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ORIGINAL PAPERS

Some Remarks Regarding the Organization of the Living World

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Abstract
The work deals with the way notions regarding the organization of the living world emerged, and the way they fit in an unitary insight via the systems theory. The connections between species and biocenoses as community-based (multi-individual) systems are briefly discussed, as well as the major part played by biocenoses in the life of individual living systems and in the creation of a more propitious environment for the existence and the perpetuation of life on Earth.

Keywords*:* living matter, living systems, systems theory, biocenosis

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Introduction

The living world is, in all its forms, extremely diverse. It consists in milliards of organisms, grouped in a vast array of associations which form several living coverings which used to coat the largest part of our planet (Botnariuc, 1961, Godeanu 2007, Godeanu et al., 2010, Godeanu 2012). The fact is that in this huge biodiversity there is an order, a certain organization, which ensures the durability of life, in ways that cange with the altering of the environmental conditions present at the earth's surface (solar radiations, atmoshere, water, rocks, landforms, types of soil).

Practical knowledge regarding the organization of the living world has been, even since the emergence of man, a vital necessity. The survival and perpetuation of the species (i.e., of human populations) relied on the capacity of individuals to recognise plants and animals – useful ones or pests – and the places they could find theme. When some of the human populations started migrating, men became aware of the great changes occurring in nature, on more and more vast and geographically diverse areas. One can assert that man, from the moment it became a thinking and speacking being, knew species – as individuals, as populations, as biocenoses (as part of ecosystems or of ecozones). When communicating, people used concrete names: goat, wolfe, falcon, herd, forest, meadow, desert etc. This is also attested by primeval art (cave paintings, jewelry), as by animal and plant debris found on archeological sites, by ritual dances (Eliade, 1991), as well as by writings (Aristotel) and art \from antiquity and the middle ages [Bauhin (1550-1613) and Gesner (1516-1565) cit. Botnariuc 1961]

The scientific knowledge of the living world – i. e., the elaboration of general notions regarding this world's units and the investigation of these units by special methods – developed mainly during the last three centuries, when global economy gained momentum, a generalized learning was adopted and society's needs diversified, hence, in the present period of the scientific knowledge's development.

The units of the living world were gradually established, as a consequence of the numerous aims of society and of the growing interest and dedication of concerned scientists.

To begin with, attention was paied to indivual organisms, their structure and functioning (Gesner and Ray, cit. Botnariuc, 1961). It is during that time that morphology, anatomy, physiology – later, cytology and microbiology – emerged. Notions as organism, organ and cell appeared (Hooke). When, after the great exploring expeditions, rich collections of plant and animal specimens were assembled, the necessity of setting them in order appeared. This led to the notion of species (Ray, cit. Botnariuc ,1956, Linne 1753) and to the emergence of other sciences, such as taxononomy and systematics.

In the course of these expeditions, it was noticed that, on territories governed by different clime conditions, vegetal and animal world looked and developed differently (Humboldt, 2014). This remark led to the notions of natural zone and biosphere (Vernadsky, 1926) and to the emergence of biogeography, as a branch of geography.

Towards the end of the XIXth century, it was discovered that plants and animals live together, in associations that have been called biocenoses (Mȍbius, 1877). At the beggining of the XXth century it was ascertained that these associations are connected to certain environmental non-living conditions (Morozov, 1912). This ensembles were named ecosystems (Tansley, 1935). A new science thus emerged – biocenology (synecology) (Mȍbius, 1877) and the biome was definit (Clements, 1916).

Applied sciences – as agriculture, sylviculture, praticulture, pisciculture etc. – which took over much from the advances of fundamental sciences and adapted them to the actual needs of society developed concurrently with the fundamental life sciences.

During the XXth century, the expansion of genetical and ecological research triggered more and more intricate issues and led to the conclusion that there is a unit of the living world – the population of organisms – within which genetical species-specific processes take place (Ford, 1964), while the same unit plays a part in the ecological processes within biocenoses, i.e. ecosystems (Odum, 1971). Ecological genetics (Ford, 1964), and demecology (Braun-Blanquet, 1921, Du Rietz, 1930, Odum, 1953, a.o.) thus emerged.

Towards the middle of the XXth century, geographical research led to the identification of complex territorial units within geographical zones; these units, characterized by certain differences in climate, landforms, rocks, soil and types of biocenoses, were named landscapes (Opel, 1884, cit. Troll, 1938) and became the subject of a new science, landscape ecology, dealing with this specific unit of the living world – the <u>biolandscape</u> (Troll, 1939).

Hence, during the centuries when scientific knowledge concerning the living world developed, the main notions refering to units this worls is structured in: <u>organism</u>, <u>cell</u>, <u>species</u>, <u>population</u>, <u>biocenosis</u>, <u>biome</u>, <u>bioshere</u> (Brewer, 1994, Botnariuc, 1967), were defined. Certain connections between these units were also pointed out (e.g., between organisms, populations and biocenoses, types of biocenoses and biolandscapes, biomes and biosphere etc.), but no unique insight concerning the place of each unit within the living world and the connections between them was advanced. Such an insight was possible only after the systems theory (elaborated, then developed by L. Von Bertalanffy, 1940, 1968) appeared. According to this theory, the entire universe is ordered in systems, i.e., in „ensembles of interacting elements" manifesting themselves as whole, heterogenous units provided with the capacity of self regulation.

The theory was also applyed to the living world (in Romania, especially by N. Botnariuc – 1976, 1984, 2005) with some characteristics one must take into account:

- living systems are ensembles of individuals connected by relationships which, alongside wholeness, heterogeneity and self regulation have the capacity of self reproduction and self modeling (self patterning, self adaptation and self evolution);
- living systems are open systems which, in order to exist, need a permanent source of matter and energy – an environment which they alter by interrelating with it;
- living systems are forming at several levels of organization and they differ in size as well as in structure and vital functions;
- living systems are integrating one into another, from the smallest (microscopic) to the largest one (the biosphere), thus generating a hierarchy of systems;
- consequently to this integration, each inferior system is included in the superior one via subsystems and is submitted to the laws which govern this system, without loosing its own structure and function;

The appliance of the systems theory has shown that the living world is a vast unit including a great diversity of tightly interconnected entities. Concerning the hierarchies within living systems, their content and their names, some remarks have yet to be made.

Within biological hierarchies, one can distinguish three categories of systems: the individual ones (at the bottom of the hierarchy), the communitarian (multi-individual) ones, in the middle – and the space-based (multi-biocenotic) ones at the top.

Regarding individual systems, the approaches differ in respect of their number, their content and their names. It have been proposed to consider the way these systems emerged and evolved and the forms in which they still exist (Godeanu, 2007, Botnariuc, 2005). Individual systems could thus be precellular, precariotic cellular, eucariotic cellular or pluricellular (privided with tissues and organs) ones (Figs. 1 and 2).

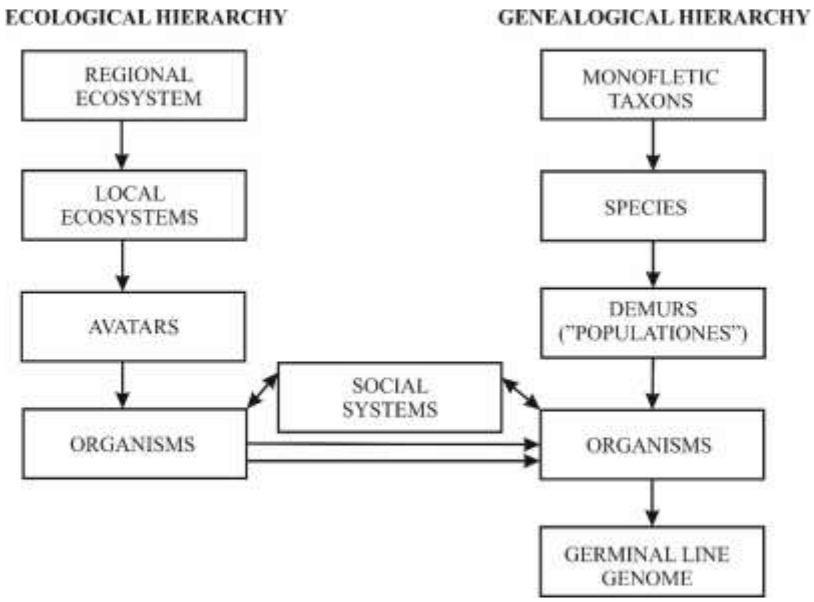

Fig. 1. Hierarchy within the living world (Botnariuc, 2005)

Regarding community-based systems, the main issue concerns the relationship between the two systems involved in the hierarchy: the species and the biocenosis.

The specie was – and still is – defined mainly as a genetic unit, involved in reproduction, heredity, multiplication, adaptation and evolution (Zawadsky, 1961, Mc.Arthur et.al., 1970, Ceapoiu, 1988, Mayr, 1982, 1957, Ghiselon, 2002, Apaloo, 2002). It is not specified that it also is an ecological unit. Research concerning ecological genetics revealed the important role populations are playng in evolution, hence in genetical processes (Ford, 1964, Stern & Roche, 1974). Detailed study has been dedicated to adaptive processes connected to the environment (the ecological niche), without noticing that this was the very way in which the ecological character of the species was emphasized.

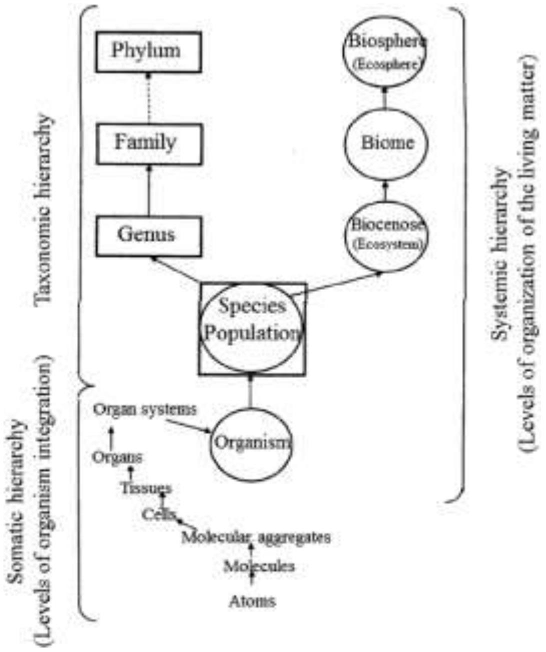

Fig. 2. Hierarchic relationships in the living world (Botnariuc, 1976)

Biocenosis was at first considered as merely an association of specie (Braun-Blanquet, 1926, Godeanu & Donita, 2016, Donita & Godeanu, 2019). It was only after population was defined as „a group of organisms belonging to the same species and inhabiting a biocenosis" (Du Rietz, 1930) and it has been specified that the population is part of an ecosystem (Tansley, 1935) that more detailed studies concerning its ecological role started (in synecology) (Odum, 1971).

But neither in ecological genetics nor in synecology studies has the relationship between species and biocenosis been approached – although, in an ecology treatise, one chapter was called „The species, the individual within the ecosystem" – but without discussing this subject (Odum, 1971).

In order to clear up the connection between species and biocenoses, one can start from several statements:

- species are not only genetic systems and taxonomic units, they also are ecological units, provided with adaptations which ensure their surviving and their evolution in the most diverse conditions of the nonliving environment, at a global scale (Van Valen, 1976, Doniță & Godeanu, 2019);

- species are functionally differentiated in three large ecological categories: producers, consummers and bio- and necromass decomposers; (Doniță & Godeanu, 2019);

- in consequence, in the wild, species can not live separately, autonomously, but only in mixed associations – in biocenoses – integrated in their specific non-living environment, i.e., in ecosystems;

- within biocenoses, species do not exist as a whole, but are reprezented by populations (ensembles of individuals belonging to the same species) which become structural and functional parts of the biocenosis they belong to;

- these populations are found (only one at a time) in several biocenoses of the same type, where the living environment (other species' populations) and the non-living one (the particular biotope) are consistent with their ecological adaptations;

- within biocenoses (hence, at ecosystems' level) the ecological processes of production, consumption and decay of bio- and necromass are taking place, as a result of relationships between the organisms which form the species' populations, integrated in trophic chains and networks; these processes ensure the energy and the matter necessary to the ontologic development and to the current existence of species, by eliminating the necromass and recicling the vital elements it is composed (Botnariuc 2005);

- within biocenoses, too (respectively, within ecosystems), genetic processes concerning species' perpetuation and evolution (reproduction/heredity multiplication, adaptation, emergence of new subspecies, then species) are taking place, at the level of each population (Godeanu & Donita, 2016, Donita & Godeanu 2017).

Considering all these remarks, we can affirm that, at the community-based (multi-individual) organization level, there is only one system, the biocenosis, in which species – which cannot exist independently, being ecologicaly differentiated – are integrated, via their populations. It is only within the biocenosis and its non-living environment (the biotope) that the ecological process ensuring the existence of species and of the biocenosis takes place, as well as the genetical processes ensuring species' perpetuation and their evolution – implicitly, that of the biocenosis.

Hence, the hierarchy of living systems migh have the following shape (Fig.3 and 4).

Being integrated in biocenoses, species have a more efficient access to vital resources and are abble to ensure their perpetuation and evolution, without loosing their genetic and taxonomic identity.

Biocenosis plays an upmost role in the hierarchy of living systems (Doniță, Godeanu 2019).

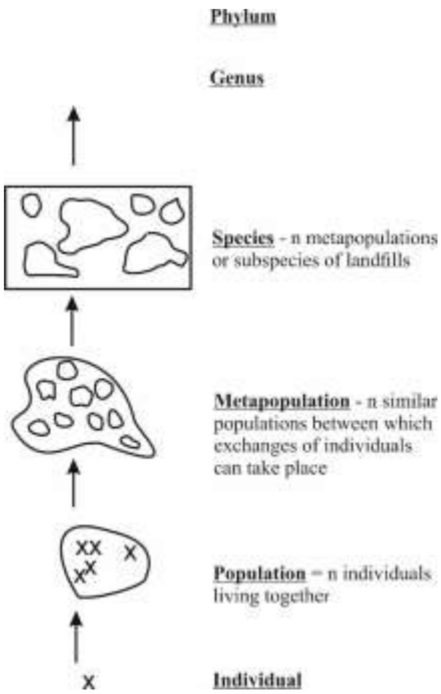

Fig. 3. Detailing of the living systems, from individuals to phylla

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It is within the biocenosis and its environment (the biotope) that all inferior individual systems are integrated (indirectly, via the populations already incorporated in the pluricellular individual system and directly, via cellular and precellular systems' own populations). In the biocenosis, inferiour systems come into contact with one another and with the non-living environment, thus generating the ecological process wich ensures their existence and their evolution.

The biocenosis is in the same time the elementary constituent of superior systems (biolandscapes, biomes, biosphere), through the territorial ensembles it forms. The local alterations triggered by biocenoses and their ecological activities, greatly amplified at the scale of the superior levels, generate, on the surface of the planet, an environment which is more favorable to the existence and the perpetuation of life.

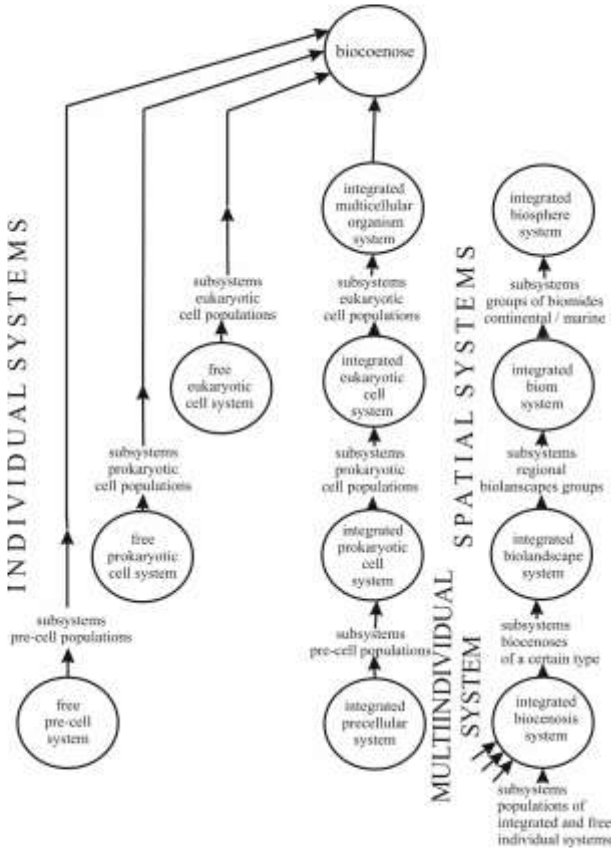

Fig. 4. Hierarchy of living systems and subsystems
(for technical reasons the diagram is interrupted at the level of biocenose)

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