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Potential management of young-growth stands for understory vegetation and wildlife habitat in southeastern Alaska

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Abstract

I review the current state of knowledge about dynamics of understory vegetation in postlogging succession and responses to silviculture treatments in southeastern Alaska, and I derive implications for future research and development. The classic Alaback [Ecology 63 (1982) 1932] model of postlogging succession has dominated ecological thinking in the region for the past two decades. Understory vegetation is believed to increase dramatically immediately after logging but decrease to near-zero levels as the young stands attain conifer canopy closure. Depauperate understories are believed to persist for >100 years. Early studies indicated that understory response to thinning of even-aged stands is mainly by dominant shrubs and is short-lived; response by herbs, especially forbs, is slight. Western hemlock (*Tsuga heterophylla*) was identified as a potential long-lived, second layer, understory dominant in stands thinned to wide spacing. Recent studies, however, indicate three important deviations from conventional wisdom: (1) Red alder (*Alnus rubra*)–conifer, even-aged stands produce species-rich and high-biomass understories comparable to those of old-growth forests and much greater than similar-aged pure conifer stands. (2) "Commercial thinning" of older, even-aged stands may result in much greater understory biomass, including forbs, than previously thought, but time requirements might be longer than previously thought. (3) Extrapolation of data from small scales of research plots to large scales of timber-management stands tends to greatly overestimate stand homogeneity and underestimate understory biomass of even-aged conifer stands. The new findings provide a basis for renewed research into even-aged stand management in southeastern Alaska. I suggest a two-pronged approach emphasizing autecological studies of light and soil requirements of major understory species coupled with an "engineering" approach to designing optimal understory environments through silviculture. New silviculture prescriptions can be designed for specific understory objectives. Testing and application of new prescriptions is recommended at the scale of timber-management stands through adaptive management studies in collaboration between the Pacific Northwest Research Station and the Tongass National Forest.

Keywords: Silviculture; Forest management; Even-aged forests; Clearcutting; *Picea sitchensis*; *Tsuga heterophylla*

1. Introduction

Clearcut logging has been the predominant timber-management practice in southeastern Alaska since the advent of large-scale logging in the 1950s. It is a

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preferred harvest method for a number of silvicultural reasons (Ruth and Harris, 1979): (1) The old-growth western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*) forests have much defective timber (dead or dying trunks) that is best removed from the new stand. (2) Maximum opening of the forest canopy provides maximum light and soil temperature for regenerating trees. (3) The more commercially valuable Sitka spruce is less shade tolerant than is western hemlock. (4) Physical damage of residual trees, eventually leading to disease, is minimized in the regenerating stand. (5) Logging costs per unit of timber harvested are least with the clearcut method. However, natural overstocking of the regenerating stand is a common silvicultural problem following clearcutting of the hemlock–spruce forests (Harris and Farr, 1974).

Even-aged forests resulting from clearcutting are widespread in southeastern Alaska, and clearcutting is expected to continue as a harvest technique. At the close of year 2000, there were over 160,000 ha of Tongass National Forest and about 85,000 ha of Alaska Native corporation forests in an even-aged condition (Eugene DeGayner et al., USDA Forest Service, Alaska Region, Juneau, AK, unpublished report based on data in Forest Service files). The record of decision on the 1997 Tongass Land and Resource Management Plan projected an additional 35,000 ha harvested per decade, with 80% of that harvest by clearcutting. About 100,000 ha of Alaska Native Corporation forests not yet harvested will likely be harvested by clearcutting.

Although clearcut logging is a highly preferred timber-management practice, it is recognized as having negative consequences for wildlife habitat in southeastern Alaska, primarily because of its effects on understory vegetation in the regenerating stand (Wallmo and Schoen, 1980; Schoen et al., 1981, 1988; Samson et al., 1989; Hanley, 1993). Dense conifer regeneration and canopy closure result in a very depauperate understory from about 25–150 years stand age (Alaback, 1982, 1984a, 1984b). Understory vegetation is very important as food for herbivores and as cover for ground-nesting and ground-foraging birds and small mammals. Silvicultural thinnings of young stands have shown few encouraging results for long-term maintenance of a diverse and productive understory (Alaback and Tappeiner in Hanley et al., 1989, pp. 5–6; Deal and Farr, 1994). Recent observations, however, indicate new potentials for young-growth management along two lines of approach very different from earlier thinking: (1) inclusion of red alder (*Alnus rubra*) in the regenerating stand, leading to an alternative pathway of secondary succession (Hanley and Barnard, 1998); and (2) commercial thinning of older, even-aged conifer stands (Zaborske et al., 2002).

The purpose of this paper is to review the evolution of knowledge about even-aged stand management for understory vegetation in southeastern Alaska, to examine potentials for new approaches based on the most recent findings, and to suggest implications for the future for both research and application.

2. Empirical evidence and theoretical considerations

The 1982 *Ecology* paper by Paul Alaback (Alaback, 1982), based on his Ph.D. research of understory response to postlogging succession, became a classic in the ecological literature for southeastern Alaska. It described the pattern of understory biomass and production along a chronosequence of 60 stands ranging from 3 to >550 years of age, with greatest emphasis on stands <100 years old. The pattern observed by Alaback was clear and dramatic: understory production, especially shrubs, increased strongly within the first decade or two after removal of the forest overstory, but within 25–30 years, understory became overtopped by young conifers and was quickly shaded almost out of existence, and that condition persisted through at least 150 years stand age (Fig. 1). With an anticipated rotation age of about 100 years, even-aged stands 30 years to rotation age appeared very poor as wildlife habitat.

The use of silvicultural thinnings to increase and maintain understory in even-aged stands has not been encouraging. In 1984, Alaback and Tappeiner (P.B. Alaback and J.C. Tappeiner II, Oregon State University, Corvallis, OR, unpublished report) measured understory biomass in twenty-nine 0.4 ha even-aged stands that had been thinned 5–7 years earlier at three levels of between-tree spacing. All stands were a mixture of western hemlock and Sitka spruce and ranged in age from 20 to 72 years when measured by Alaback and Tappeiner. The stands were distributed throughout southeastern Alaska as part of a mensurational study of effects of stand density on tree growth and yield