Concluding Remarks from the Editors

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Continuous cover forestry (CCF) refers to forest management methods that exclude clearcutting to preserve forest-like conditions and promote natural regeneration. This book compiles and synthesises research results and experiences of CCF in Fennoscandia. It aspires to be a source of inspiration, a reference for further reading, and a guide for future research, but also a potential aid for decision making.

Because of differences in forest types, forest history, industrial development, ecological conditions, and land ownership among others, CCF (as defined in Chap. 2) has not been practised on a large scale in Fennoscandia (see Chap. 1 for the history of CCF use in Fennoscandia). In other parts of Europe, CCF has become

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increasingly common, mostly on public land, since the 1990s (e.g. Bauhus et al. 2013).

As defined for this book in Chap. 2, CCF encompasses different silvicultural systems, including some considered to be rotation forestry (RF). Harvest interventions in these systems vary in magnitude and periodicity, creating a variety of post-harvest conditions and stand dynamics suited for different forest types and management situations. The outcomes of these silvicultural systems can be diverse, despite all being considered as CCF. As a result, the different systems should be studied and evaluated separately, as they may be more or less suitable under different management settings. This is especially true for the two primary soil types found in the region: mineral and organic soils (e.g. Chaps. 8 and 13).

Many chapters of this book point out knowledge gaps and outline research needs, in particular how CCF impacts regeneration dynamics (Chap. 3), growth and yield (Chap. 4), genetic diversity (Chap. 7), susceptibility to biotic and abiotic disturbance agents (Chap. 12), and multiple use (Chap. 10). In general, comparisons between RF and CCF do not always lead to straightforward, consistent findings, as it depends on the subject studied. Contrasting findings can be observed even within the same discipline, e.g. forest damage (Chap. 12) and multiple use (Chap. 10). The outcome of a shift from RF to CCF also appears to vary among the different silvicultural systems that qualify as CCF (Chap. 2), corroborating that the different systems need to be studied separately. In addition, available studies are often short term and only evaluate the impact of single cuts rather than effects and dynamics over entire rotations (RF) or as a result of the multiple harvest cycles in CCF (e.g. Chap. 11). The long-term monitoring of well-designed experimental trials with permanent plots in CCF-managed forests thus deserves more attention in the near future.

Findings from beyond Fennoscandia on how CCF influences stand dynamics and the provision of forest goods and services cannot be transferred unconditionally to the Nordic region. Nevertheless, they can provide a first insight into the potential effects of CCF under Fennoscandian conditions. Fundamentals and basic theory can provide a foundation for inferences within a limited number of research fields covered in this book (e.g. Chap. 15). A summary of the most urgent research needs identified in each chapter is provided in Fig. A.1.

CCF is not likely to solve all problems currently attributed to RF in the region (e.g. Mönkkönen et al. 2018). Extending the fundamental principles of CCF with additional management actions and activities like deadwood retention and habitat tree preservation is a way toward better incorporating other management goals than timber production (e.g. Gustafsson et al. 2020a). This is especially true for promoting and conserving biodiversity (Chap. 11, see also e.g. Larsen et al. 2022), but some of these actions and activities are also relevant and suitable for RF (Gustafsson et al. 2020b). To what extent these additional management measures provide any benefit regarding CCF under Fennoscandian conditions remains largely unstudied.

CCF is not suitable or advisable in all locations. Successful and economically feasible implementation requires trained personnel and a permanent forest road infrastructure (e.g. Chap. 6). Whether CCF is a suitable approach depends primarily on the owner's management goals (Nyland 2016). It is plausible that CCF works

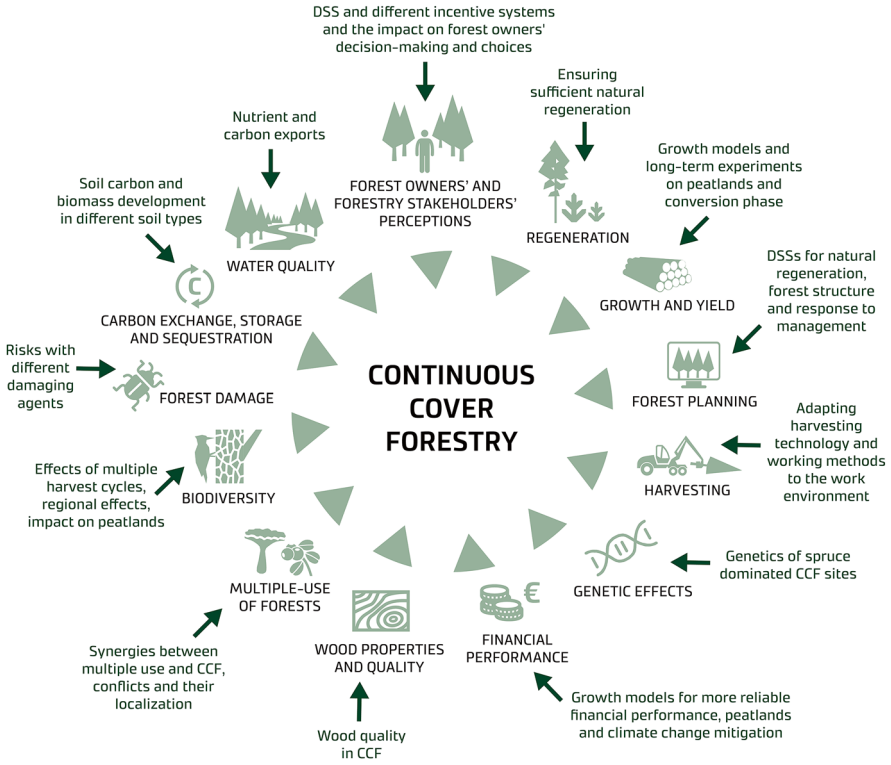

Fig. A.1 Major knowledge gaps and future research needs for CCF in the Nordic region

better than RF under specific conditions and for certain suites of management goals (see e.g. Chap. 10). This is likely why local forest administrations aim to or have already begun to shift toward CCF in forests close to larger settlements in Fennoscandia, such as in the Oslo community forest. However, a shift to CCF will often require conversion of stands established, and so far managed, under the RF paradigm. Best practices for the conversion of even-aged stands under Fennoscandian conditions are also lacking, and appropriate research is needed (Chap. 2).

Whether CCF is a suitable approach for adapting Fennoscandian forests to climate change remains to be seen (Felton et al. 2024). Proper species selection and the right choice of a CCF-conforming silvicultural system are crucial (Chap. 2). In addition, other forest management measures such as mixed-species forestry (Felton et al. 2016, Huuskonen et al. 2021), and suitable thinning regimes (Moreau et al. 2022) likely offer better prospects in the near term (see also Triviño et al. 2023b). However, these elements can be implemented both in CCF and RF.

Forest ecosystems in Fennoscandia are currently expected to meet many different management goals, such as raw material production, carbon sequestration, biodiversity conservation, and adaptation to climate change. Some of these goals may conflict with each other (Högbom et al. 2021). A wide range of forest management

approaches and methods is likely needed to meet these contrasting goals (Eyvindson et al. 2021). In addition, stand- vs. landscape-level and mid- vs. long-term considerations are crucial in forest management and need to be taken into account. Defining the best targets and opportunities of each management approach and combining different treatment methods appropriately can provide greater well-being, income, biodiversity, carbon sequestration, and recreational opportunities than any single approach or method alone (e.g. Duflot et al. 2022, Triviño et al. 2023a). While CCF is likely to gain a wider application throughout Fennoscandia in upcoming years, this might happen in parallel to resumed larger-scale RF operations (Eyvindson et al. 2021). Research is needed on the effects of CCF management, to assure a better, more balanced, and targeted provision of goods and services from Nordic forests as a result of this development.

The multiple CCF-related knowledge gaps revealed in this book must be addressed to enable appropriate advice to forest owners and stakeholders on when (and where) to apply CCF or RF. The research needs highlighted here will help direct CCF-related research in Fennoscandia over the coming years. Without solid scientific evidence, knowledge-based decisions about best forest management practices cannot be made. This could lead to underuse of Fennoscandian forests' potential in achieving the UN Sustainable Development Goals, such as biodiversity protection, climate change mitigation, and sustainable economic growth.

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