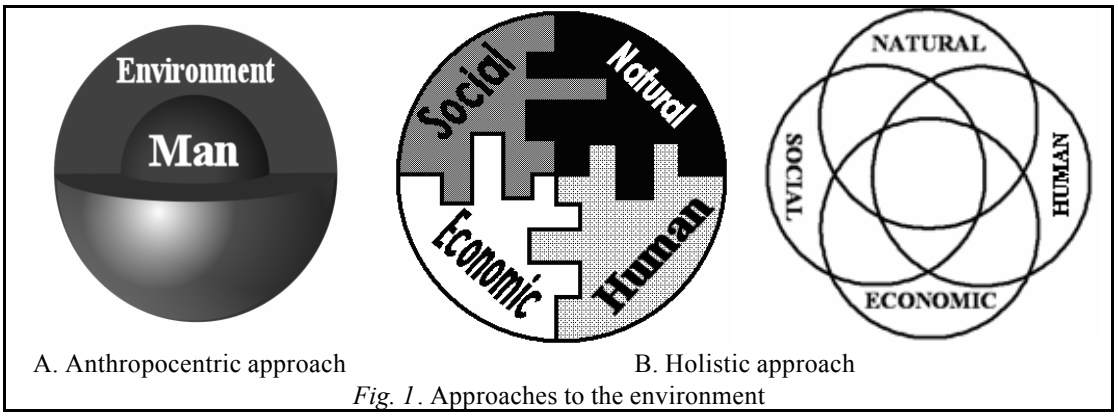
The Environment

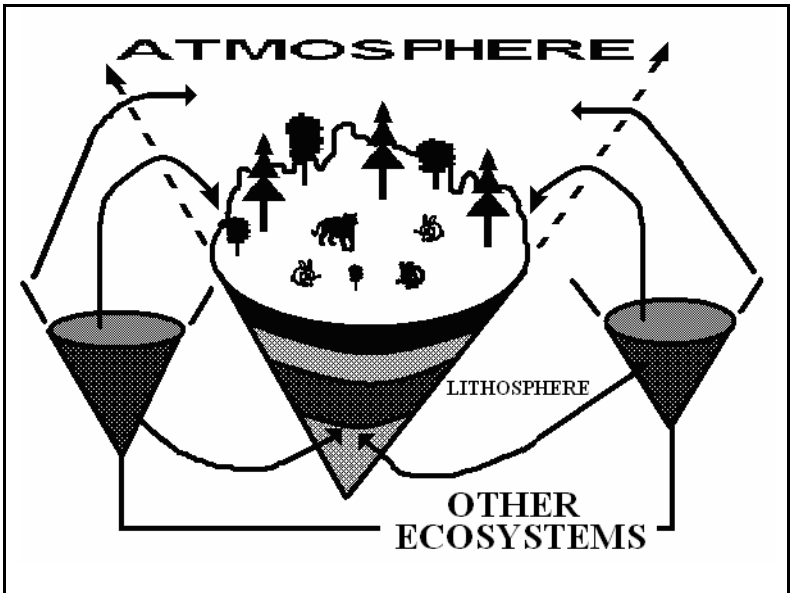
Views on the environment could be classified as either anthropocentric (man-focused) or holistic (no focus) - *Fig. 1*. Anthropocentric views (*Fig. 1A*) are sectoral (the so-called natural environment is divided into *environmental factors*: water, air, soil, flora and fauna) or un-sectoral. The holistic approach does not make any distinction between the natural and man-made (man-dominated) systems. All the following concepts rely on the holistic approach (*Fig. 1B*).

Holistic definition of the environment: the environment is the hierarchy of organized ecological systems.



A. Anthropocentric approach B. Holistic approach

Fig. 1. Approaches to the environment



An ecological system (*Fig. 2*) consists of a lifeless (***abiotic***) component, *i.e.*, all geological, geographical, climatic etc. factors, and a live (***biotic***), component, *i.e.*, all vegetal and animal species. The two are tightly connected and form a whole. Ecological systems depend on exchanges with other similar systems. The transit area between two ecosystems is called *ecoton*.

The main functions of ecological systems are ***biogeochemical circuits*** and ***self-regulation***; the later provides for the continuity of structure in time and space in a dynamic equilibrium, as ecological systems evolve continuously through ***ecological succession***. The first function is carried via food chains and webs (*Fig. 3*). Matter circulates via metabolism (organisms eat each other, substances are decomposed and used to build own constituents), while energy is embedded in chemical links and spent in metabolic processes. Since the numbers and biomass decrease across food chains, a better representation is the food pyramid (*Fig. 4*).

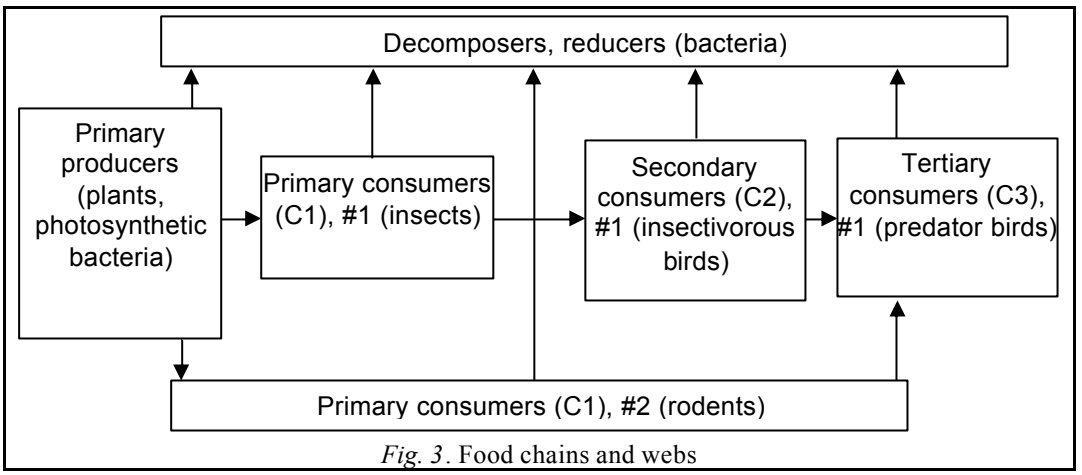


Fig. 3. Food chains and webs

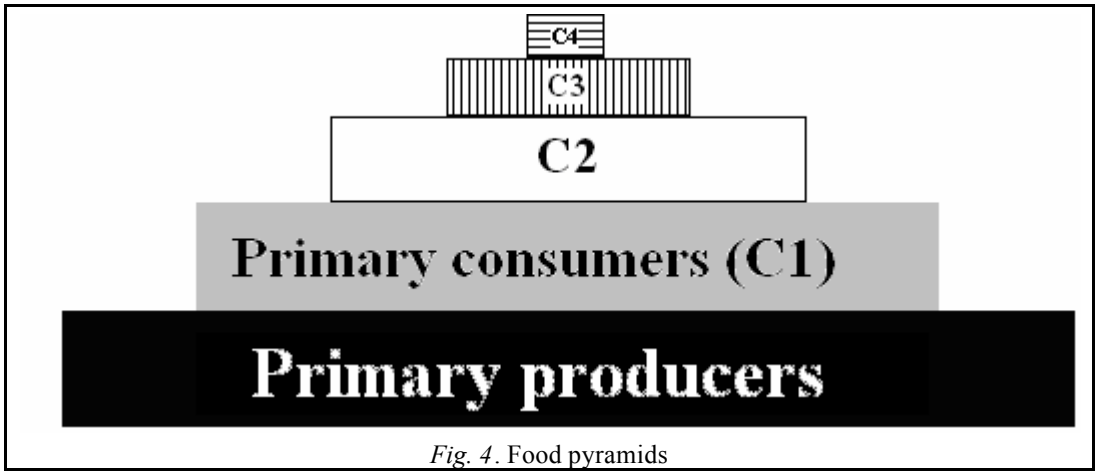


Fig. 4. Food pyramids

Ecological systems suffer transformations in time, maintaining their stability through self-regulation under dynamic equilibrium conditions. These transformations are called generically *succession*. Primary succession occurs after catastrophic events that destroy the biocoenose completely. Secondary succession represents the gradual transformation of a biocoenose into a new one (*Fig. 5*).

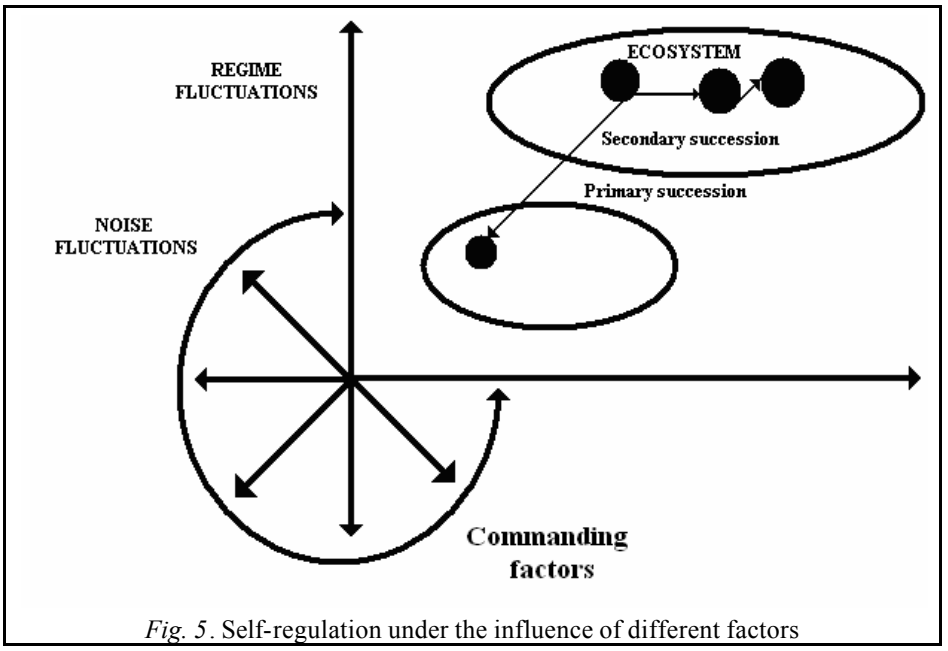


Fig. 5. Self-regulation under the influence of different factors

Interpreting the stability of ecological systems (Vadineanu, 1998);

- ***Resilience*** – speed of the return of variables to equilibrium after impact – large for stable systems
- ***Persistence*** – conservationism to impacts – measured by duration of stability under impact – large for stable systems
- ***Resistance*** – amplitude of changes under impact – small for stable systems
- ***Variability*** – frequency of changes under impact – small for stable systems.

Ecological systems form a hierarchy (*Fig. 6*).

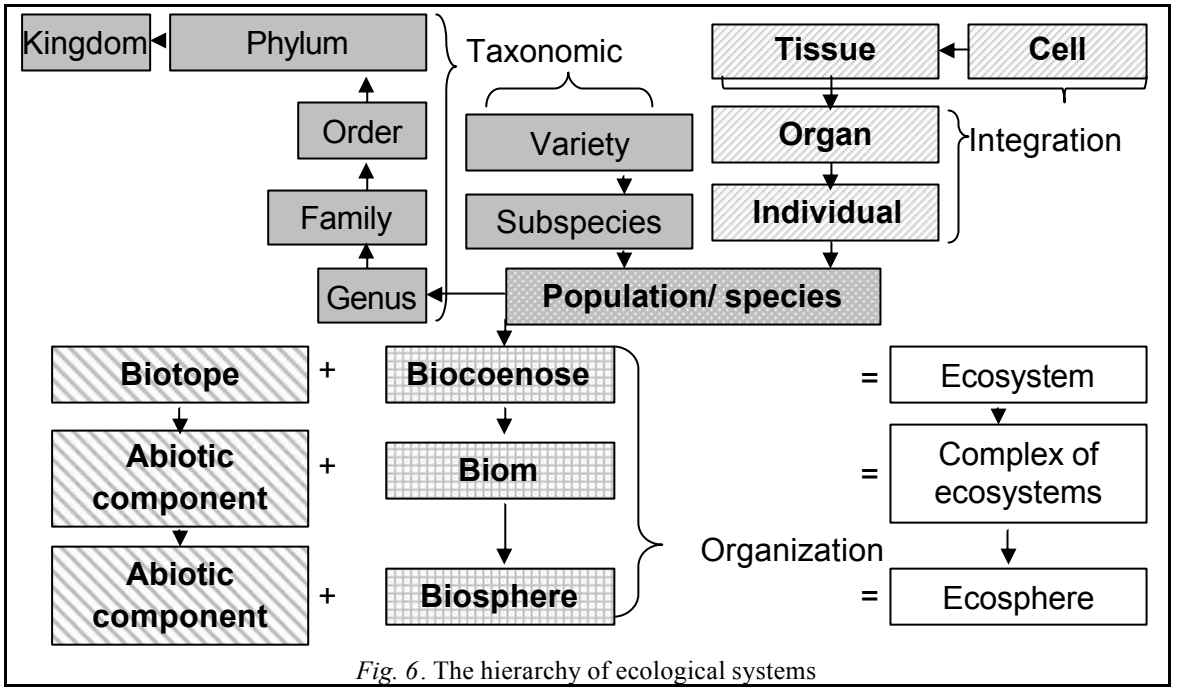


Fig. 6. The hierarchy of ecological systems

Deterioration of the Environment

The concept is an "umbrella" covering negative environmental effects of human activities: pollution – linearization of food and energy circuits, loss of biodiversity, fragmentation of habitats, introduction of alien species, genetic manipulation, construction of dams and other water works etc.

The leading causes are the growth of human population and its needs. Abraham Maslow has proposed a pyramid of needs: (1) physiological, (2) safety, (3) social acceptance, (4) self-esteem, prestige and success, and (5) self-realization.

Responses to the Deterioration of the Environment

1. "Zero-growth" solution – Club of Rome, 1972
2. Sustainable development: equally meet present and future needs (1987 – Brundtland Report, 1992 – Rio de Janeiro). Sustainable development equally implies a sustainable (wise) use of natural resources within the limits of the carrying capacity, conservation of biodiversity (via natural and cultural protected areas), ecological restoration of deteriorated systems and preventive actions embedded in sectoral development strategies, including the internalization of environmental costs and environmental impact assessment. The main components of sustainable development are displayed in *Fig. 7*. The carrying capacity represents the ability of a system to maintain its structure and function, producing a certain amount goods and services for a given human population.

Conservation: the "zero-growth" model promotes strict conservation called *preservation*; in sustainable development, conservation means to bring a system to a condition where it can self-regulate (within the limits of its carrying capacity).

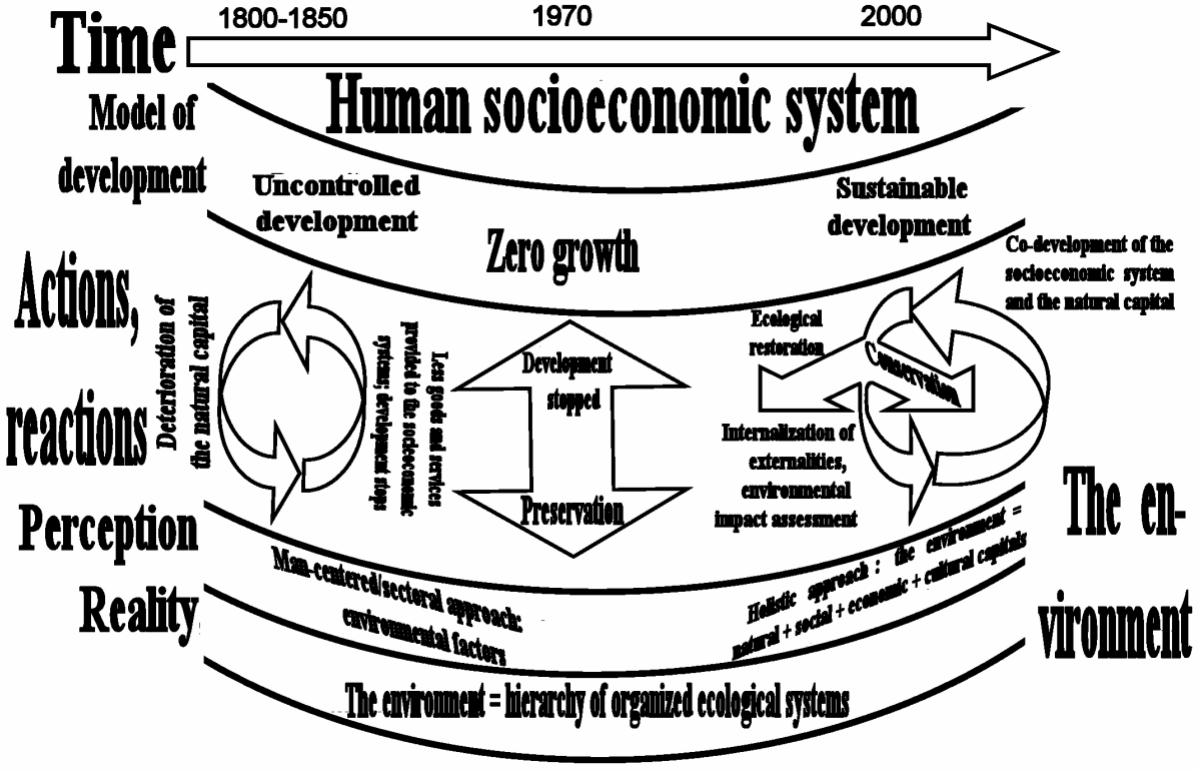


Fig. 7. Sustainable development: timeline

Techniques used by Ecological Engineering to Reconstruct Deteriorated Ecological Systems

- ***Restoration***: bring the system to a previous state/condition
- ***Mitigation***: diminish or compensate functional loss
- ***Creation***: convert a system to another one that did not exist on site in the last 100-200 years (otherwise refer to restoration). Such systems can either survive naturally or helped by man.
- ***Enhancement***: improve some values of parts or the whole – others may decrease
- ***Rehabilitation***: sometimes synonym with restoration or a component of it; represents a return to a system that did not exist on site; however, the reference is that the final goal is not the previous state, but some situation better than the current one.
- ***Amelioration / regeneration***: similar to rehabilitation, start from parts remained from the previous system.
- ***Bio-manipulation***: use fauna or flora to recreate or enhance deteriorated systems.

Biodiversity

Rio de Janeiro convention on biological diversity: variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

What means: diversity of biocoenoses, biotopes; of complexes of ecosystems (including ecosystems), of human population and artificial ecological systems.

Components:

- Ecological diversity, at several levels: complexes of ecosystems, species and ecological niches
- Diversity of organisms – taxonomical hierarchy
- Genetic diversity – genotypes, frequency in populations
- Cultural diversity – interaction of man at all levels, traditional lifestyles