Preface

The new book presents the latest research on ecology, which is the study of the interrelationships between organisms and their environment, including the biotic and abiotic components. There are at least six kinds of ecology, among them ecosystem, physiological, behavioral, population, and community. Specific topics include: acid deposition, acid rain revisited, biodiversity, biocomplexity, and carbon sequestration in soils, coral reefs, ecosystem services, environmental justice, fire ecology, floods, global climate change, hypoxia, and invasion.

Chapter 1- Soil is also considered as living tissue, a reservoir of nutrients and the seat of biological activity. Soil fauna influence soil physical properties, nutrient cycling and decomposition of biomass and organic matter. The degradation of soil is increasing as a function of increasing population and pollution. The depletion of organic matter in intensively used agricultural land leads to reduction in productivity of soil. This problem may irrepairable. In some areas of the world the loss of structure, organic matter and actual soil is impossible to compensate. The degradation of soil may cause many social and environmental problems. A common feature of all sorts of soil degradations is the significant decrease of organic reserves and severe decline in soil invertebrate communities, especially earthworms. A number of books have appeared which describe the role of earthworms in soil system. Earthworms are an indicator of biological health of most soils. Its density and biomass range from less than 10 individuals and 1g m^{-2} to more than 1000 individuals and 200g m^{-2}. They help considerably in building soil fertility of pedoecosystem. Earthworms have dynamic potential. They are very useful in pollution control and land reclamation, soil improvement, organic waste management and generation of growth stimulating and biopesticidal substances. Therefore, maintenance of earthworm biodiversity is crucial for sustainable management of soil properties and minimizing risks of soil and environmental degradation. In light of the above view, it was considered of an interest to review dynamic role of earthworms in soil system.

Chapter 2 - Various efforts have been made in the past to understand the role of invertebrates in soil processes. Since extreme exploitation and maltreatment of land in a number of countries has had devastating impacts on terrestrial ecosystems (i.e., loss of biodiversity), the biodiversity issue became a political topic. Recently, biodiversity has been linked to agroforestry practices. Publications of reports on sustainable land use and soil biodiversity by various international organizations leave the impression that soil fertility is controlled by soil biodiversity. It means that low soil fertility occurs together with a decrease in soil biodiversity. This is the point of attraction for biologists to look into the role of below-ground faunal biodiversity in maintaining sustainability of soil system. Since valuable reports propagate below-ground biodiversity as a soil health indicator, the authors take an opportunity here to critically and experimentally analyze this notion.

Chapter 3 - This chapter explores the survival and persistence of cultivable *E. coli* in surface waters, the interplay between *E. coli* as a member of the bacterioplankton and biofilms and its immediate neighbours, predators and phages. It also examines the extrinsic physicochemical environmental variables as they may influence numbers of indicator bacteria present, the intrinsic bacterial responses or adaptations that may permit their survival, and effects on the predator-prey relationship. The methods used to detect indicator bacteria are addressed together with the limitations of these methods and the consequences for the quality of the data obtained. An attempt has been made to separate the discussion into logical sections but there is inevitably some overlap that may require the reader's attention, and is necessary to avoid duplication. Furthermore, there are topics that are mentioned but cannot be addressed in detail even though they are relevant: an example is the cell-cell communication that occurs among members of a bacterial community and its interruption. This is considered outside the general scope because too little is known about its operation in situ in natural microbial assemblages. This chapter does not review the sources of *E. coli* to the soil or aquatic environments, though each of these may have somewhat different effects, nor does it address microbial transport; both of these issues are critical to risk analysis and risk management.

Chapter 4 - Microbial ecology studies have been focused on bacteria, archaea, microscopic eukarya and viruses interacting with their biotic and abiotic environments. The study of microbial ecology can help us to improve our lives via the use of microorganisms in environmental restoration, food production and bioengineering of useful products, such as antibiotics, food supplements and chemicals. The study of these diverse creatures that are everywhere is fascinating and appeals to our curiosity. For example, an average gram of soil contains one billion microbes representing probably several thousand species. Nevertheless, most types of microbes remain unknown and it is estimated that we know less than 1% of the microbial species on Earth.

Chapter 5 - Since long ago, humans have been using plants, animals and also microorganisms as source of chemicals and products. With recent developments in the exploration of the microbiological and genetical world, this resource became still more promising, and stimulated a new area of research, bioprospection. Roughly speaking, it comprises the search of new economically viable compounds, produced via catabolic reactions, which can be efficiently manipulated and applied to some chemical processes of interest in industry, health or environment. As an example of new trends in ecology microbiology, this chapter is concerned with the bioprospection of bacteria, looking for biocatalysts to prepare pure enantiomerically compounds, to be applied to pharmacology, and hydrocarbonoclastic consortia, to be applied to bioremediation of oil-contaminated environments. One hundred and six bacteria strains, with potential for synthesis of chiral molecules, were obtained using 8 different carbon sources (4 nitriles, 2 alcohols and 2 ketones). Moreover, 5 bacteria strains, capable of degrading hydrocarbon compounds (between 16 - 45%) in laboratory conditions, were also isolated from a hydrocarbonoclastic consortium. Unexpectedly, when this consortium was applied to some *in situ* microcosms (planted on a mangrove ecosystem) the oil compounds were not reduced significantly. This result shows the necessity of making *in situ* experiments to test the real potentiality of the microorganisms for remediation of contaminated sites. It also reinforces that natural ecological systems are very complex and hard to control, and that our knowledge about the biotechnological potential of microorganisms has much to be developed. Meanwhile, the authors discuss the importance of selecting a suitable culture media (carbon source) and the modern tools for studying the biodiversity of the samples and the chemical potential of the isolates.

Chapter 6 - Of all characteristics of animals, body size most crucially relates to the overall integration of other features. Knowing only the mature mass of a species allows fairly accurate prediction of the majority of other important functional features and life history traits. These include aspects like metabolic rates, longevities, time to mature, proportional sizes of tissues such as brain and fat, fecundity, gestation time, population growth rates, and a host of others spanning molecular to community levels of organization. This represents the science of allometry. Although allometry powerfully describes the integration of features associated with size, it says virtually nothing about why species evolve to particular sizes. Remarkably, besides predicting longevity, body size also predicts both extrinsic and intrinsic mortality rates. This chapter melds allometry to the two crucial dimensions governing life history evolution (allocation and risk). This yields a synthetic theory that spans both the integrative ramifications and evolution of body size. This framework yields quantitative descriptions of organismal integration and links aspects of fitness to body size to explain body size evolution.

Chapter 7 - Spontaneous pattern formation, the appearance of inhomogeneities that are not directly imposed by external forces, can be an important but overlooked factor in the origin and maintenance of genetic diversity in populations, and in parapatric speciation. Using agent-based simulation models with multilocus genetics, the authors show that such patterns form in spatially distributed populations with local mating neighborhoods. Under these conditions, disruptive selection induces spontaneous pattern formation and coarsening in the spatial distribution of genotypes, and thus increases the persistence of genetic diversity. The lateral motion of hybrid zones between different genotypes of similar fitness is affected by their topological shape. Hence, the shape of these boundaries plays a crucial role in determining the rate of genetic variation and the long time behavior of the population. These patterns also interact with boundary and internal obstacles of habitat structure, so that diversity persists the longest in habitats with the most irregular geographical features. Localized obstacles contribute to the maintenance of genetic diversity even if they do not preclude interbreeding, by inhibiting the movement of hybrid zones between areas dominated by different genotypes. The authors' results imply that the most effective size of such obstacles for maintaining diversity is about the same as the radius of a local deme. These results are relevant to spatial ecology and conservation biology, in which both genetic diversity and the size and shape of population reserves have great import for the long-term survival of species in the wild. They also imply significant coupling of population level and ecological properties to evolutionary dynamics. The persistence and amount of diversity, the relationship of diversity to evolutionary change, and the survival of types is controlled by the genetically undetermined spatial distribution of types and the structure of the habitat.

Chapter 8 - Wild aquatic birds, in particular *Anseriformes*, are believed to harbour the entire gene pool of influenza A viruses in a well adapted host-parasite balance, thus playing a crucial role in influenza ecology. This stable interaction allows the natural circulation of lowly pathogenic (LP) avian influenza viruses (AIVs) responsible for avirulent infections in these wild species. All of the 16 haemagglutinins (HAs) and 9 neuraminidases (NAs) detected so far circulate in the wild avian reservoir, from which AIVs can occasionally spread to nonreservoir avian and mammalian hosts.

This interspecies transmission causes a rapid viral evolution, a typical example of which is observed when H5 and H7 subtypes infect *Galliformes* birds. When a similar event occurs, virus pathogenicity may increase dramatically and, in some cases, represent an emerging risk for human health.

Until 2002, mortality episodes due to highly pathogenic (HP) AIVs were extremely rare in wild aquatic birds; the only reported case occurred in 1961 in South Africa, where a HP AIV (H5N3) hit a common tern colony. In late 2002 an outbreak of HP avian influenza due to a H5N1 subtype was detected in waterfowl found dead in two natural parks in Hong Kong; compared to the 1997 H5N1 viruses, that killed 6 humans in Hong Kong, these novel strains showed an increased pathogenicity in ducks.

Currently, new epidemiological aspects regarding the spread of H5N1 influenza viruses in large parts of the Eurasian area in 2004-05 are emerging, and the potential zoonotic implications of these viruses pose a great concern in both the scientific community and public opinion. Taking into account these recent developments, in this chapter the authors describe and discuss the epidemiological role played by different species of wild avifauna in maintaining and spreading these dangerous viruses.

Chapter 9 - It will be argued that research in Ecology is not exhausted at the level of natural sciences. The human interference in all natural systems of the world is so pervasive that a description of ecosystem dynamics not considering even only indirectly the consequences of human activity will lead to wrong predictions of the natural processes. If this statement is true, in the sense that it is empirically testable, and if human action is assumed to be an outcome of a decision process, then research in ecology has to be considered in the context of a decision making process, where individual and social values as well as scientific and technological knowledge have to be interrelated. This interrelationship may be formulated in terms of modal logic such that value judgments and scientific statements are expressed in the same linguistic form. It is claimed that the focus on the decision process as the primary phenomenon of ecological investigation leads to an epistemological framework allowing formally the same analytical treatment of both fields of natural and social science. Ecology, thereby, becomes a praxis encompassing the two realms (a) of empirical possibilities of our actions on the non-human world and (b) of our changing ecological and other ideals to which the individual or social group strives at in historical moments. Therefore, ecological action has to be considered as a constructivist process of mankind in shaping its natural environment. The article focuses the theoretical aspects of this approach and its practical consequences as applied to a complex model of species preserving management of a neotropic forest.