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The Place of Ecological Silviculture, Now and in the Future

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21.1 Introduction

Elements of ecological silviculture have been in existence for over a century [1], yet many of the principles and applications did not emerge broadly until the 1990s (e.g. [2]), with particular emphasis on Douglas-fir-dominated forests of the Pacific Northwest [3]. The chapters in this book highlight how far this silvicultural model has evolved over the past several decades, both in geographic extent and the diversity of forest ecosystems and management contexts for which natural models have been applied. In contrast to generic mischaracterizations of ecological silviculture as solely being concerned with postharvest retention, the chapters in this volume have clearly demonstrated the art and creativity associated with practicing ecological silviculture and the resultant diversity of silvicultural approaches now being applied across various regions of the globe. In this chapter, we review the ecological silvicultural systems presented in preceding chapters, looking at commonalities and differences that reflect varying types of forests, societal concerns and objectives, and economic environments and what the growth opportunities are moving forward.

21.2 A Diversity of Approaches for a Diversity of Forests

In developing this book, we hoped to illustrate a range of ecosystems and regions where natural models of development were being used to inform ecological silviculture. In total, we showcased 19 ecological silvicultural systems spanning 19 distinctly different forests across six countries and four continents (Figure 21.1). Our coverage was heavily skewed toward North American forests with 14 contributions coming from either the United States, Canada, or both. The heavy contribution from North America reflects both our professional experience, as well as the state of the development in the field as early applications of ecological silviculture in North America often served as a catalyst for later exploration and adoption in other countries [4]. Nevertheless, similar ideas have long been pursued elsewhere, (e.g. close to nature forestry in Europe; [5]), but have a distinctly

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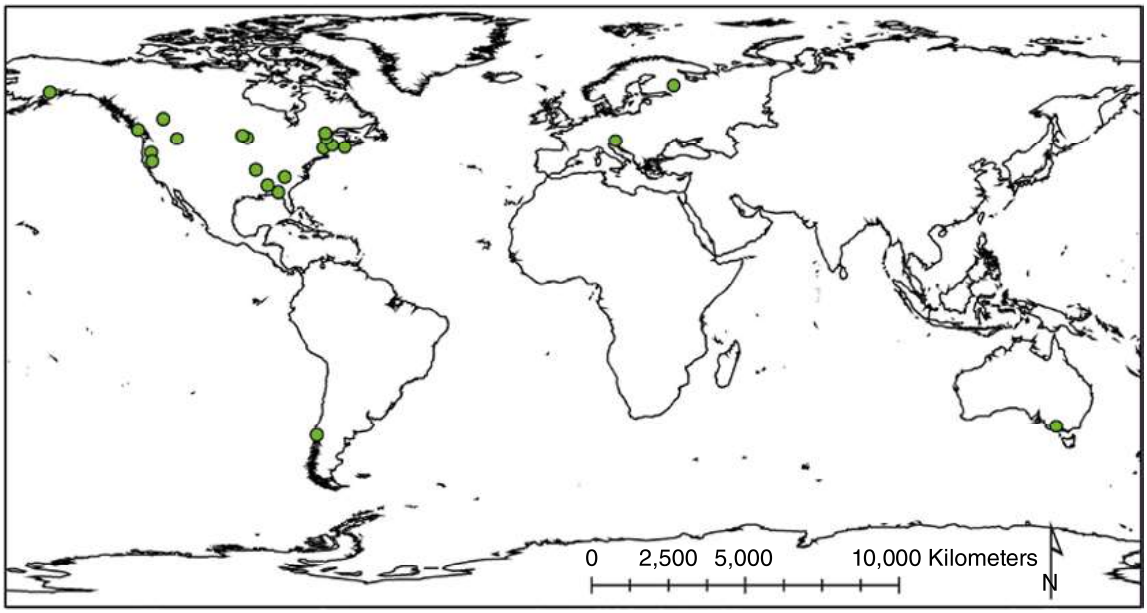

Figure 21.1 General locations of forest systems and associated ecological silvicultural systems highlighted in this text.

different approach than one based on emulation of a natural model. Regardless, the growth in application of ecological silviculture within North America and other countries reflects increasing recognition of the potential shortcomings of traditional silviculture for sustaining the full range of ecosystem services. Additionally, on a positive note, this growth reflects both increasing operational experience with implementing these strategies, as well the consistency of outcomes of ecological silviculture with societal goals around biodiversity conservation and ecosystem resilience and associated forest policies and certification schemes. As such, we would expect future compilations of ecological silviculture in practice to extend far beyond the geography and bioclimatic domains covered in this initial volume.

21.2.1 Commonalities Among Ecological Silvicultural Approaches

Despite the diversity of forest ecosystems covered by this book, a common element is for application of ecological silviculture in the context of forests simplified by historical, intensive land use and timber-focused silviculture. This includes secondary forests developing following widespread harvesting, or recovering of land cleared for agriculture, as well as restoration of industrial plantations. The desire to restore complexity in composition, structure, and dynamics to these forests represents a broad recognition of the evolution of management goals that are inclusive of sustainability of ecosystem services broadly, maintenance of native biota, and adaptation to changing global conditions. Although traditional silvicultural models exist for many of the forests and regions examined, often focusing on sustainability of commodity outputs, the collection of chapters in this text illustrates these are not always sufficient for meeting these other diverse goals.

Importantly, the silvicultural systems we present are inherently more ecological by design, rather than simple modifications to traditional timber-focused approaches. Often these approaches are based on a deeper understanding and emulation of natural models of development, including the natural disturbance dynamics for an ecosystem of interest and the corresponding patterns in

structural and compositional development. Of note, in each included forest attention is given to regeneration methods and intermediate treatments necessary to sustain economically important tree species in these forests, underscoring the necessity to continue sustaining wood production from these forests, but with a shift toward ecological models to do so.

From a purely silvicultural sense, all of the chapters demonstrate the growing application of multi-aged silvicultural methods to achieve diverse management objectives (Figure 21.2). This is not surprising given the greater consistency between multi-aged approaches and natural developmental dynamics for most, if not all, global forest ecosystems; however, it stands in stark contrast with the silvicultural methods currently providing almost half of our global wood needs (i.e. even-aged plantation systems; [6]). As has been pointed out elsewhere, there is a continued need for areas of intensive production to minimize the landbase required to meet wood demands, as this in turn increases area available for ecological reserves and the practice of ecological silviculture [7]. Yet, the incongruity between ecological conditions created by intensive models and the values and services society increasingly expects argues for an expansion of ecological systems to a larger portion of the landscape, in fact, the majority of the global forest might best be managed using an ecological approach. Our goal with this book has been to demonstrate the many domains across which this expansion is possible, with many more likely not captured by this work.

In examining the regeneration methods used in the various chapters, there is general consistency in methods chosen based on prevailing natural disturbance regime (Figure 21.2). For example, variable retention harvest (VRH) were most commonly used in forests characterized by infrequent severe disturbance, such as Douglas-fir-western hemlock forests in the Pacific Northwest and mountain ash forests in Australia. In contrast, these methods were rarely used in forests dominated by frequent gap-scale disturbances (e.g. Chilean temperate forests, Central European mixed

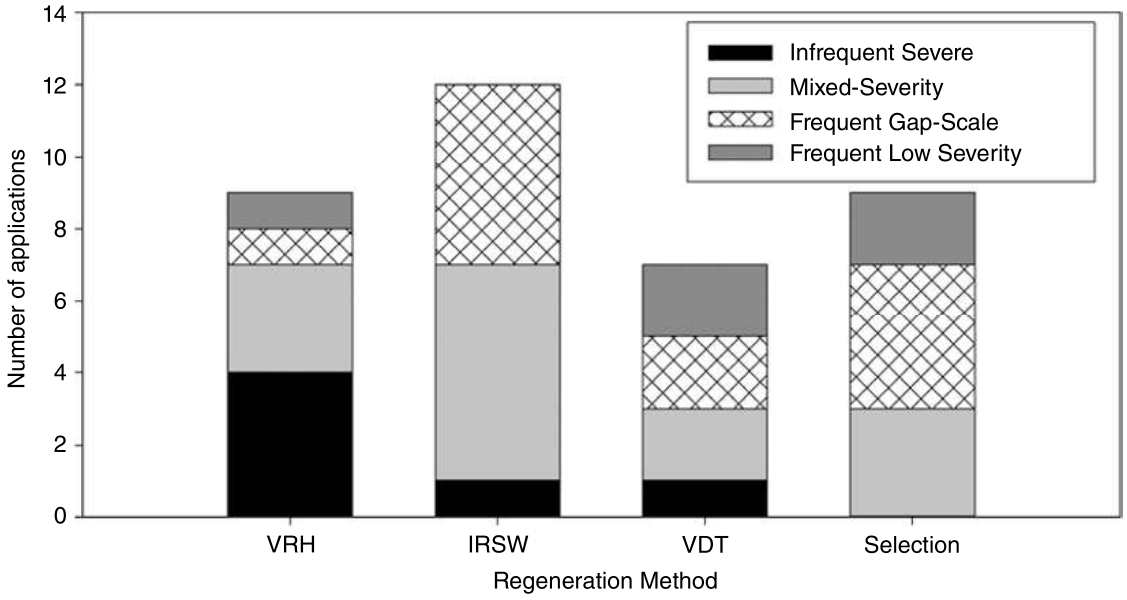

Figure 21.2 Frequency of regeneration methods used in ecological silvicultural systems presented in this text in relation to prevailing natural disturbance regimes for a given forest type. Most ecological silvicultural systems presented included multiple potential regeneration methods as options. VRH, variable retention harvest methods; IRSW, irregular shelterwood methods; VDT, variable density thinning methods; Selection, selection methods.

species forests) or frequent low-severity fire regimes (e.g. longleaf pine in the southeastern United States). For these ecosystems, selection systems, variable density thinning, and irregular shelterwood methods were often commonly applied to approximate the fine-scale mosaics generated by natural disturbance over time in these forests. Not surprisingly, forests characterized by mixed-severity disturbance regimes included examples from each multi-aged regeneration method presented in Figure 21.2, reflecting the variation in disturbance scale, severity, and frequency associated with these forests. Overall, irregular shelterwoods were the most commonly employed method across the ecosystems presented, due to their flexibility in accommodating diverse forest compositions, structures, and disturbance regimes and the consistency of silvicultural outcomes associated with these approaches with those following natural dynamics for many forest ecosystems [8].

21.2.2 Differences Among Ecological Silvicultural Approaches

There is no one-size-fits-all approach to ecological silviculture, as the underlying guide is applying the natural development model associated with a given ecosystem, in combination with creativity of the forester. As such, it is not surprising that differences existed among contributors regarding the ecological silvicultural systems developed, as there was wide variation in interpretations of natural models of development as a basis for a silvicultural system. Consequently, not all contributors present their silvicultural systems using the type of developmental model we outlined in Chapter 1, although the similarities largely outweigh the differences.

Where differences did exist in a silvicultural system compared to our generalized model (Chapter 1), they were often related to (i) differences in scale of emphasis (e.g. approaches to landscape allocation of harvesting strategies versus stand-level prescriptions); (ii) reliance on historical silvicultural models and frameworks for presenting silvicultural strategies; or (iii) limited examples of ecological silviculture in practice for a region. These differences point to the nascent stage of ecological silviculture relative to traditional models in some regions and the opportunities for growth where operational translation of natural models into on-the-ground practice has not yet occurred.

Additionally, the differences among contributions also reflect varying opinions among authors on the usefulness of historical silvicultural terminology and concepts for describing ecological silvicultural prescriptions. Although aspects of historical silvicultural systems are useful starting points for developing the regeneration methods and other silvicultural treatments contained within an ecological silvicultural system, the timber-focused intent of these strategies results in key differences between the desired outcomes of ecological silviculture and timber-focused models. As pointed out in Chapter 1, and also reflected in several of the chapters, it is imperative that terminology and silvicultural approaches evolve to encompass the methods being used (or desired) by stakeholders to meet diverse objectives beyond the regions presented in this book.

Finally, there are some notable differences in tone across chapters regarding the ability of an ecological silvicultural approach to be widely adopted and make a meaningful difference in how forests are managed. This very much speaks to the socioeconomic and management contexts within which natural models are being applied, with some regions facing significant hurdles to operationalize ecological silviculture given heavy current reliance on traditional models for supplying wood. For example, the prevalence of widespread, industrial clear-cutting in Australia (Chapter 18) has generated significant barriers to implementation of ecological

silviculture, including mismatches with industry expectations of short-term forest yields, limited manager experience with alternative silvicultural systems, and reduced social trust in forest management given a legacy of poor ecological outcomes. Similarly, areas such as the Pacific Northwest or southeastern United States in which high-yield plantations are the dominant management model represent a challenging environment to promote ecological silviculture, given the emphasis on short-term commodity production. However, even in these regions, increased public demands for diverse outputs from forests have motivated policies and certification approaches that encourage application of silviculture following natural models. This, coupled with the growing application or expansion potential of ecological silviculture in many regions addressed in this book, underscores the value of continued experimentation and evolution of local approaches building from natural models, even if current contexts are less conducive to widespread application.

21.3 Conclusions

The last decade has been a time of significant change in regard to social expectations and values tied to forests, as well as the environmental stressors and challenges facing the long-term sustainability of the services they provide. Changing values have included greater emphasis on enhancing carbon sequestration and storage benefits, conserving native biodiversity, restoring Indigenous access and rights, adapting to changing climate, disturbances, and invasive pests, and increasing opportunities for wellness and renewal.

During this same time, there have been growing calls to eliminate forest management as a tool, particularly from large areas of native forest, due to public reactions to clear-cutting and elevated focus on carbon storage benefits of older, unmanaged forests. This growing sentiment, particularly in more affluent regions [9], starkly juxtaposes against the continued increases in the proportion of global wood provided by industrial plantations and suggests we may be further careening into the bifurcated global forest estate proposed by Bennett [10]. Such a bifurcation, in which there is no middle ground between protected areas and intensive plantations, represents an unacceptable solution from both a global equity perspective, as well as in regard to the future of the forestry profession. If we cannot be entrusted to manage native forests for the multiple benefits and objectives society expects, then we have failed at achieving what has been a central tenet of forestry and silviculture for almost a century; managing forests to benefit people.

We argue that ecological silviculture, as evidenced by the diversity of contributions to this text, is uniquely poised to provide a fruitful pathway forward for our profession by growing the middle ground between the two endpoints of the forest management bifurcation using a natural models approach. These contributions showcase the potential for silvicultural strategies across diverse geographies that address the challenge of sustaining biodiversity, and all other aspects of ecosystems, with potential application over the bulk of the forest estate in ways that satisfy the public's desire for a wide range of ecosystem services. Forests arguably have never been more highly valued by society, yet they also have never been so threatened by changing environmental dynamics, necessitating the need for creativity, balance, and an adaptive mindset shared among ecological foresters. We believe, as do many of the contributors to this book, that growth of the middle ground and wider application of ecological silviculture provides the pathway needed to sustain and elevate the role of foresters as trusted professionals for meeting the challenges described above.

References

1 D'Amato, A.W., Palik, B.J., Franklin, J.F., and Foster, D.R. (2017). Exploring the origins of ecological forestry in North America. *Journal of Forestry* 115 (2): 126–127.

2 Seymour, R.S. and Hunter, M.L. (1992). *New Forestry in Eastern Spruce-Fir Forests: Principles and Applications to Maine*. Orono, ME: College of Forest Resources, University of Maine.

3 Franklin, J.F., Berg, D.R., Thornburgh, D.A., and Tappeiner, J.C. (1997). Alternative silvicultural approaches to timber harvesting: variable retention harvest systems. In: *Creating a Forestry for the 21st Century* (ed. K.A. Kohm and J.F. Franklin), 111–140. Washington, DC: Island Press.

4 Gustafsson, L., Baker, S.C., Bauhus, J. et al. (2012). Retention forestry to maintain multifunctional forests: a world perspective. *Bioscience* 62 (7): 633–645.

5 Schutz, J.P. (1999). Close-to-nature silviculture: is this concept compatible with species diversity? *Forestry* 72 (4): 359–366.

6 Payn, T., Carnus, J.-M., Freer-Smith, P. et al. (2015). Changes in planted forests and future global implications. *Forest Ecology and Management* 352: 57–67.

7 Himes, A., Betts, M., Messier, C., and Seymour, R. (2022). Perspectives: thirty years of triad forestry, a critical clarification of theory and recommendations for implementation and testing. *Forest Ecology and Management* 510: 120103.

8 Raymond, P., Bédard, S., Roy, V. et al. (2009). The irregular shelterwood system: review, classification, and potential application to forests affected by partial disturbances. *Journal of Forestry* 107 (8): 405–413.

9 Moomaw, W.R., Masino, S.A., and Faison, E.K. (2019). Intact Forests in the United States: Proforestation Mitigates Climate Change and Serves the Greatest Good. *Frontiers in Forests and Global Change* 2: https://doi.org/10.3389/ffgc.2019.00027.

10 Bennett, B.M. (2015). *Plantations and Protected Areas: A Global History of Forest Management*. The MIT Press.