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Editorial

Forest Management and Biodiversity Conservation: Introduction to the Special Issue

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Forest ecosystems contribute to human wellbeing and the economy through the complex ecosystem services they provide [1–6]. The sustainable and regular supply of ecosystem services by forests requires excellent knowledge of the functional and biological diversity in these complex ecosystems [7–10]. This is related to the management of forests, which evolves over time in order to face contemporary challenges [11–15]. One of the major challenges in forest management is the sustainability of the resource itself, while the challenge for the conservation of biological diversity is to secure a minimum set of strategically located primary forests in representative areas with high diversity and endemism [16–21].

This Special Issue contains a total of 18 articles from many different countries, including Brazil, Bulgaria, Ecuador, Germany, Malaysia, Peru, Poland, Romania, Slovakia, and Slovenia situated on three continents (Figure 1).

Figure 1. Countries where the research articles were conducted.

These research articles are highly varied and can be classified into eight sub-domains that are representative of the chosen domain: natural and human disturbances, genetics, site conditions, tropical forest, peri-urban forest, forest soils, forest reserves, and mountain ecosystems (Figure 2).

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Citation: Dinca, L.; Zhiyanski, M. Forest Management and Biodiversity Conservation: Introduction to the Special Issue. *Diversity* **2023**, *15*, 1078. https://doi.org/10.3390/d15101078

Received: 15 September 2023
Revised: 7 October 2023
Accepted: 10 October 2023
Published: 11 October 2023

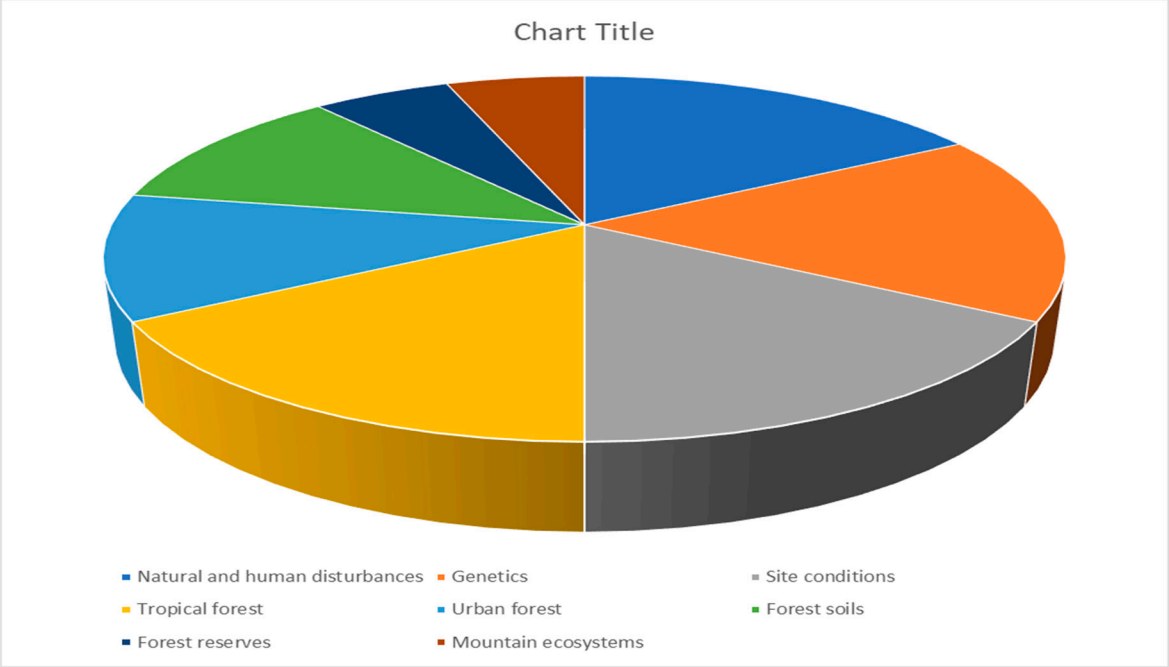

Figure 2. Research domains.

Ecosystems and individuals or local communities are important aspects in the recent research conducted to assess such relations and their effects. In this Special Issue, there are four papers that focus on this research topic.

Peri-urban forests [22–25], like urban forests [20,26–30], play an important role for urban agglomerations. This theme is highlighted in this Special Issue via the analysis of tree species, the position and shapes of trees, and the biometric characteristics of trees (diameter at breast height). The results indicate that the stand will be highly stable for future generations, meaning that the human–nature interactions, such as recreational and outdoor activities, are secure.

In addition to its relation to human activities, the main objective of ecotourism, i.e., ecological tourism [31–33], is to promote sustainable development by visiting natural environments to minimize the negative impact of traditional tourist activities and support the conservation efforts of those regions [34–37]. The second paper in this sub-domain discusses the how local communities can use such knowledge related to plant diversity and cultural–archaeological offerings. The authors of this study conducted a survey which detected 384 species of vascular plants with 220 genera and 69 families, the main proportion of which comprised *Asteraceae*, *Poaceae*, and *Fabaceae*. Through applying methods centered around biological, ecosystem, and cultural values, this study revealed the potential mitigation measures that local authorities should implement.

A paper in this sub-domain [38] investigated an urbanization gradient of a tropical city where 96 woody plant species belonging to 71 genera and 42 families were present in the research area. This study reports remarkable results that emphasize that when urbanization spread from wildland areas to suburban areas, a 67.6% reduction in the native species took place, whereas the non-native species remained stable.

The last paper in this sub-domain also focuses on human factors through describing the perceptions of local inhabitants on the used land management systems in the rainforest of Ecuador [39]. In this study, natural forests were the most positively rated type of forest, while the managed ones were the least positively rated, revealing an important trend among the participants, and human intervention was not the foremost landscape-related factor affecting this perception.

Also, research papers concerning management, non-management practices, tree growth, or disturbances that may occur have made an important contribution to the

understanding of such practices [40–43]. Five papers in this Special Issues address these topics through collecting data from various forests, from the Amazon area to European forests. The first of these papers deals with the effects of management abandonment on vegetation dynamics in a non-native Douglas fir forest in Germany. It is worth noting that such analyses are of great importance to understand the impact of some non-native species on biodiversity. This paper's survey showed consistent development after management abandonment while also showing that the species became less diverse and more shade-tolerant.

In addition to human intervention in the context of forests, natural phenomena can also have important impacts, as noted by the authors of [44] in their analysis of species turnover. For this paper, five plots and one control plot were analyzed in the southern part of Slovenia. The total number of species recorded in the gaps was 184, with the highest number (106) being recorded for the largest forest gap and 58 species being recorded for the control one. Based on their findings, the authors determined that a forest gap represents a significant habitat patch, especially for plant species which were not present there before.

Economical aspects are also import in a forestry system [45–47]. The third paper in this sub-domain proposes a silvicultural management system that has the potential to recover and improve the productivity of an intensively logged tropical forest due to the fact that the applied management techniques are intended for natural forests. The targeted area spanned 535.6 ha (selected trees with dbh $\geq$ 25), and two treatments were designed. Applying the harvesting criteria resulted in a positive cost–benefit ratio, which was superior to the control treatment in all scenarios. This can favor the maintenance of biodiversity, promote the expansion of populations of low density species, and improve the quality of forests.

The fourth paper in this sub-domain documents the impact that forest management can have on the germination and growth [48] of seeds and seedlings from different geographic provenances rich in *Robinia pseudoacacia*. In total, eight Romanian provenances were selected for the study. The researchers applied water-soaked seeds and heat/cold treatment on one side and sulfuric acid on the other side. The results highlighted that one provenance (Satu Mare) had the lowest germination with both treatments, while the highest germination occurred in the Bihor provenance (68.2%). Such aspects are of great importance to forest managers, as they can help inform their decisions to ensure they apply the correct method when preparing new seedlings.

The last paper in this sub-domain focuses on examining black locust (*Robinia pseudoacacia* L.) from a silvicultural point of view; for this study, the authors conducted a literature review [49] with special emphasis on Romania wherein aspects such as species propagation, stand management, and vulnerability issues were covered and addressed to highlight the knowledge accumulated by Romanian foresters and researchers. Aspects such as ecological adaptability, CO_2 sequestration, and biomass yield are highlighted as positive, while short lifespan, invasiveness, and even dieback in drought were listed as negative aspects. However, aspects such as genetics, invasive potential, and adaptation to climate change require more research.

Also, another paper in this Special Issue analyzes harvesting operations and their outcomes from a practical point of view [50]. Damage and tolerability thresholds for the remaining trees was established for specific stands from southwest Romania. It has been well documented that damages to remnant trees will cause health deterioration and rot development. Equations were created to determine the tolerance threshold, and record values of 0.09 for thinning, cuttings, and final cuttings from shelterwood were obtained; a final value of 0.10 was obtained for the first intervention cuttings, as well as for the preparatory and seed cuttings.

Trees can be affected by biotic factors that can harm the health and productivity of certain species. In order to fight the effects of such aspects, certain genotypes can be selected [51–53] over time to improve the presence of the species. In another study, *Ophiostoma novo-ulmi* in Romania after 1990 was extensively studied for three years through

conducting tests on *Ulmus minor*, *Ulmus glabra*, and *Ulmus laevis* in 38 provenances. The authors of this study artificially inoculated a local strain of *O. novo-ulmi* to observe the outcomes. New observations materialized after almost 30 years, and a new hybrid form was identified between *O. novo-ulmi* ssp. *americana* x *O. novo-ulmi* ssp. *novo-ulmi*. Of the three elm species, European white elm showed a constant tolerance to the disease, while Wych elm was extremely sensitive to it.

Three papers in this Special Issue analyze soil aspects. The first paper focused on microbial abundance in post-bauxite mining land [54]. Mining activities leave a footprint on the environment for decades; even though restorative measures can be taken, they require a great amount of energy consumption. Soils are a reservoir for bacteria, and in this study, the bacterial potential was calculated by using the bacterial soil quality index (BSQI), while the Shannon diversity index and the Jaccard distance was used to show the level of bacterial diversity for the two studied plots. The results of this study are promising; the chemical and microbiological parameters determined in the adjacent area indicated similar soil conditions to the site that had been ecologically reconstructed 15 years earlier.

Even though no anthropic activities were observed, importantly, the authors of [55] researched the changes made to the soil microbiota by planting different tree species. The analyses took place in central Slovakia. The researchers created special areas wherein pasture land was afforested to observe the possible changes in soil properties that took place after decades to gain insights into the relation between soil and trees. After applying multivariate physico-chemical analyses to the soil, there was an overlap in terms of soil between Douglas fir and spruce areas but a clear separation of beech from sycamore. It is notable that microbial activity and diversity were highest under Douglas fir, followed by sycamore, with the beech and spruce having the lowest values.

Relief and soils were the focus of the last article from this sub-section [56], in which environmental and stand conditions were analyzed for silver fir (*Abies alba* Mill.). The database used in this study consisted of 77,251 stands covering an area of 211,954 ha. Data were computed by using MATLAB scripts (The MathWorks Inc. (2022)); eight factors—altitude, field aspect, field slope, soil type, participation percentage, road distance, structure, and consistency—were processed. It is well known that forest owners and managers wish to maximize the potential of afforested areas. This study revealed that the highest silver fir productivity is found at altitudes of up to 1200 m, on mid and upper slopes, on NW field aspects, and on eutric cambisols and dystric cambisols, with a 10–20% participation in stand composition among relatively even aged, fully consistent stands.

The environmental conditions in the tropical rain forest are studied in one paper in this Special Issue. In this specific paper, a non-metric multidimensional analyses was conducted to determine the correlation between plot altitude and stand characteristics. Support was provided by the Biological Reserve of San Francisco, and a 13 ha area was monitored. By using statistical methods like CCA (canonical correspondence analysis) and "Four Corners" analysis, the hypothesis that altitude and some stand characteristics are the key factors for the formation of the two studied forest types were validated.

Elsewhere in this Special Issue, climate change aspects were analyzed in the Rila Mountain, Bulgaria, with the help of modern technologies such as remote sensing vegetation indices from a period spanning 42 years, Copernicus High-Resolution Layer products, and climate change reanalysis data from a period spanning 40 years. A series of trends in ecosystem extent and functioning were found, and new candidate indicators that are suitable for the remote monitoring of climate change effects were defined. Climate change is an important topic as its effects affect both communities and nature.

The final two papers in this Special Issue deal with genetics, analyzing in depth information that normally cannot be perceived by the human eye.

Conservation can ensure the timely propagation of tree species, and the authors of the penultimate paper in this Special Issue observed genetic processes in the largest national forest park in Poland. The focus of this study was the core mother pine stand from the protected area, with its progeny generation occurring on the basis of its chloroplast DNA

(cpDNA). The degree of variations observed declined by generation, with the results showing that the significant genetic diversity of the studied stands was found to be reduced over the course of generations.

The authors of the final paper in this Special Issue utilized noninvasive genetic monitoring, sampling, and collection techniques to achieve desirable results. They reviewed 148 genetic research papers that had specific content pertinent to the geographic region. In North America, hair samples were collected in favor of feces, while in Europe, both types of samples are recommended, though there is more focus on feces. Also, methods like Isohelix can be applied on a national level, while in the field, trained dogs for feces detection could be used, along with specialized personnel during the autumn and winter periods. Due to the field's difficulties in obtaining these samples, the large-scale noninvasive genetic monitoring of large bear populations represents a challenge; however, if this challenge can be alleviated valuable insights into biodiversity monitoring and climate change could be gained.

The papers contained in this Special Issue address many research topics, from the bacterial world to trees, animals, communities, and climate change. Even though we may initially think that some research topics are not linked to each other, as is the case in nature, everything is connected. For example, by understanding genetics, we can apply valid conservation methods and promote and preserve genetic heritage; by improving the awareness of local authorities, sustainable management can be applied; by understanding diseases, we can mitigate their effects; by understanding what is in the Earth's soils, we can draw correlations regarding above-ground vegetation. The main goal of all of these research endeavors is to promote the understanding and wellbeing of the ecosystem.

Conflicts of Interest: The authors declare no conflict of interest.

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