PREFACE

Current loss of biodiversity places a premium on the task of recognizing and formulating proposals on potential areas for biological conservation based on scientific criteria; among these tasks, identification of hotspots has a relevant role on conservation of biodiversity. In this book, the authors discuss the application of different biogeographic methods to identify plant biodiversity hotspots. The areas recognized as such have a relevant role in plant biodiversity and are important in conservation due to their climatic conditions, the historical factors that have been involved in their evolution, and the restricted distribution of some plant taxa that inhabit them. Furthermore, the consequences of deforestation on biodiversity are substantial and widely recognized. This book predicts future land-use change, generates ecological niches of large mammals and assesses wildlife concentrations and their hotspots in different areas of the world. The evolution of the forest fragmentation in the Brazilian Atlantic forest, the present situation of its remnants, and the main strategies, conflicts and potentials for conservation are evaluated as well.

Chapter 1 - The Brazilian Atlantic forest is a hotspot of biodiversity, characterized by high species richness, level of endemism and danger of extinction. The remnants of this biome stand in the most populated and developed region of the country and their conservation is in constant conflict with strategies of development. The author's study was developed in the State of Espírito Santo, in the municipalities of Linhares and Sooretama. Located at the north of Rio Doce, it was one of the last regions of the Atlantic forest to be deforested, and forest fragmentation took place mostly after 1950. The author's purpose were: 1) characterize the evolution of the forest fragmentation in this region, the present situation of its remnants, and the main strategies, conflicts and potentials for conservation; 2) evaluate the conservation value of the forest fragments based on a study of the community of a group of insects: the community of Blattaria; 3) integrate these information to propose guidelines to resolve potential conflicts based on positive and non conflictual conservation recommendations. The landscape of Linhares and Sooretama is dominated by plantations, among which can be found two large reserves and fragments of diverse sizes, shapes and degrees of disturbance. Only in Sooretama there are 213 fragments, which, with the Sooretama Biological Reserve, cover 44% of the municipality area. Similarly to the reserves, the fragments were preserved by the imposition of the law and due to the interest of people of keeping the forest as a reserve of value. Fragments are used for several purposes, being submitted to strong disturbances that could lead to their massive disappearance in a near future. The analysis of the community of Blattaria showed that the number of species shared among sites is very low (between 22.9%

and 39.6%), with a high number of species found only in single fragments and nowhere else; the richness per area in small fragments is not smaller than in large reserves; habitat diversity is stronger than the effect of area *per se*. These results show that even after more than 50 years of fragmentation and isolation, the situation of the biodiversity in this region is not lost: small and very disturbed fragments still shelter important biodiversity of insects, and can be of extreme interest for composing a set of remnants that maximizes the number of species to be protected. Based on it, the management and conservation of the biodiversity should first of all include the fragments, and for this reason should be conceived in the landscape or regional scale. At this scale, fragments should be envisaged in a management plan, in which restrictions and possible uses are explicitly established. In such a context, the choice of priority fragments should be done taking in account the landscape diversity: it should include fragments from different hydrographic basin, soil types, vegetation *facies*, as well as the diversity of use.

Chapter 2 - Modern technology of baked goods largely uses sourdoughs because of the many advantages offered over baker's yeast. Sourdough is characterized by a complex microbial ecosystem, mainly represented by lactic acid bacteria (LAB) and yeasts, whose fermentation confers to the resulting product its characteristic features such as palatability and high sensory quality. Raw materials used in baking are not heat-treated; thus, they bring their wild microorganisms to the production process. Investigation of the composition and evolution of microbial communities of sourdough and raw materials is relevant in order to determine the potential activities of sourdough microorganisms. LAB are the main factor responsible for flavor development, improvement of nutritional quality as well as stability over consecutive refreshments of sourdough. LAB also establish some durable microbial associations, and the cell-cell communication process is crucial in determining sourdough performance during fermentation. The central aim of this chapter is to report on the knowledge of LAB hosted in raw materials and sourdoughs, their biodiversity and evolution before and during fermentation, their useful properties, their quorum sensing mechanisms and the methods routinely applied to their detection and monitoring in sourdough ecosystems.

Chapter 3 - Rapid deforestation occurred in northern Thailand over the last few decades and is expected to continue. The consequences of deforestation on biodiversity are substantial and widely recognized. The objectives of this chapter were to 1) predict future land-use change, 2) generate ecological niches of large mammals, and 3) assess wildlife concentrations and their hotspots as priorities for biodiversity conservation. Three land use change scenarios between 2002-2050 were evaluated. Scenario 1 is a continuation of land use trends and predicts that forest cover will decrease from the present 57% to only 45% in 2050. Scenario 2 is an integrated-management scenario and scenario 3 is a conservation-oriented scenario directed by government policy to maintain respectively 50% and 55% forest cover (natural forest and plantation) and strictly prevent encroachment in protected areas. Geographic Information Systems (GIS) and a spatially-explicit model (CLUE-s) were employed to explore land use changes. In addition, a machine learning algorithm based on maximum entropy theory (MAXENT) was used to generate ecological niches of 18 large mammal species as a proxy of biodiversity. The likely occurrences of selected wildlife species were aggregated and classified as wildlife concentrations. In addition, the predicted deforestation areas were overlaid on high wildlife concentration to determine threats to wildlife or wildlife hotspots both inside and outside protected areas.

The results reveal that forest cover in 2050 will mainly persist in the west and upper north of the region, which is rugged and not easily accessible. In contrast, the highest deforestation is expected to occur in the lower north and remnant habitats will disappear in this area. Current suitable habitats for most wildlife species are located in the west, north and east of the region. The predicted areas of high wildlife concentration or richness (≥ 7 species likely present) are found in the western forest complex and in the northeast of the region, covering approximately 16,000 km^2 or 9.3% of the region. In addition, wildlife hotspots derived from the trend scenario encompass approximately 3,100 km^2 or 1.8% and 74% is predicted in protected area coverage. These areas are identified as high priority for biodiversity conservation. In contrast, the hotspots are predicted of less than 0.5% for the scenarios 2 and 3. Based on the model outcomes, the authors recommend conservation measures to minimize the impacts of future deforestation on wildlife hotspots.

Chapter 4 - Microscopic green algae are among the most widespread microrganisms occurring in terrestrial environments. For more than two centuries, generalizations on the diversity and biogeography of these organisms have been based entirely on morphological species concepts. However, ultrastructural and molecular data produced in the last 30 years have revealed a scenario in substantial contrast with morphological classifications. It has become clear that these organisms have been affected by an extreme morphological convergence, which has restricted their morphology to a narrow range, not indicative of their great genetic diversity. Their habit is very simple and uniform, usually referable to a few types (unicellular, uniseriate filamentous, sarcinoid colony) and offers very few characters useful for taxonomic and systematic purposes. These factors make the identification of terrestrial green algae and a correct interpretation of their biogeography very difficult. "Flagship" taxa with easily recognizable habit are the ones for which the best generalizations are possible. Examples of such taxa include the order Trentepohliales (for the highest diversity occurs in humid tropical regions of central-south America and south-eastern Asia) and members of the order Prasiolales (which are typically associated with polar and cold-temperate regions). In consideration of the recent developments, it is clear that many basic concepts about the biogeography of terrestrial green algae will have to be reconsidered critically. A deep understanding of this topic will require considerable work on many aspects of the biology of these organisms (systematics, distribution, dispersal, physiology), in which species circumscriptions based on molecular data will be a mandatory requirement.

Chapter 5 - Compared to other major regions of the North Temperate Zone, China harbours a large number of representatives of very ancient plant lineages. Relict taxa are generally survivors of formerly much more widespread lineages, having also suffered the extinction of their close relatives. Moreover, in some cases they have remained superficially unchanged for millions of years, thus being regarded as true 'living fossils'. Chinese relict lineages are mainly concentrated in the central and southern regions of the country (usually below latitudes of 35°N), where the occurrence of numerous and extensive glacial refugia has been hypothesized. Some well known examples of relict plants still surviving in China are *Cathaya argyrophylla*, *Cyclocarya paliurus*, *Eucommia ulmoides*, *Ginkgo biloba*, and *Metasequoia glyptostroboides*. Most of the abovementioned species are now threatened because of their small distribution areas and increasing habitat destruction and fragmentation. The extirpation of such relict taxa would imply the loss of unique evolutionary history.

Chapter 6 - New Caledonia is a peculiar hotspot, a small-sized island (ca. 17,000 km^2), relatively isolated from any continent (ca. 1200 km from Australia), with moderately high

mountains and complex orography. Its biota is very rich in endemic species and highly endangered. The author's analysis of the number of references in systematics, ecology and conservation shows that its biota attracts attention of scientists since long ago. In a first and long period, references focused on the description of the biodiversity. More recently these descriptions were *intensified and complemented by ecological and* later by conservation studies. Recent researches on phylogenetics and biogeography indicated that the biota of New Caledonia is characterized by short range endemism and rarity, with three patterns of endemism: (I) species regionally endemic to New Caledonia distributed in the whole range of an ecosystem; (II) short range endemics with parapatric/allopatric distributions; (II) short range endemics with disjunct distributions. Researches on conservation showed that this biota is highly endangered due to three main threats: fire, mining and invasive species. In this chapter the authors detail these threats and elaborate a model based on their frequency and spatial distribution to understand how they could affect species with contrasting patterns of endemicity. The author's analysis show that the conservation of the biodiversity in a context where species are dominantly short range endemics and rare is a main problem to be faced by New Caledonian authorities as well as by scientific researchers that must provide the basis for political decisions. Regardless the biogeographical pattern of endemism the chances of survival of rare species with short ranges in the case of large scale habitat destruction are quite low. In the case of threats that are more restricted in area, the loss of a species disjunctly distributed is more problematic in terms of loss of phylogenetic diversity. In this case, speciation by niche conservatism can be hypothesized to be less frequent, thus each species can be implied to be more original and in stronger need of conservation by itself. In addition, due to the distances from one another, the number of closely related species in a small island can be much lower than in the case of species with parapatric/allopatric distribution. Fires, mining and introduced species need special control. The two firsts for the habitat destruction they promote over extensive areas and the later by the possibility of continuing to endanger even in areas officially protected.

Chapter 7 - The current study was carried out on a longitudinal reach of an intermediate zone of the River Allier (France) that incorporates a flooded gravel pit, representing a significant depositional zone. The survey compared the macroinvertebrate communities of erosional and depositional forms along the study section. Fourty four taxa were recorded in the erosional forms and 46 in the depositional zones, 57 % being common. Globally, the biodiversity in the deepest areas including the former gravel pit, did not diverge significantly from the other parts of the studied section. Further analysis of 22 samples from each geoform type revealed that total and EPT richness per sample were higher in the erosional areas than in the others. In the two geoforms the feeding groups and locomotion/substratum relations differed also, both underlining ecological and functional differences. Body size of the four dominant taxa (Orthocladiinae, Chiromini, *Hydropsyche* and *Psychomyia pusilla*) present in both erosional and depositional zones was also analysed and only Orthocladiinae differed between geoforms and depth, the larger individuals being in depositional zones and deeper water. Overall these results suggest that in the context of a rapid but reliable water quality assessment for biomonitoring, surveys of shallow, and thus more accessible erosional areas of gravelbed rivers may provide adequate representation of whole system. The ability to omit sampling of deeper depositional zones without adversely affecting the reliability of the outcome may prove both practicable and cost effective. The fact that erosional forms were

seen to contain higher biodiversity than depositional areas and to shelter many of the taxa generally considered the most pollution-sensitive, gives further confidence.

Chapter 8 - The Semen Mountains, a U.N. World Heritage Site is located in the North Ethiopia, in the Gondar Administrative region. The park encompasses a wide altitudinal range: which extends from below 2000m to above 4000m asl. It includes extensive high plateau areas (roughly 3200 m to 4000m), steep escarpments and lower-lying parts (below 3000 to 2000 m) and flat areas. This results in a rich mosaic pattern of different habitats, which promotes species richness and high biodiversity. The Semen lowlands, primarily harbouring afro-montane vegetation, are richest in species, whereas the afro-alpine belt, although, the most spectacular part of the mountains, is the poorest. In general, species diversity decreases with increasing altitude. At present, approximately 550 taxa of angiosperms are recorded. The park is famous for their rare and endangered animals (including the endemic Walia ibex, Capra walie) also harbour endemic plant species, i.e. *Rosularia semiensis* and *Maytenus* cortii. The Semen Mountains is the historic plant collecting locality, and about 40% flowering plants originate from this region alone. But in the past few decades, the park is facing deterioration due to socio-political problems in the North of the country.

Chapter 9 - Current loss of biodiversity places a premium on the task of recognizing and formulating proposals on potential areas for biological conservation based on scientific criteria; among these tasks, identification of hotspots has a relevant role on conservation of biodiversity. Among the approaches used in their recognition, biogeographic methods have a relevant role. In this study, the authors discuss the application of different biogeographic methods to identify plant biodiversity hotspots, based on the congruence among areas of endemism, panbiogeographic nodes, and Pleistocene refugia. Land plants are one of the best known biological groups that can be used as a test model for studies in biological diversity. The author's study is based on previous biogeographic analyses of mosses, gymnosperms and angiosperms carried out in different places around the world, where panbiogeographic nodes and areas of endemism have been proposed for these plants, also including refugia proposed worldwide based on different biological groups. A remarkable congruence among these areas recognized by the application of different biogeographic methods for these plant groups is noted in western North America, Appalachian, Mesoamerica, southern Chile, southeastern Brazil, central Africa, Japan, southeastern China, Tasmania, New Caledonia, northeastern Australia, New Guinea, and New Zealand; this congruence indicates that these areas deserve special status in plant biodiversity and conservation. The authors propose that these areas identified by different biogeographic methods are important biodiversity areas and can be recognized as hotspots; these areas have a relevant role in plant biodiversity and are important in conservation due to their climatic conditions (refugia), the historical factors that have been involved in their evolution (nodes), and the restricted distribution of some plant taxa that inhabit them (areas of endemism).

Chapter 10 - The traditional oasis in the North African region are considered, by the experts of biodiversity, as a natural genetic reserve for the majority of species tolerants to arid conditions. In fact, those kinds of oasis are multi-storey exploitations existing in the arid zones in which the author apply an intercropping system. This later is defined as an agricultural practice to grow several crops simultaneously on the same field: all sorts of date palms, many kinds of fruit trees (olive, almond, fig, apricot, pomegranate, orange, citron, vine, bananas...), cereal grower (Lucerne, wheat, oats, barley, sorghum, maize, rice...) and

the majority of market gardening species (pepper, parsley, tomatoes, potatoes, onion, salads...). Determining the water need of every species, fixing the optimal arrangement between them, releasing local ecological indicator and proposing a scientific methods to monitor their sanitary state and the risk of diseases propagation are necessities if not obligations to conserve the plant biodiversity. In this work the author are presenting basic equations and approaches to reach those goals by establishing models that can be generalised.