forests

MDPI

Editorial

Modeling of Species Distribution and Biodiversity in Forests

Giorgio Brunialti * and Luisa Frati

TerraData Environmetrics, Spin-off Company of the University of Siena, 58025 Monterotondo Marittimo, Italy; frati@terradata.it

* Correspondence: brunialti@terradata.it

Understanding the patterns of biodiversity and their relationship with environmental gradients is a key issue in ecological research and conservation in forests. Several environmental factors can influence species distributions in these complex ecosystems [1,2]. It is therefore essential to distinguish among the effects of natural factors from the anthropogenic ones (e.g., environmental pollution, climate change, forest management) by adopting reliable models able to predict future scenarios of species distribution [3].

In the last 20 years, the use of statistical tools such as Species Distribution Models (SDM) or Ecological Niche Models (ENM), allowed researchers to make great strides in the subject, with hundreds of scientific researches in this field [3]. This Special Issue includes 12 research articles and 1 review paper, where these methodological approaches are the starting point to deepen many timely and emerging topics in forest ecosystems around the world, from Eurasia to America.

Climate change is actually receiving more and more attention and five articles focused on this topic. In total, three of them used SDM to evaluate the effects of climate change on the distribution of a single plant species [4–6], giving useful tools for decision making in terms of conservation and management of endangered species or plants of economic importance. The use of SDM techniques allowed Pecchi et al. [7] to obtain an uncertainty assessment of the potential impact of climate change on Italian forests, suggesting adaptive forest management strategies. With a study carried out in a wetland and surrounding watershed forest in Ukraine, Kirichenko-Babko et al. [8] focused on the effect of climate variations on the structure of the assemblage of ground beetles. They concluded that the resistance of forest habitats to climate aridization is somewhat exaggerated and, very likely, the structure of the community of arthropods in forests will significantly change.

Some of the above-mentioned articles discussed the strengths and limitations of SDM and gave useful recommendations to select the most appropriate model [4,7]. Other contributions in this Special Issue also focused on the methodological aspects of species distribution modeling. In particular, Keren [9] examined an approach based on modeling species count data to investigate tree distribution patterns in two Dinaric old-growth forest stands. He suggested using this approach to supplement future studies of tree diameter distributions based on scattered plots, especially in mixed forests. Kotlov and Chernenkova [10] tested modern approaches to spatial modeling of forest communities at the regional level, based on supervised classification. An interesting approach is represented by the work of Di Pasquale et al. [11], which explored the combined use of ENM and charcoal analysis to evidence a picture of past geographic distributions of *Pinus* species in the Last Glacial Maximum. They showed the potential presence of a glacial refugium of *P. nigra* on the Tyrrhenian coast of southern Italy.

In a subtropical forest in China, Wei et al. [12] explored the topic of species distributions from a phylogenetic point of view. They showed that a dominant species plays an important role in structuring the distribution and coexistence of neighbor species. They found also that this relationship depends on community successional stages.

Forest management can represent an important driver affecting species distribution and conservation. This is especially true for umbrella and flagship species, which re-

Citation: Brunialti, G.; Frati, L. Modeling of Species Distribution and Biodiversity in Forests. *Forests* **2021**, *12*, 319. https://doi.org/10.3390/f12030319

Received: 17 February 2021
Accepted: 3 March 2021
Published: 10 March 2021

quire spatial and temporal continuity of the forest habitat [13]. In their review paper, Lohmus et al. [14] examined the literature on spatial habitat modeling of focal species for sustainable forest management, providing an interesting overview of the topic. They illustrated an approach focusing on the threatening process, conceptualizing it through major dimensions of habitat change, which are then parameterized as habitat quality estimates for focal species. They also provided a working example based on recent additions to the forest reserve network in Estonia. On comparing logged and unlogged stands in Mediterranean oak forests, Bianchi et al. [15] pinpointed a lower growth of the threatened lichen *Lobaria pulmonaria* in the logged stands than in the unlogged ones. They suggested that effective conservation-oriented management for this species should be tailored at the habitat-level and, especially, at the tree-level. Still considering lichens, Brunialti et al. [16] hypothesized that the dispersal abilities due to the different reproductive strategies drive the species' beta diversity depending on forest age and continuity. They showed that sexually reproducing lichen species have high turnover, while vegetative species tend to form nested assemblages, especially in old-growth forests with respect to non-old-growth ones.

In a different context, Tornwall et al. [17] also focused on beta diversity. In particular, they studied the dispersal capabilities of aquatic macroinvertebrates, amphibians, and zooplankton of small wetlands in forested ecosystems of the Appalachian region. They demonstrated that the local environment and spatial relationships between local sites explain community variations and forest and landscape-level management and planning techniques need to account for these differences.

To conclude, we are aware that the topic addressed in this Special Issue is far from being exhaustive. However, we hope readers may be inspired by the articles included here, and find interesting food for thought for their research.

Finally, we would like to thank all the authors for their contribution to this Special Issue. Thanks also go to the external reviewers for their valuable contribution. We also wish to thank the staff members at the MDPI editorial office (in particular Dr. Jason Cao) for their support.

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

References

1. Gaston:, K.J. Global patterns in biodiversity. *Nature* **2000**, *405*, 220–227. [CrossRef] [PubMed]
2. Yao, L.; Ding, Y.; Xu, H.; Deng, F.; Yao, L.; Ai, X.; Zang, R. Patterns of diversity change for forest vegetation across different climatic regions—A compound habitat gradient analysis approach. *Glob. Ecol. Conserv.* **2020**, *23*, e1106. [CrossRef]
3. Guisan, A.; Thuiller, W.; Zimmermann, N. *Habitat Suitability and Distribution Models: With Applications in R (Ecology, Biodiversity and Conservation)*; Cambridge University Press: Cambridge, UK, 2017.
4. Zhang, K.; Sun, L.; Tao, J. Impact of Climate Change on the Distribution of *Euscaphis japonica* (Staphyleaceae) Trees. *Forests* **2020**, *11*, 525. [CrossRef]
5. Garza, G.; Rivera, A.; Venegas Barrera, C.S.; Martinez-Ávalos, J.G.; Dale, J.; Feria Arroyo, T.P. Potential Effects of Climate Change on the Geographic Distribution of the Endangered Plant Species *Manihot walkerae*. *Forests* **2020**, *11*, 689. [CrossRef]
6. Resquin, F.; Duque-Lazo, J.; Acosta-Muñoz, C.; Rachid-Casnati, C.; Carrasco-Letelier, L.; Navarro-Cerrillo, R.M. Modelling Current and Future Potential Habitats for Plantations of *Eucalyptus grandis* Hill ex Maiden and *E. dunnii* Maiden in Uruguay. *Forests* **2020**, *11*, 948. [CrossRef]
7. Pecchi, M.; Marchi, M.; Moriondo, M.; Forzieri, G.; Ammoniaci, M.; Bernetti, I.; Bindi, M.; Chirici, G. Potential Impact of Climate Change on the Forest Coverage and the Spatial Distribution of 19 Key Forest Tree Species in Italy under RCP4.5 IPCC Trajectory for 2050s. *Forests* **2020**, *11*, 934. [CrossRef]
8. Kirichenko-Babko, M.; Danko, Y.; Musz-Pomorksa, A.; Widomski, M.K.; Babko, R. The Impact of Climate Variations on the Structure of Ground Beetle (Coleoptera: Carabidae) Assemblage in Forests and Wetlands. *Forests* **2020**, *11*, 1074. [CrossRef]
9. Keren, S. Modeling Tree Species Count Data in the Understory and Canopy Layer of Two Mixed Old-Growth Forests in the Dinaric Region. *Forests* **2020**, *11*, 531. [CrossRef]
10. Kotlov, I.; Chernenkova, T. Modeling of Forest Communities' Spatial Structure at the Regional Level through Remote Sensing and Field Sampling: Constraints and Solutions. *Forests* **2020**, *11*, 1088. [CrossRef]
11. Di Pasquale, G.; Saracino, A.; Bosso, L.; Russo, D.; Moroni, A.; Bonanomi, G.; Allevato, E. Coastal Pine-Oak Glacial Refugia in the Mediterranean Basin: A Biogeographic Approach Based on Charcoal Analysis and Spatial Modelling. *Forests* **2020**, *11*, 673. [CrossRef]

12. Wei, S.; Li, L.; Lian, J.; Nielsen, S.E.; Wang, Z.; Mao, L.; Ouyang, X.; Cao, H.; Ye, W. Role of the Dominant Species on the Distributions of Neighbor Species in a Subtropical Forest. *Forests* **2020**, *11*, 352. [CrossRef]
13. Brunialti, G.; Frati, L.; Ravera, S. Ecology and Conservation of the Sensitive Lichen *Lobaria Pulmonaria* in Mediterranean Old-Growth Forests. In *Old-Growth Forests and Coniferous Forests. Ecology, Habitat and Conservation*; Weber, R.P., Ed.; Nova Science Publishers: New York, NY, USA, 2015; pp. 1–20.
14. Lõhmus, A.; Kont, R.; Runnel, K.; Vaikre, M.; Remm, L. Habitat Models of Focal Species Can Link Ecology and Decision-Making in Sustainable Forest Management. *Forests* **2020**, *11*, 721. [CrossRef]
15. Bianchi, E.; Benesperi, R.; Brunialti, G.; Di Nuzzo, L.; Fačkovcova, Z.; Farti, L.; Giordani, P.; Nascimbene, J.; Ravera, S.; Vallese, C.; et al. Vitality and Growth of the Threatened Lichen Lobaria pulmonaria (L.) Hoffm. in Response to Logging and Implications for Its Conservation in Mediterranean Oak Forests. *Forests* **2020**, *11*, 995. [CrossRef]
16. Brunialti, G.; Giordani, P.; Ravera, S.; Frati, L. The Reproductive Strategy as an Important Trait for the Distribution of Lower-Trunk Epiphytic Lichens in Old-Growth vs. Non-Old Growth Forests. *Forests* **2021**, *12*, 27. [CrossRef]
17. Tornwall, B.M.; Pitt, A.L.; Brown, B.L.; Hawley-Howard, J.; Baldwin, R.F. Diversity Patterns Associated with Varying Dispersal Capabilities as a Function of Spatial and Local Environmental Variables in Small Wetlands in Forested Ecosystems. *Forests* **2020**, *11*, 1146. [CrossRef]