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FUNCTIONING AND DYNAMICS OF PERTURBED ECOSYSTEMS

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PREFACE

Natural milieus - Anthropized milieus. What is the future for Ecology?

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The ecologist is, to an increasing extent, confronted with man's actions on ecosystems, and is becoming more and more preoccupied by their impacts. The characterization and evaluation of these actions and impacts are under debate, particularly in zones where they have been occurring for centuries, even millennia. The debate develops simultaneously in various ways: theoretical, scientific, administrative and political. The word milieu is frequently used in expressions, such as *marine milieu*, *terrestrial milieu*, *natural milieu*, *perturbed milieu*, and even *ambient milieu*, although the latter is a pleonasm. Other terms, such as *population*, *ecosystem* and *ecocomplex*, are also commonly used. According to the approach, one word may be used in preference to another, often without taking into account that this could lead to misinterpretation, possibly having catastrophic consequences on a mid- or long term scale. Therefore, it is essential to know the definition and use of such terms.

In the French "Robert Dictionary", *milieu* is defined as *all material objects, living beings and physical, chemical and climatic conditions, that surround and influence a living individual* (translated from the enclosed French version). In the Dictionary of Ecology and Environmental Sciences (Ramade, 1993), only *natural milieu* is specified, defined as *the term used in physical geography to denominate geographical entities which share common ecological characteristics* (translated from the French version). In fact, milieu is not a well-defined scientific feature, like "peuplement", another French word commonly used by ecologists. Such words have broad meanings and should be defined by the author using the word.

Some authors, such as Jollivet and Pavé (1993, 1994), have suggested substituting milieu and nature by environment. Jollivet and Pavé (1993) define *environment* as: *all the natural (physical, chemical, biological) and cultural (sociological) conditions influencing living organisms and human activities*, adding *direct or indirect effect, immediate or later*, and a more recent definition (1994): *the environment is all natural or artificialized systems of the ecosphere, in which man is living, exploiting and transforming, and all non-anthropized systems necessary for its survival* (translated from the French version).

In contrast to milieu, the word environment is an anthropocentric concept because it integrates socio-economic characteristics and development. Consequently, the scientific term *ecosystem* is given a social dimension, as defined by Lindeman (1942): *the ecosystem may be formally defined as the system composed of physical-chemical-biological processes active within a space-time unit of any magnitude, i.e. the biotic community plus its abiotic environment.* Such an opinion has recently been developed within the concept of *ecocomplex* (Blandin and Lamotte, 1985). Blandin and Bellan (1994) pointed out that *the present state of an ecocomplex results from the combined effects of different categories of processes which have played, and still play,a role on present and different time scales. Some are purely spontaneous, that is to say, only due to a series of physical, chemical or biological events, while others have an anthropic origin, when all the events are initially or permanently due to human activities. According to the studied ecocomplexes, the relative importance of the processes of anthropic origin can be of no account here, considerable elsewhere, with all possible intermediate stages* (translated from the French version).

In the context of these definitions, the opposite concept to natural milieu is anthropized milieu, and can be expressed within the range of various processes, from those limited to the series of natural events (physical, chemical or biological) to those in which man's actions occur in all their forms. Traditionally, one distinguishes between natural milieus and perturbed milieus: however, this is incorrect because a natural milieu can be strongly perturbed by a natural cause (such as fire induced by thunderbolt, heavy rains provoking a fall of salinity in a lagoon or a flood). Therefore, it is more appropriate to contrast natural milieu with anthropized milieu. Nevertheless, such a statement must be moderated when considering the importance of man's historical impact on the ecosystems, mainly the continental ecosystems. Furthermore, several questions can be asked: Do natural milieus, which have not yet been influenced by social-man or socio-economic-man, still exist? The only remaining milieus, on which man has a weak direct influence, are the harsh milieus, deep-sea and polar ecosystems. How does one distinguish a milieu anthropized by man as species from that anthropized by social-man? How does one distinguish a milieu perturbed by a natural phenomenon from one perturbed by anthropization, as in regions which have recently experienced flood events? Finally, how would artificialized milieus evolve if human pressure dropped, increased, or changed in nature? The scenarios developed from such changes constitute, for the ecologist, a field of quasi-experimental investigation allowing the evaluation of the characteristics of the ecological systems, their capacity of

resilience and/or their capacity to evolve. The future of renaturalized systems is biologically and ecologically unpredictable since, according to the history of disturbance, one does not know whether the system will return to a state of previous maturation or develop towards a new evolutionary trend. Therefore Ecology, and consequently ecologists, faces up to new situations in a competitive world dominated by the conciliation of the environment's quality (socio-economic) and the needs and expectations of human societies' development. The evolution of terrestrial ecosystems, on both sides of the Mediterranean Sea, is in this respect highly exemplar. For centuries, the terrestrial Mediterranean ecosystems have been under pressure due to the effects of agro-sylvo-pastoral activities. This has led to huge desertification in southern Mediterranean regions, while in northern regions there is currently a return of spontaneous forest systems, which are expanding. This return may lead to a re-naturalization resembling the former situation. However, what is the real situation?

The ecologist's approach must recognize three main successive steps: - the highlighting of the problem according to an ecological procedure, which is original and specific to Ecology as a science; - the ecological study based on rigorous well-defined methods; - the proposal of a diagnosis. In any case the ecological study is intuitive and/ or leads to a formal decision which is the responsibility of the politician and/or the decision-maker.

The **ecological procedure** analyses specific processes of the milieu, but the study of the milieu can only be systemic because a separate analysis of each process does not lead even partly to a solution, but provides merely the bases in understanding the multiple interactions, which provide a realistic image of the milieu.

The ecological approach is interdisciplinary, contrary to the environmental approach which is multidisciplinary. An ecological prospective study represents neither a prediction nor a forecast of what the future of the environment should be. No long term view outlined in an ecological scenario is ambitious enough to predict what will happen, nor give simple formulas for future actions. Its objectives should mainly be to fix the limits and provide the framework to the socio-economic scenarios.

The different simultaneous approaches of the milieu have to take into account the multiplicity, and the fitting in, of space and time scales, and the fluctuations and interactions of physical, chemical and biological features in relation to the organization levels of the biological and ecological systems (individuals, populations, biocoenoses;

species, ecosystems, ecocomplexes). Such scales develop from local order to biosphere, from present to geological eras, from macromolecules to ecosystems.

The main difficulty is to distinguish the natural fluctuations and variability from the fluctuations and variability which are, or have been, induced by human activity. Indeed, the diversity and importance of the actions and effects of anthropization on natural milieus occur through quadruple intervention: 1. distribution and concentration of the constituents of the environment (mineral and living resources) leading to a modification of the spatial distribution; 2. synthesis and utilization of new "products", and introduction of new "species" interfering in the major cycles; 3. involuntary or voluntary destruction of ecocomplexes with the consequences on neighbouring ecocomplexes and biodiversity; 4. major changes of the populations' life conditions, including those of humans.

Ecological problems, particularly those related to pollution or to utilization of resources, rarely concern only the local order, because they affect large geographical zones and many varied ecosystems. They are directly related with environmental management because the politicians and decision-makers generally want to consider only those problems in their zone of intervention, which is of local order. Examples, such as the nuclear catastrophe of Chernobyl, the utilization of lead (by the Romans), traces of which have been found even at the Poles, or sylvo-pastoral behaviour and traditions which have fashioned the landscapes, illustrate perfectly the extent to which local risks have become a danger for the biosphere. On the other hand, the global level generally masks local or regional evolution and does not take into account unpredictable or predictable events, natural catastrophes or technological accidents, which may all highly influence the entire, or an important part of, the biosphere. Ecological scenarios may be leaked out, modified, adapted, sometimes rejected by the socio-economic scenarios which are prepared and governed by other scientific disciplines, including geography, history, economics, and sociology.

The **ecological study** of a milieu is the indispensable and necessary basis for all future evaluations of the environment. Such a study focuses on the characteristics of the concerned milieu, which are:

1. the biological constituents and the physical, chemical, geological factors, and their dynamics;

2. the functional processes, implying the constraints and interactions of the above space-time-depending constituents and factors. The biodiversity is closely related to this

aspect, because its dynamics, maintenance and development are directly linked to the ecosystem structure and functioning, while its characterization belongs to taxonomy and systematics.

At each stage of the study, the "natural" part of each character has to be weighed up against the role played by human intervention. This latter anthropic part belongs to the ecological study but has no socio-economic dimension in this study. The ecologist's analysis represents an independently-based approach, in which his research fixes the fundamental limits of the environmental scenario. However, he is not directly concerned by the environmental approach, which is socio-economic. Nevertheless, the ecologist is directly confronted by:

1. the technology. He has to follow carefully the evolution of the techniques developed by man when they lead to new introductions into a milieu (such as molecular, culture or exploitation processes...) or when they induce recovery or modification means of natural or anthropized milieus (such as processes involving sewage and purification);

2. the management and protection of the species and milieus. The ecologist has to interfere within the economic and judicial arsenal, at regional, national and international levels, to limit and reduce problems, such as urbanisation pressure (for example in France through the "Plan d'Occupation des Sols" or the actions of the "Conservatoire du littoral"), and to propose the creation of biological preserves, parks or sanctuaries. He must also fight against threatening economic ventures and fearsome effects of the Biodiversity on man's cultural diversity.

The ecologist should get a more or less complete **diagnosis** of the situation and propose a dynamic scenario, or perhaps even a model. Ecological data, though, tend to be minimized in relation to economic data (agriculture, industry, energy, tourism, transportation), to social factors (demography, urbanisation), and to basic natural resources (forests, freshwater, coastal zones, seas). The socio-economic scenarios have a predominant importance in the environmental context, because they strengthen, support, and justify the orientations for the action of governments, international organizations, and local and regional authorities. Indeed, the tendency is towards continuously increasing economic and popular pressure, especially during economic difficulties. However, political choice, which is inevitably limited, should not promote socio-economic orientations in favour of ecological imperatives. These orientations should be developed within the limits, context and frameworks of the ecological scenarios. The latter, though, are all too often considered

as limits to the stakes of human societies, because the measures, results and analyses of the ecological scenarios, which are essentially objective, do not allow any compromise, while the socio-economic disciplines based on a subtle interaction with human society are inescapably subjective. If socio-economic acceptability continues to prevail over bio-ecological acceptability, the survival of human populations, perhaps of the human species, is in danger.

Currently, Ecology is a young science, lacking manpower and funds. Nevertheless, Ecology is the "basic science" for environmental and " Global change" programs, but should not be considered as an integral part of these programs, as stated above.

Presently, the ecological studies are limited to certain regions of the globe. Therefore, much progress is needed before being able to propose ecological models which will envisage a planetary or global evolution. However, models on a planetary scale could be oversimplified, so much so that they would not take into account what is already known on smaller-scaled systems and hide the complexity of the interactions between bio-ecological levels and between integration assemblages within the biosphere. The validity of the global ecological analyses and their estimates remain related to the account of the evolution at local and regional scale ("theory" of the flight of the butterfly!). Consequently, such analyses for socio-economic purposes should, at present, be used carefully when applied to planetary changes.

The European Union has to facilitate the ecological studies in countries in which ecological management has been neglected, to say the least, and should itself apply a reasoned management of the environment for long term development (Rio Conference).

Can man be considered as a constituent of the weakly, supposedly natural, anthropized milieus while highly anthropized milieus represent a category "created" by man? With this book, we wanted to provide the ecologists with a stand to express themselves, pool new results, and share observations and anxieties on the dilemma of *Natural milieus-anthropized milieus.*

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