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Climate-Smart Forestry in Mountain Regions

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This book is dedicated to the memory of Professor Giustino Tonon: our friend, colleague, and a co-author of many of these chapters. Giustino conveyed great passion and commitment for forests and conservation; it showed in his words, his actions, and the intensity of his listening. Yet his calm and steadfast manner allowed him to work with everyone. His work brought a rigorous scientific approach to understanding the challenges faced by humans and nature in a time of rapid change. He was unfailingly caring and considerate of others, and his positive outlook on life invariably lifted the mood of those in his company. When he passed away on 7 July 2021, he was in a place he loved, the mountain forests of the Dolomites.

Preface

This book is one of the outputs of the COST Action CA15226, Climate-Smart Forestry in Mountain Regions (CLIMO). Funded by the EU's Horizon 2020 COST Action programme, CLIMO has been developing in the last few years as a new concept, which is central to the changes in the way forestry resources are used by the European community. While climate change is increasingly filling the policy agenda at global level, mountain regions are extremely vulnerable to its effects. Because climate change increases the frequency and intensity of ecosystem imbalances, the economic value and adaptive capacity of these regions is jeopardised, which has led to a call for changes in forestry polices and management.

Initiated in October of 2016 and finished in April of 2021, CLIMO addressed the complex issue of forest management, which plans for the long term, while dealing with uncertainties related to the productivity and health of forest ecosystems, and their adaptation to short-term environmental changes. The establishment of this network, which mobilized more than two hundred researchers from 28 countries, focused on mountain environments, considered as a climate change hotspot. Given the growing pressure on mountain regions by climate change, there is a need to emphasise forest production systems that are resilient to climate-driven disturbances. These climate targets can be mainstreamed through multidisciplinary Climate-Smart Forestry, paying attention to regional circumstances, opportunities and challenges. This multidisciplinary approach, from tree to landscape and with a variety of tools, was made possible through networking and stakeholders' engagement.

A three-dimensional approach was presented to enhance adaptation and resilience to climate change within forest ecosystems, optimising the provision of ecosystem services. A new definition of Climate-Smart Forestry advocated by this COST Action, supported by the development of indicators, allowed a balanced understanding of adaptation and mitigation potentials of mountain forests facing climate change. CLIMO also contributed to the debate concerning the resilience of forest and the provision of ecosystem services. This way, the seeds of progress in forest practices were sown, which hopefully will germinate into results that will allow for a more sustainable future.

The multiscale and multidisciplinary approach allowed evaluating social-ecological resilience of tree individuals and forest stands to climate change. In particular, the Action advanced our understanding on how to assess adaptation and mitigation trade-offs and synergies over time, in forest systems of mountain regions. In addition, a network of about 200 temporary and long-term experimental plots was established, including major forest tree species (beech, spruce, fir). Monitoring tools and advances of forest processes and ecosystem services were also addressed thanks to the collaboration between scientists from different disciplines, also involving colleagues from Brazil and Canada. There is now potential to build process-based monitoring networks and invest in schemes for payment for ecosystem services.

All of the above converged in several academic articles and in this book which has been planned as the way to put together concretely many authors from many countries on the same topic, while promoting interdisciplinarity. This book appeals to academics and researchers in forestry and related areas, also providing practical support to forest managers and decision makers.

Campobasso, Italy — Roberto Tognetti

Inverness, UK — Melanie Smith

Bolzano, Italy — Pietro Panzacchi

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About the Editors

Roberto Tognetti completed undergraduate and master's degrees, majoring in forestry, at the University of Firenze (Italy). He got a PhD in botany from the Trinity College of Dublin (Ireland). He is full professor of forest ecology and management in the Department of Agricultural, Environmental and Food Sciences at the University of Molise (Italy), acting as chairman of the second level degree courses in forestry and environmental sciences. He studies the ecophysiological mechanisms underlying plant responses to environmental conditions and the influence these responses have on ecological patterns and processes. Plants live in a wide range of environments, and the conditions in these environments fluctuate over the time scale of seconds to years and beyond. He uses the combined potential of biometeorology and ecology to study the effects of disturbances on tree productivity and plant development. He focuses on the basic environmental physiology of carbon, water and nutrient cycling and strives to integrate these physiological processes to gain an understanding of plant functions and ecosystem processes, in a changing global environmental setting. Experimental observations are made at a range of spatial scales and a modelling framework is used in an effort to relate mechanistic responses to ecosystem functions and services.

Pietro Panzacchi got his master's degree in forestry from the University of Firenze (Italy) and a PhD in forest ecology from the University of Bologna (Italy). He currently works in the Center for Inland Areas and Apennines (ARIA) at the University of Molise (Italy) where he acted as project manager of the Cost Action CLIMO. His research focusses on the effect of climate change in forests biogeochemical cycles, with special interests for carbon and nitrogen cycling. Atmospheric nitrogen deposition, climate change and carbon stock potential of forests are strictly interwoven and their study at field level is challenging. In the last 10 years, his collaboration between University of Bologna (Italy), Free University of Bolzano/Bozen (Italy) and University of Molise (Italy) put him in the privilege position to study the effect of different drivers on different environments, from fruit orchards and poplar plantations in the Po plain (Italy) to miscanthus plantations in the UK to Alpine forest in South Tyrol. He started his collaboration with Roberto Tognetti while working for

the EFI's Project Centre on Mountain Forests (MOUNTFOR) when he firstly approached the concept of Climate-Smart Forestry.

Melanie Smith graduated with her undergraduate joint honours degree in biology and geography from Royal Holloway, University of London. She completed a PhD in palaeoecology and woodland history with London University and Historic Scotland, investigating the interactions through the Holocene between people and their environment in northern Scotland. Currently she is assistant principal academic and research with Inverness College, University of the Highlands and Islands (Scotland), where she has worked since 2003, primarily leading the development and delivery of research and innovation. Throughout her career of nearly 30 years, she has led research projects and teaching in ecology and conservation, landscape ecology, forest history and catchment management. Her research in application of palaeoecological data to forest and conservation management led her to investigate further how an identification and understanding of forest functional traits over long time frames can inform the management of forests as complex adaptive systems for Climate-Smart Forestry.

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