

Features

Silvology Redefining the biological science for the study of forests

Gabriel Hemery and Jens Peter Skovsgaard propose a formal definition for a term that describes the scientific study of forests and woods.

Forest science may be defined as the collective body of scientific disciplines and methods applied to a range of bio-physical and socio-economic aspects of forests, forestry, forest products and forest services. Contemporary forest science originated in the 1700s and is connected closely to the utilisation of forests and the introduction of sustainability as a management concept (von Carlowitz, 1713). Forest science has developed in line with the needs of forestry to include biological, technological and social aspects related to forests, thereby separating it from other sciences such as biology, engineering, and sociology. Forest science consequently integrates many disciplines, and its role as a scientific discipline in its own right is often debated.

Symptomatically, it is difficult, if not impossible, to trace an agreed definition of forest science. For more than a century even prestigious forest science encyclopaedia, from the *Central European Handbuch der Forstwissenschaft* in 1887-88 (Lorey, 1887-88) to Elsevier's international *Encyclopedia of Forest Sciences* in 2004 (Burley et al., 2004), failed to provide a definition. Possibly, no such definition may ever be agreed and it may be contended that forest scientists should conduct their research within the frames of more 'genuine' sciences. Similarly, within forest science, several separate disciplines are often recognised and this detracts from the concept of a unifying science for forests, forestry, forest products and forest services.

Forest science is therefore the science pertaining to forestry, with forestry defined in the broadest sense as "the practice of managing and using for human benefit the natural resources that occur on and in association with forest lands" (Ford-Robertson, 1971). Forest science encompasses the policy, management, use and utilization of all types of forests including natural, sown or planted woodlands as well as

urban, agro-forestry, silvo-pastoral and other ecosystems with a more-or-less extensive cover of trees. It is also the science of the products, services and values derived from forests.

The International Union for Forest Research Organizations (IUFRO) considers itself the global network for forest science. IUFRO recognises a number of separate disciplines within the natural and social sciences as well as interdisciplinary and science policy groups (<http://www.iufro.org>, accessed July 2017). Each of these is divided further into a large number of 'units'. IUFRO currently has nine divisions. Two of these are classified as dealing with social science issues, and seven relate to natural science issues. Interestingly, IUFRO as an organisation does not yet acknowledge technological sciences in their own right. IUFRO's natural science divisions cover: Silviculture, Physiology and Genetics, Forest Operations Engineering and Management, Forest Assessment Modelling and Management, Forest Products, Forest Health, and Forest Environment. These reflect the historical development of forest science as well as the contemporary focus of international forest policy. In addition to IUFRO, several other scientific and professional organisations, especially within the biological sciences, include forests in their structure or work programme.

Scientists working in forest science may choose to label themselves using a variety of different terms: forest scientist, forest ecologist, silviculturist, geneticist, forest statistician, forest modeller, forest engineer, wood technologist, sociologist, etc. In contrast to many practical disciplines of forestry there is no term in existence that adequately describes the biological science of studying forests. There are terms that describe people dealing with the management and culture of forests, such as silviculturist, forester or forest

manager, and of individual trees, such as arborist or arboriculturist. Only for individual tree science is there a distinct discipline in dendrology, but the dendrologist's study interests do not extend to the forest stand, nor to forest ecosystems or silviculture.

In this article we propose 'silvology' as a uniting term for the biological science of studying forests. Silvology is meant to capture all qualitative and quantitative aspects of ecology and silviculture in the context of forest ecosystems.

The study of forests and woods - history

The term silvology was proposed first by Roeloff Oldeman (born 1937, Professor of Silviculture and Forest Ecology at Wageningen Agricultural University 1977-2002) over twenty years ago but has never been adopted widely. Oldeman (1990) described it as the science of forest ecosystems "without the usual division of man and nature". He sought a single term for the science of forestry, integrating the study of forests and forest ecology, ranging from single-tree autecology to complex natural forest systems.

Oldeman's silvology term was never broadly accepted, perhaps because it was presented in a complex argument within a specialist publication. Moreover, it was put into context in a form that was not applicable immediately in research or forestry practice. A single science for forestry implies a division of man and nature, because forestry, by definition, is human manipulation of the forest ecosystem for the benefit of humans or the conscious decision to refrain from (direct) manipulation. Evidently, the term forestry contrasts natural forest development and dynamics in some respects. Nevertheless, we believe that Oldeman's concept of an integral and holistic approach is viable. It is a significant component, either explicit or implicit, of contemporary silviculture philosophy, in research as well as in forestry practice.

Elements of study

Following Oldeman's outline, the discipline of silvology would focus on the study of forest ecosystems and on silvicultural science.

A forest ecosystem is an area of forest consisting of biotic elements (e.g. fauna, flora, fungi, bacteria etc.) and abiotic elements (e.g. soil, water, carbon, nutrients, sunlight). From a forestry perspective, trees and shrubs are among the most prominent elements of the forest ecosystem, but all elements are interdependent either directly or indirectly. Forest ecosystems are also dynamic, periodically experiencing disturbances that may subtly alter the forest structure or reset the development to an earlier stage. Beyond the effects of disturbances, ecosystems are changing and these changes may be directional towards, for example, a later stage of development. Any intervention by humans, including silviculture, may affect the forest ecosystem by altering the direction of development and providing a modified set of stand structures, values, and, indeed, a different ecosystem.

Silviculture may be defined as the art, practice and science of caring for forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis. This definition is in line with classical and agreed definitions of silviculture (Ford-Robertson, 1971; Winters, 1977; Helms, 1998). Modern forestry embraces fully the term sustainable forest management. This is defined in the Helsinki resolution as:

"The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems" (MCPFE 1993).

Silviculture is practiced generally within a frame of silvicultural systems that are designed to ensure the delivery



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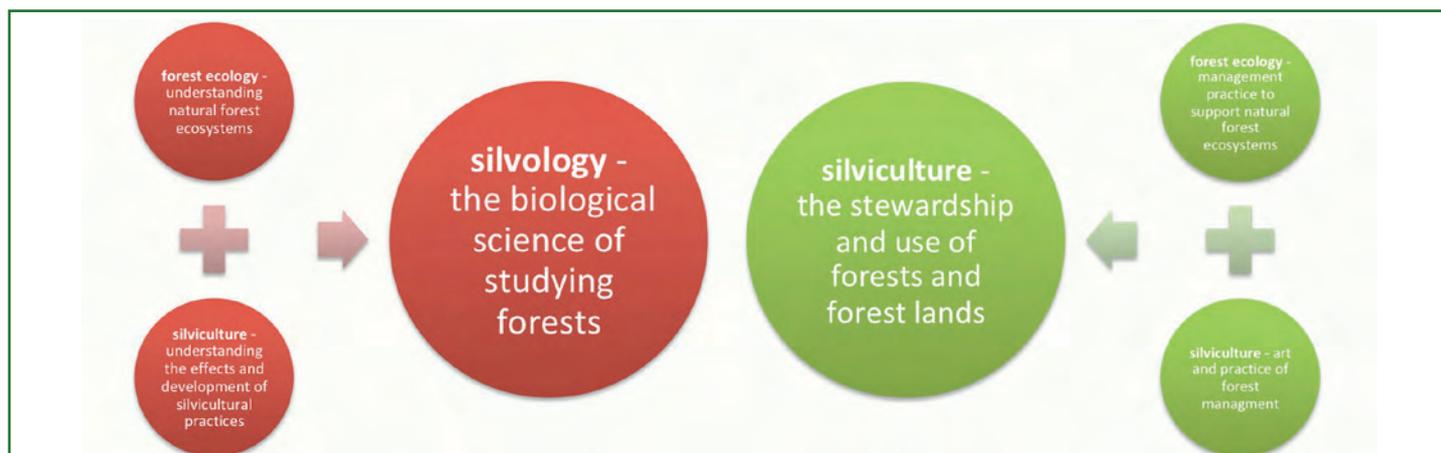


Figure 1. Silvology is the biological science of studying forests, incorporating the understanding of natural forest ecosystems, and the effects and development of silvicultural practices. The term compliments silviculture, which deals with the art and practice of forest management.

of sustainable forest management. Silviculture consequently is a key discipline that may be described as applied forest ecology (Dengler, 1935). In contrast to other disciplines no terminology has developed to distinguish the practice of silviculture from its scientific counterpart. For example, agronomy for agricultural science and technology; dendrology for the study of trees; and, ecology for the study of organisms and their interactions with environments. We argue that silvology is the appropriate term for the scientific discipline dealing with such activities and consequently a uniting term for qualitative and quantitative aspects of forest ecology and the practice of silviculture.

Silvology - etymology

Silvology is etymologically awkward as it combines Latin *silva* or *sylva* (forest, wood) with ancient Greek -λογία (-logy, i.e. study), but the suffix may be seen as a continuation of the Latin -logia, from which it was derived in English. It could be argued that since ὕλη (*hyle*) is ancient Greek for forest, the

preferred term might be *hylology*, however we believe this would be unintelligible in general usage as the prefix *silv-* is used widely in modern language in relation to trees and forests. Consequently, we believe *silvology* best describes the study of forests, which no other single term achieves.

Silvology defined

In order to promote the discipline of silvology the authors propose the following definition:

Silvology is the biological science of studying forests, incorporating the understanding of natural forest ecosystems, and the effects and development of silvicultural practices.

For clarity, other forms of silvology include:

silvologist n., silvological, silvologic, silvologous adj.

The role of silvology

Silvology is therefore the study of forests, and as defined above incorporates understanding of both natural systems and the effects of interventions by man in the form of silviculture. We argue that silvology is easily distinguished from silviculture provided that science is separated from art and practice. Examples of the two disciplines would include:

- A forest engineer studying compaction from forest vehicles (*silvology*) as opposed to building a forest road (*silviculture*).
- A geneticist observing heritability for a trait in a field trial (*silvology*) compared to a forest worker thinning the field trial (*silviculture*).

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- A forest mensurationist recording basal areas (silvology) and the forest manager using basal areas to implement a thinning regime (silviculture).
- A forest economist developing mechanisms for attracting payment for ecosystem services (silvology) as opposed to the forest manager maintaining forest condition to adhere to regulations or grant incentives (silviculture).
- A forest ecologist observing impacts of delayed tree thinning on ground flora (silvology) versus making a forest management decision to delay tree thinning (silviculture).

Scientists working in the biological science of studying forests may call themselves silvologists, and refer to their discipline as silvology. The term could be particularly helpful within the forestry sector (which by its nature is very broad) by helping separate scientific roles and responsibilities from practical jobs. Silvology could be applied to university courses, or book and journal titles. Within scientific papers that deal with forest science silvology could be adopted as a keyword, and this may prove particularly useful where the number of keywords is limited, providing space for detailed keywords for particular elements of study.

Summary

The diverse nature of forest science, yet the lack of a defining and simple term for the scientific discipline for the study of forests and woods, is a surprising juxtaposition. 'Silvology' is proposed as a new scientific discipline for scientists working in the fields of forest ecosystem and silviculture research.

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