The Theoretical and Empirical Basis for Understanding the Impact of Thinning on Carbon Stores in Forests

Mark E. Harmon

Presentation Abstract

Thinning of forests has been proposed as a means to increase the carbon stores of forests. The justification often offered is that thinning increases stand productivity, which in turn leads to higher carbon stores. While thinning of forests clearly increases the growth of residual trees and increases the amount of harvested carbon compared to an unthinned stand, there is little theoretical or empirical basis for believing that this activity increases the average carbon stores of forests. By removing trees, leaf area is temporarily decreased and carbon input to the forest via photosynthesis is also temporarily decreased. In theory, reducing the input of carbon to a forest will reduce its average carbon stores. Moreover, by increasing the amount of carbon harvested over a rotation, a greater proportion of carbon is removed, which general ecosystem theory also predicts will lower average carbon stores.

The few empirical studies that have examined long-term impact of thinning on carbon stores have indicated that as thinning intensity increases either in amount or frequency, the average long-term carbon store decreases. Simulation models indicate very similar trends. Both results are in line with predictions from general ecosystem theory. Despite the finding that thinning reduces average carbon stores relative to not thinning, this management practice may lead to increases of carbon stores compared to a system of clearcut harvesting. By replacing clearcut harvesting with a series of partial harvests, carbon stores in forests could be increased significantly.

Keywords: thinning, uneven-aged management, regeneration, structural diversity, species diversity, Douglas-fir.

Editors' suggestion:

Harmon, M.E.; Marks, B. 2002. Effects of silvicultural practices on carbon stores in Douglas-fir–western hemlock forests in the Pacific Northwest, U.S.A.: results from a simulation model. Canadian Journal of Forest Research. 32: 863–877.

Mark E. Harmon is a professor, Department of Forest Ecosystems & Society, Oregon State University, Corvallis, OR 97331; mark.harmon@oregonstate.edu.

Western Washington and Oregon Elk Foraging: Use and Nutritional Value by Vegetative Life-form

John G. Cook and Rachel C. Cook

Presentation Abstract

Recent research and modeling of Elk (*Cervus elaphus*) habitat selection and nutrition is establishing the key importance of nutritional value of plant communities (NV, e.g., digestible energy and protein of forage in ungulate diets) to habitat use and productivity of Elk herds in

western Oregon and Washington. These data show that NV of many sites can be improved via active forest management. No exhaustive studies have been conducted in western Oregon and Washington to identify relationships between thinning strategies and changes in NV of plant communities. Our work, however, suggests general patterns of NV that reflect interactions between plant community composition and forage selection capabilities of Elk and, in turn, between plant succession patterns and potential natural vegetation (PNV) zones. These have relevance for understanding and predicting effects of thinning on large ungulate nutrition and may include four patterns:

I. Thinning significantly changes plant composition in mid- and late-seral stages to include more early-seral, shade-intolerant species and (A) these species are considerably more nutritious and palatable than pre-thinning shade-tolerant species, or (B) these species are neither more nutritious nor palatable than pre-thinning shade-tolerant species.

II. Thinning invokes little change in plant composition but increases abundance of attendant shade-tolerant species, and (A) these species are nutritious and palatable, or (B) these species offer low nutrition and/or palatability.

Our foraging/nutrition research evidently offers examples of these patterns in Oregon and Washington. For example, many plant association groups may exhibit the IIB pattern in the Western Hemlock (*Tsuga heterophylla*) PNV, particularly those that support primarily Salal (*Gaultheria shallon*) and/or Swordfern (*Polystichum munitum*) understories, and in the Douglas-fir (*Pseudotsuga menziesii*) zone with Madrone (*Arbutus menziesii*), Manzanita (*Arctostaphylos* spp.), and Tanoak (*Lithocarpus densiflorus*) understories in extreme southwest Oregon. Thinning may only increase the abundance of these highly unpalatable species and thus offer little opportunity to improve the NV of these communities. In contrast, our data suggest that thinning increases abundance of a variety of shade-tolerant and -intolerant species that are palatable and nutritious in the White/Grand Fir (*Abies concolor/A. grandis*) and Mountain Hemlock (*Tsuga mertensiana*) plant associations of the Cascades (west slope) (pattern IA). Thinning in these communities may offer considerable improvement of their NV. Thinning influences on sunlight and soil moisture also may alter plant phenology, chemistry, and thus nutrient levels in ungulate forage. Integrating data of ungulate nutritional ecology and plant succession patterns eventually will be necessary for developing reliable thinning strategies to improve NV and the associated carrying capacity of landscapes for large ungulates.

Keywords: Elk, foraging, nutrition, nutritional ecology, plant composition, plant succession, thinning, ungulates.

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John G. Cook is a wildlife biologist, and *Rachel C. Cook* is a wildlife biologist, National Council for Air and Stream Improvement, La Grande, OR; cookjg.ncasi@gmail.com; cookrc.ncasi@gmail.com.