The Role of the Silviculturist at Multiple Scales

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Abstract—Traditionally, silviculturists have been involved with fine resolution landscape assessments. Today, silviculturists are asked to go beyond that scale to look at a wide range of objectives (including wildlife, commodities, sustainability, diversity, and ecosystem resilience) on scales ranging from landscape to adjacent stands, watershed, regions, and sub-regions. As the issues facing natural resource management become more complex, more contentious, and more political, assessments will become an integral part of management, putting the silviculturist in a vital role of looking over a broad range of temporal and spatial scales.

Introduction

The practice of silviculture in the United States can trace its roots to late in the 19th century when Schlich (1896) and others started organizing the methods and concepts of the discipline. During the 1900s, silviculturists tended forests using both art and science to meet the objectives of landowners (Hawley 1937; Toumey 1928). During this time the majority of wood products produced in the United States were used by developing towns and cities throughout the Western and Midwestern United States (Hutchison 1942). By the end of the 20th century, the practice of silviculture entailed developing methods and systems for establishing and maintaining communities of trees and other vegetation that people value (Nyland 1996; Smith and others 1997). To develop these systems silviculturists depend on a plethora of knowledge including zoology, botany, ecology, physics, wildlife, silvics, pathology, soils, engineering, law, economics, and many others (Nyland 1996). Silviculture evolved, to become an integral component in the management of forests and woodlands and is essential to most adaptative management models (fig. 1).

As we begin a new millennium silviculturists are being asked to design silvicultural systems for diverse objectives ranging from maintaining and renewing ecosystems to producing wildlife habitat and commodities. Moreover, the silviculturist is often asked to design systems to sustain the integrity, diversity, and resiliency of ecosystems. Treatments are applied to stands to meet these objectives but they need to be placed in context of adjacent stands, landscapes, and watersheds. Different stand treatments often need to be interspersed across landscapes and planned to occur over decades and even centuries. Silviculturists are very knowledgeable about vegetation and vegetation dynamics and this places them in the role of teachers both within their respective organizations and to the general public. To be effective and efficient in prescribing stand level treatments to meet this diverse array of objectives and to fulfill the many other obligations of the position, silviculturists need to be involved at many different spatial and temporal scales.

Scales

There are several different notions of scale and often there is confusion between geographic extent and data resolution (Haynes and others 1996). Geographic extent refers to the area covered by an assessment and resolution describes the amount of detail incorporated in the data describing the geographic extent. Broad-scale (regional) assessments use coarse resolution data to address issues for national and regional planning, mid-scale (sub-regional) assessments use

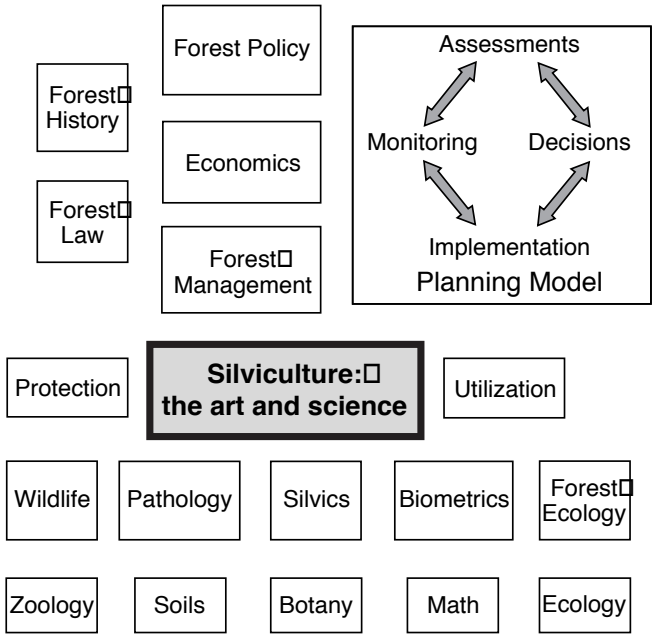

Figure 1—Silviculture is an integrative discipline well founded in the basic sciences. This knowledge combined with management skills and technical knowledge make the practice central to the management of forests and woodlands (adapted and modified from Nyland 1997).

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midresolution data to address issues at the state and regional planning levels, and fine resolution data in small scale (landscape) assessments are used for Forest and District planning. In addition to these spatial scales, temporal scales ranging from minutes (measured in seconds) to millenniums (measured in centuries) can be used to describe natural resources. Depending on the issue, location, or need, a variety of scales can be displayed in assessments to inform the public about decisions on natural resource management.

Assessments

Assessments have always been part of forest management. At a local level silviculturists used exam to design stand treatments, while wildlife biologists used habitat surveys and animal censuses to plan hunting seasons and habitat improvement projects. But it became apparent that the cumulative effects of these local management actions and the ever expanding resource issues facing today's managers crossed jurisdictional and ecosystem boundaries (FEMAT 1993). The protection of northern spotted owl (*Strix occidentalis caurina*) habitat, the harvesting of temperate rain forests, and the protection of anadromous fish habitat in the Columbia River Basin are examples of these kinds of contentious resource management issues. Therefore, to make informed natural resource decisions the need for understanding and addressing these issues requires assessments at and across different spatial and temporal scales.

At the largest geographic extent or the broadest scale, assessments describe resources and conditions at sub-continental, continental, and global scales. Global warming, world climate, ocean temperature, or ozone assessments fall into this category. Satellite technology, large-scale models, or even expert knowledge are used to complete these assessments. They use coarse resolution data and are used for national and international planning (Hulme and others 1999).

Regional assessments are used for national and regional planning and cover millions of acres (table 1). Forest health, catastrophic wildfire, anadromous fisheries, community stability, and timber harvests were only some of the issues addressed by the Interior Columbia River Basin (ICRB) assessment. This assessment described the social, economic, terrestrial, aquatic, and landscape components covering 23.6 million acres of the inland Northwestern United States. Coarse resolution data were used in this assessment covering the majority of the Columbia River Basin. The assessment was organized around multiple watersheds and the detail of information reported was in the order of 250 acres for landscape elements (in other words, vegetation) and states and counties for economic and social elements (in other words, income, population) (fig. 2) (Quigley and others 1997; Hann and others 1997).

In contrast to the large continental and world assessments, the issues addressed at regional scales are more specific but still relatively general. Issues such as ecosystem health, areas or wildlife at risk, sustainability, or long-term productivity are often addressed at this broadscale. The information produced at these scales usually draws conclusions and makes inferences about large areas or subunits of large areas. For example, the ICRB assessment divided the interior Columbia River Basin into 13 ecological reporting units (ERU) each having similar terrestrial and aquatic characteristics. Data were summarized for each ERU and conclusions drawn about the ecological condition of each area. Similarly, the ICRB assessment used 164 subbasins for addressing ecological integrity and landscape patterns (fig. 3). In addition to describing common attributes, these broad-scale assessments can identify unique features that may provide development opportunities or be areas of concern needing special care or protection. For example, the broadscale assessment of the ICRB identified stream reaches dispersed throughout the Basin that were key salmonid strongholds potentially needing protection (Lee and others 1997).

Using midresolution data, subregional assessments are often conducted covering states or smaller areas (fig. 4). The

Table 1—Attributes and characteristics typically associated with different kinds of ecological assessments.

Attribute	Assessment
Region	Regional (broad), sub-regional (mid), landscape (small)
Size (acre)	Millions to billions, thousands to millions, tens to thousands
Geographic extent	River basin, multiple watersheds, watershed(s)
Organizational hierarchy	Multiple watersheds, watershed, streams, and vegetation patterns
Data resolution	≥250 acres (coarse) ≤250 acres (mid) ≤50 acres (fine)
Map scale	≥1:100,0001:100,0001:24,000
Planning level	National/regional Regional/state Forest/district, silviculturist participation desired, critical

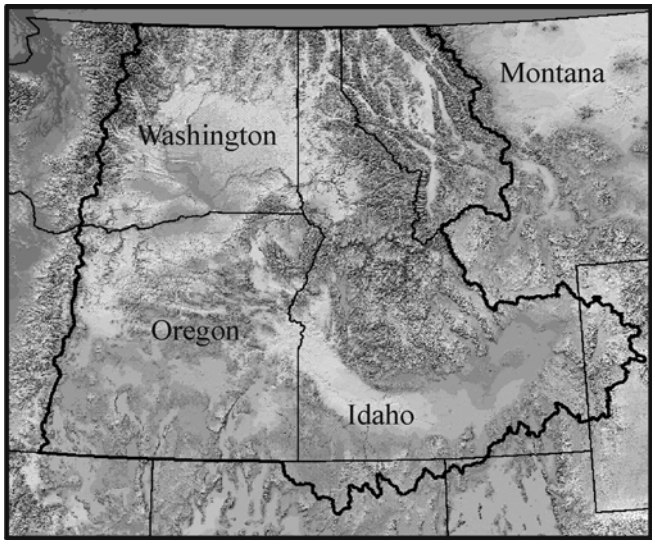

Figure 2—The interior Columbia Basin assessment used coarse resolution data to describe a large portion of the inland Northwestern United States. These kinds of assessments are used for regional and state planning.

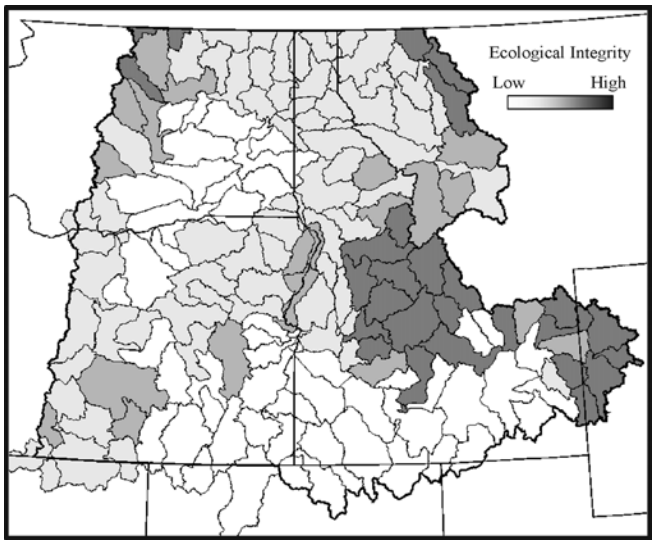

Figure 3—Ecological integrity was rated for watersheds throughout the interior Columbia Basin. The silviculturist has the knowledge experience to be involved in these kinds of assessment processes.

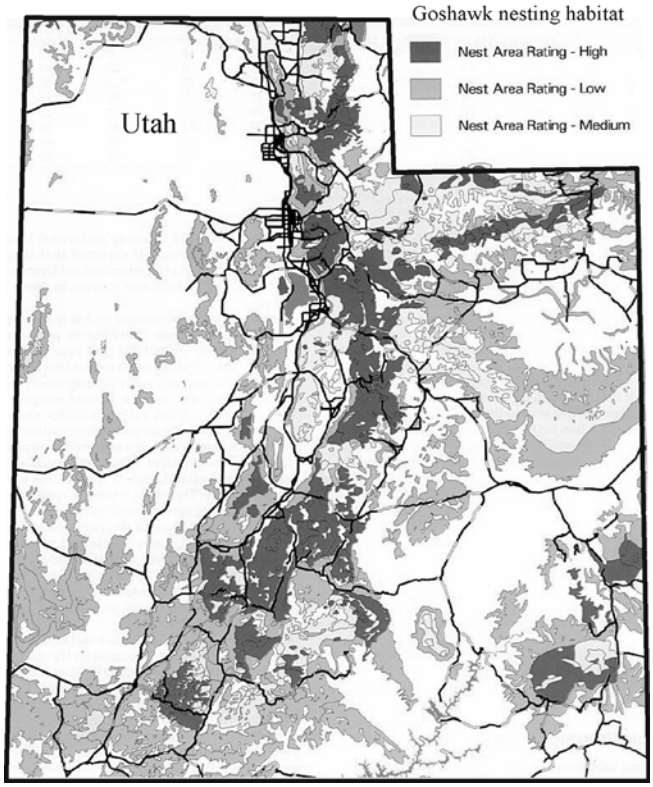

Figure 4—Mid-scale assessments use medium resolution data to describe ecosystems and are usually more specific in the issues they address. This map shows nesting habitat in Utah and the silviculturists of Utah were instrumental in developing these nest area ratings.

extent of these assessments usually covers multiple watersheds with landscape elements displayed with resolutions less than 250 acres and socioeconomic elements commonly derived from county data (table 1). The map scales used in these assessments can range from 1:24,000 to 1:100,000. The issues addressed at this scale are similar in nature to those addressed at the broader scale, but they are usually more specific. For example, instead of addressing general questions about plants or animals, mid-scale assessments may address one species such as the northern goshawk (*Accipiter gentilis*) or one ecosystem such as the pinyon/juniper (*Pinus edulis*/*Juniperus osteosperma*) woodlands (Graham and others 1999b). At these mid-scales, present and predicted ecosystem conditions are commonly displayed as are more specific descriptions and locations of vegetation, species, communities, and risks.

Silviculturists, biologists, and most resource managers and specialists are most comfortable collecting and analyzing fine resolution data over watersheds, stands, and other small areas (table 1). These landscape assessments are ordinarily conducted at the District and Forest level within the Forest Service to plan and implement vegetation, watershed, and range projects. Both landscape and socioeconomic assessments at this scale are often conducted using fine resolution data with vegetation sampled using patches less than 50 acres while economic and social information are collected using households as the sample unit. Questions and issues addressed at this scale are usually site specific such as the location of culverts impeding fish passage in a particular stream, or describing fire risk near cabins at a particular lake. For example, the landscape assessment of the Coeur d'Alene Mountains in northern Idaho determined the proportion of stands containing western white pine (*Pinus monticola*) in watersheds for use in restoration management strategies (fig. 5).

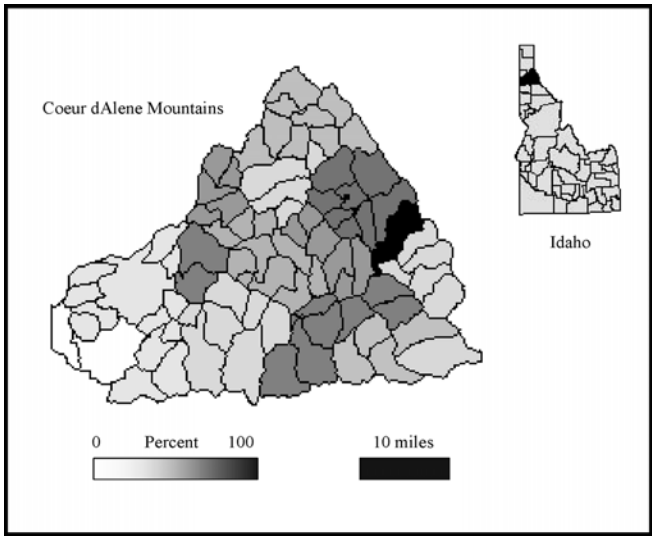

Figure 5—This map shows the proportion of stands in watersheds of the Coeur d'Alene Mountains where western white pine is currently present. The silviculturist should be an active player in these landscape assessments.

Assessment Applicability and Silviculturist Involvement

The silviculturist can, and should, play a variety of roles in assessments. By being involved early and continuously through the assessment process, silviculturists can integrate their knowledge (displayed in fig. 1) into recommendations which may become future Forest Plan standards or guides. The consequence of not being involved is that standards and guides used to direct forest practices coming directly from recommendations developed in assessments will not contain their knowledge. Silviculturists prescribe the majority of the treatments applied to a forest and they need to ascertain that standards and guides affecting treatments are ecologically sound and applicable. Moreover, a silviculturist can help develop assessment recommendations that are not prescriptive (in other words, by defining silvicultural systems) but describe desired conditions that meet management objectives.

Involvement in the assessment process allows silviculturists to recognize the utility of assessments, which depends on the need, issue, scale, and decisions to be made. In addition, the silviculturist can insure the findings and data from assessments are properly applied. In general most silviculturists, wildlife biologists, hydrologists, and managers are most comfortable collecting, analyzing, and using fine resolution data describing stands, stream reaches, or other small areas. Because of this comfort, there is a tendency to utilize fine resolution data gathered at small scales for mid and broad-scale assessments even though fine resolution data may be inappropriate for use at larger scales (Graham and others 1999a). When coarse resolution data from broad assessments are used to describe small areas it is easy to criticize them as wrong, when in reality they are misapplied. Similarly, if the processes, assumptions, and scope of the assessment are not well understood it is easy to assume the assessment is not applicable for addressing a certain issue or condition.

Silviculture is an integrative discipline thus it is critical that silviculturists should participate in sub-regional and landscape level assessments (fig. 1). At the broadest scale, the silviculturist needs to be aware of processes and content of the assessment and understand what contributions these assessments provide towards planning forest treatments. Broad-scale assessments, such as the ICRB provide context for activities at the Region and Forest level while subregional assessments provide context for activities at the Forest and District level. By providing context, assessments disclose the conditions or circumstances that surround the situation, proposed treatment, or decision. For example, the context for a Forest Plan amendment defining northern goshawk habitat might be the amount of habitat throughout the region and the administrative and native threats to the existing habitat. Broad scale assessments can also identify unique areas such as salmonid strong holds or ecosystems in peril such as the western white pine and pinyon/juniper systems (Hann and others 1997; Lee and others 1997; Graham and others 1999b). They can also show how common a situation may be. For example, in the interior Columbia River Basin cheat grass (*Bromus tectorum*), an introduced invasive species, is very common occurring in all 97 counties. Broad scale assessments can also be used to set priorities. For example, broad scale assessments might show how wildfire regimes changed, threatening the integrity of various forest and woodland ecosystems. This information can be used to establish prescribed burning programs or wilderness fire plans.

It is imperative that a silviculturist be involved at the subregional level because they have the knowledge and integrative skills to be a key player in designing, leading, completing, and using midscale assessments. Most importantly the silviculturist can make certain the assessment is used properly, validate the information presented, and show its value for making informed decisions. Information available at this scale can be used to define areas at risk from various threats and can define management opportunities. For example, these kinds of data can indicate where vegetation treatments may reduce the risk of catastrophic wildfire or where the greatest risk for landslides may occur. Additionally these data can readily be used to plan and implement landscape level treatments by not only providing context for activities, but help define and/or locate landscape level elements such as wildlife travel corridors, late-successional forest reserves, goshawk foraging areas, or recreation sites. Also at this level, integrated information is often presented for which the silviculturist is well qualified to evaluate. These integrative systems include rating ecological integrity, valuing animal habitat, or defining wildfire risk.

Traditionally the silviculturist has always been involved with fine resolution landscape assessments. Since the early 1970s, silviculturists have been prime players in Forest Service Forest Plans or even smaller Unit Plan assessments. Additionally, fine resolution data were often used for small areas (Ranger Districts) to develop timber, range, or wildfire plans. These assessments describe resource amounts, timber volumes, fuel loading, and other site specific resource characteristics. Recently (1990s), landscape assessments have been used to address local resource issues such as Douglas-fir beetle (*Dendroctonus pseudotsugae*) epidemics or urban interface wildfire hazards. If these assessments apply procedures and concepts similar to those tested and used in subregional or regional assessments, their connectivity, usefulness, and efficiency can be greatly improved. No other person has more knowledge or understanding of the data and information collected and analyzed at this scale than does the silviculturist. It is critical that they be involved in assessing forest and woodland resources at this scale.

In the unlikely event that a completed assessment does not cover the issues a silviculturist is dealing with, or does not contain the necessary products to make an informed decision, the procedures, methodology, data, and concepts described in the assessment may be applied to address these short-comings. If no assessment product is available that meets the need, the first source of information considered should be data collected for an assessment but not reported on in the desired manner. For example, the ICRB assessment produced over 150 data layers of the entire interior Columbia River Basin at a variety of resolutions. These data are available for summarization and analysis (Quigley and others 1996). If no data are available for meeting the need,

the procedures, models, concepts, and techniques used in assessments are appropriate for developing new information. Using techniques similar to those employed in completed assessments will encourage the compatibility and usefulness of the new information. It is imperative that the silviculturist be involved with these approaches for developing new information.

Conclusion

As we enter the new millennium the personnel of the Forest Service are being ask to do more with less. Assessments, planning, consultation, consolidation, implementation, monitoring, and litigation are only a portion of the items keeping silviculturists occupied daily. Even though there are more duties required of the silviculturist then there is time, being involved in assessments and understanding their consequences, procedures, data, and information is critical. As the issues facing natural resource management become more complex, more contentious, and more political, assessments and their completion and use will become an integral part of management. Therefore, because silviculture is the center of forest and woodland management, the silviculturist needs to be creative, persistent, and innovative to ensure that they find the time and resources to be involved with assessments over various temporal and spatial scales.

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