Journal of Forestry 96(7): 40-46

Silviculture | History

"Selective Cutting" in Douglas-Fir

History Revisited

In the 1930s "selective cutting" was practiced in old-growth Douglas-fir; in the 1950s the experiment was pronounced a failure. In fact, the original concept was *not* an individual tree selection system; it called for regeneration in small clearcut patches and resembled some current proposals. Flexible application might well have been successful, but as it was practiced, removals were limited to large Douglas-fir, very old stands deteriorated after disturbance, and small openings did not allow Douglas-fir regeneration. As a result, partial cutting trials came to an abrupt end, and the consequent lack of research into alternatives to clearcutting severely handicaps current efforts to meet changing objectives and public concerns.

By Robert O. Curtis

Forest management and associated silvicultural practices have been evolving in the Douglas-fir region since about 1900. This evolution continues, and debate among foresters and the public has been heated at times. Participants in these debates often seem to lack an appreciation of the long history of forestry, of the evolution of forest practices, and the fact that there have been a number of radical changes in forestry goals and practices in the past—some well justified and beneficial, others that illustrate the dangers of widespread adoption of plausible-appearing practices in the absence of supporting research and small-scale trials.

One such radical change was the selective cutting episode of the 1930s, a case that is largely unknown to the general public and not widely known among the current generation of foresters. It illustrates the dangers of adopting plausible practices in the absence of supporting research.

Historical Background

After beginning in the 1850s, timber harvesting and processing quickly grew into a large industry in the Douglas-fir region of the Pacific Northwest. Seemingly unlimited amounts of high-quality timber were available at little stumpage cost, and in the early years there was no incentive for forest management and little for forest protection. The main concern of timberland owners was harvesting high-quality timber at minimum cost. An elaborate and efficient technology soon developed, based on rail transportation. Because of the limitations of railroad logging, there was no alternative to removing virtually all merchantable timber over very large areas as logging operations moved up the valleys. Scattered individuals or groups of defective trees and trees in inaccessible locations were often left, however, and these subsequently provided an unplanned seed source for regeneration. Though often referred to as clearcutting, this practice was really simple liquidation and quite distinct from clearcutting as a planned silvicultural system.

By the 1880s concerns over future timber supplies, watershed protection, unplanned forest liquidation, and uncontrolled forest fires were heard. The national forests were established, and forestry research began. Allen (1911) stated the requirements for establishing forest management on a permanent basis, and Munger (1911) summarized existing knowledge on Douglas-fir *(Pseudotsuga menziesii)* and its management.

The first priority, emphasized by huge fires in the early 1900s, was fire control. Wildfires threatened existing investments in harvestable timber, and efforts to regenerate harvested areas and make timber growing a permanent land use were futile without effective control. Soon there were legal requirements for lash disposal on logged lands and increasingly effective fire-control organizations.

Next in priority was regeneration. This need was met primarily by natural seeding, although there were also early planting programs to rehabilitate burned areas. Extensive research was done on seed dispersal, seed production, and seedling establishment of Douglas-fir. By the late 1920s much of the information needed for regenerating harvested areas by natural seeding was available (Munger 1927). McArdle and Meyer (1930) published yield tables demonstrating the enormous productivity of Douglas-fir forests.

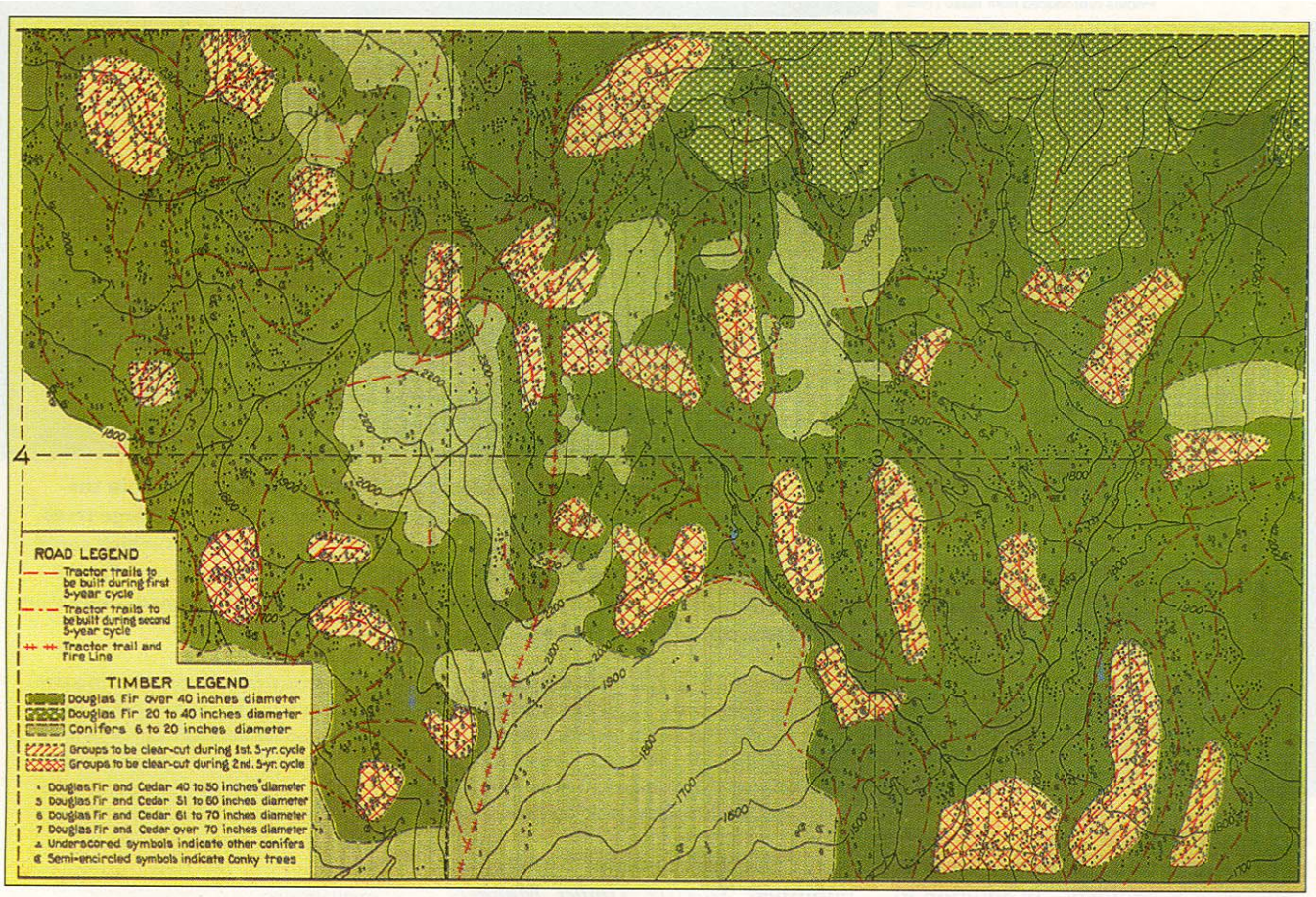

Figure 1. **Map from Kirkland and Brandstrom (1936), showing proposed distribution of cuts within a part of the area used as one of their illustrative cases. Their intent to regenerate the old-growth stands by a series of small patch cuts is clearly illustrated, but Depression-era markets and inadequate logging technology led to a very different result—and the failure to obtain Douglas-fir regeneration.**

Long-term management on a permanent basis was now possible.

The knowledge was put to use on the national forests and some other ownerships. A common requirement on national forest timber sales was leaving at least two seed trees per acre, often supplemented by some seed blocks or edges. The industry codes adopted under the National Industrial Recovery Act of 1933 (invalidated by the Supreme Court in 1935) required specific fire-protection measures and retention of seed trees or seed blocks on industrial lands (Dana 1956). Results varied with occurrence of seed crops, site conditions, and weather.

"Selective Cutting"

The introduction of the tractor and motor truck in the late 1920s brought a new flexibility in harvest operations. On moderate terrain it was now possible to remove individual trees or small groups or patches of valuable or high-risk trees while retaining other trees for value appreciation and future harvest.

It had long been recognized that harvesting and processing costs of small and low-quality timber often exceeded the value of the product, and that the prevailing practice of harvesting all trees over large areas could result in lower profits than would removal of only those trees or stands that would return a net profit on current markets. In 1929 the National Lumber Manufacturers' Association, meeting in Longview, Washington, recommended study of "The possibility of operating existing stands of timber on the basis of *selective* logging—either by size of trees, species, timber types, or areas classified with respect to accessibility and logging costs—with a view to harvesting such timber in the order of its actual economic value, and reserving for future utilization the portions of such stands whose present cutting actually yields an unprofitably low return or loss" (in Mason 1929).

Brandstrom (1930) advanced similar arguments, which became especially compelling in the depressed markets of the 1930s, when only large and high-quality timber could be handled at a profit. Note that "selective logging" was based on economic criteria that could be applied either tree-by-tree or to whole stands.

Munger (1933) discussed those considerations and some further associated potential silvicultural advantages. He (like others at the time) used "selective cutting" loosely, as a contrast to the prevailing practice of clearcuting large areas; he specifically included various forms of patch cutting

Photos reproduced from Isaac (1956)

Left: **Growing under the widely scattered old-growth Douglas-fir in the 1930s were hemlock and silver fir just under commercial size. Large trees could not be removed without serious injury to reserve trees, which could not be salvaged under the market conditions of the time.** ***Above:*** **Partial cutting in this type of forest left behind decrepit, poorly formed understory hemlock and decadent old-growth hemlock and Douglas-fir.**

as well as individual tree selection: "... the term *selective cutting* is used... loosely, merely in contrast to clear cutting over large areas. Selective cutting or partial cutting ... may be *tree selection* as in uneven-aged stands ... or *area selection* where the stand inclines to be evenaged in groups and composed of intolerant species, and the cutting must be patchwise accordingly." In addition to the advantages in harvesting and processing costs and returns discussed by Mason (1929) and Brandstrom (1930), Munger foresaw long-term gains from salvage of dead and dying timber; release of remaining trees for future growth; ease of regeneration; and maintenance of aesthetic, water-shed, and recreational values.

In 1934 Regional Forester C.J. Buck wrote to forest supervisors about the disadvantages of the prevailing clear-cutting practice:

> It is believed that these conditions can be rectified very largely by the adoption of intensive forestry practices involving light cutting systems which will retain a large percentage of the forest canopy and thereby preserve the forest growing conditions, will preserve the fertility and will obviate the burning of large areas with slash fires....The immediate future policy therefore will be to develop, test, and put into effect selective logging with individual tree and small group selection in western Oregon and Washington. Under this system clear cut areas of as much as 5 or 10 acres should be infrequent. Light cuttings involving 10 to 20 percent of the volume will either create slight additional (fire) hazard or permit its reduction at reasonable expense...

In 1936 Kirkland and Brandstrom published *Selective Timber Management in the Douglas-Fir Region.* Envisioning a rapid transition to sustained-yield management, exemplified by case studies of plans for a number of properties, they proposed initial light cuts to remove declining trees and the most financially overmature timber, plus a rapid expansion of the road system for future management. Contrary to some later interpretations, their proposal did not represent an individual tree selection system. In fact, they emphasized the need for flexibility in application and specifically recognized that satisfactory regeneration would require clearcutting 2- to 10-acre patches (Kirkland and Brandstrom 1936, p. 45) after the initial light cuts. They further stated (p. 46, 89),

> From an economic point of view this is essentially the same principle that has been applied for centuries to many European managed forests. Clear cutting in their case is the final cut following a series of thinnings (cuttings consisting of individually selected trees). Clear cutting of this sort on limited areas as needed for effective regeneration...is part and parcel of selective timber management as defined in this report.... in the practical working out of selective timber management, cutting will be of two distinct kinds, namely (a) very light individual tree selection, (b) clear cutting by small groups.

Figure 1, from Kirkland and Brandstrom (1936), shows clearly that patch cuts in the oldest stands were an integral part of their proposal. Their caption read, "When this area was cruised, trees more than 40 inches in

diameter were located as shown on the map (see legend). It is possible, therefore, to locate on the map the boundaries of heavy groups which will yield 75,000 to 200,000 board feet per acre. These should constitute about half the cut. The remainder should come from tree selection in intervening areas..."

Kirkland and Brandstrom's discussions went beyond the goal of sustained yield—they emphasized producing large high-quality timber *and* maintaining other forest values: "It is perfectly clear... that a management procedure that preserves a heavy growing stock and generally excludes extensive clear-cutting will promote also the aesthetic, protective, and other functions of the forest which make it of multiple utility" (p. 121). Their words sound surprisingly current.

The publication (with a preface by USDA Forest Service Chief F.A. Silcox) generated wide interest, and "selective cutting" was widely applied on the national forests of Region 6 from the mid-1930s to the late 1940s. It was also used by the O&C Administration (now the Bureau of Land Management).

Beginning in 1935, the Pacific Northwest Forest and Range Experiment Station began installing and measuring a series of monitoring plots on national forest sale areas. Seventeen areas were sampled; all were remeasured at year five, and 10 were remeasured at year 10. The stands in question varied in age from 150 to 600 years. They were often highly defective, and many contained well-developed understories of tolerant species, primarily western hemlock *(Tsuga heterophylla)*, western redcedar *(Thuja plicata)*, and true firs *(Abies sp.)*, which were not considered merchantable at the time. Removals in the selective cut ranged from about 20 percent to more than 50 percent and averaged 36 percent in gross board foot volume—substantially higher than those specified in Buck's 1934 letter and implied in Kirkland and Brandstrom's discussion.

Early Assessments

A preliminary discussion of results was given by Munger (1950) and a more complete report by Isaac (1956). Unfortunately, the records of stand measurements and plot locations disappeared after 1956, and I found no information on developments after the first decade of observation.

The main points in Isaac's (1956) report of results can be summarized as follows:

1. A single-tree, partial cutting system was tried under a wide range of stand conditions in the Douglas-fir region.

2. In most stands the Douglas-fir component was made up of the oldest trees and was essentially even-aged. The associated tolerant species (western hemlock, western redcedar, silver fir, grand fir) were generally younger and often in an understory position.

3. Cuts removed merchantable trees from the oldest and largest size class; these trees were usually Douglas-fir and the best trees in the stand.

4. Surviving Douglas-fir trees in most cases did not increase growth in response to cutting. There was a substantial growth response of survivors of the associated tolerant species.

5. On most but not all areas, gross growth of reserve trees was more than offset by increased mortality (primarily windfall). There was a net loss in volume in the first five years on two thirds of the areas, and in the second five years on half the areas with a second remeasurement. A few stands virtually disintegrated. A few young or very lightly cut stands suffered little mortality.

6. The study areas contained no uncut control plots allowing direct comparison of mortality and growth with cut areas. Regional temporary plot forest survey data, not fully comparable, did suggest a substantial net growth in uncut stands. (A later 36-year record of permanent plot measurements distributed over an 1,180-acre tract of 350-year-old old-growth (DeBell and Franklin 1987) showed negligible net growth, with a continuing decline in the Douglas-fir component and increase in tolerant species.)

7. More than one third of the residual trees received some sort of logging injury. This was particularly severe in the understory of more tolerant species.

8. Sufficient time had not elapsed to determine whether an all-aged forest could be developed, but the records indicated that the percentage of Douglas-fir in the stand was reduced, and since no Douglas-fir regeneration was becoming established, the species would eventually be eliminated. Tolerant species increased. If an all-aged forest could be developed, it would contain little if any Douglas-fir.

Isaac discussed further those instances where results seemed reasonably satisfactory and suggested that Douglas-fir probably could be managed under a selection system on dry sites in southwest Oregon, in the gravel soils of the Puget Sound region, and on severe southerly exposures elsewhere where moisture and shade are critical factors (and competition from more tolerant tree and brush species is not severe).

In Retrospect

Isaac and Munger were both strong personalities with long records of achievement and great prestige in the forestry community, and their conclusion that selective cutting was a failure put an abrupt end to partial cutting trials. Without question, their evaluations of the results of these cuts—as they were actually carried out—were correct. Their conclusion that the Forest Service should abandon selective cutting in favor of moderate-sized, dispersed clearcut blocks was fully justified in the context of silvicultural knowledge and economic feasibility at the time. And this became standard Forest Service and Bureau of Land Management practice for the next 30 years. Nevertheless, their interpretations, and the subsequent interpretations by others, have been less than fair to Kirkland and Brandstrom's ideas, which differed considerably

from the way "selective cutting" was actually carried out.

Much confusion arises even today from the superficial similarity of the terms *selective cutting* and *selection cutting* (or *selection system).* And this semantic confusion is evident in foresters' discussions of the selective cutting episode. *Selective timber management* and the *selection system* are not the same thing.

Selective cutting is a vague term, now in disrepute among silviculturists. It has at one time or another been used for almost any cutting that leaves some trees standing, from beneficial thinnings and improvement cuts, to destructive highgrading that leads to wholesale degradation of the forest. In the early days of North American forestry it was used loosely by foresters seeking to convince landowners that there were viable alternatives to liquiddation, and by landowners seeking to convince the public of their own responsible management.

Selection cutting, or the *selection system,* on the other hand, is a specific and long-established silvicultural practice that aims to develop uneven-aged stands with a wide range of tree ages within the individual stand. In *a single-tree selection* system, different age classes are developed in a stemwise mixture through removal of individual mature or low-vigor trees in relatively frequent light cuts distributed over the area. In *group selection,* a mosaic of small even-aged groups or patches of differing ages is created within the stand.

Close reading of Kirkland and Brandstrom's proposal shows clearly that they were not proposing an individual-tree selection system as defined above and in standard texts. Rather, they proposed preliminary light salvage cuts intended to lead into a system of regeneration on small clearcuts of 2 to 10 or more acres, combined with thinning in younger stands. Many of their contemporaries and most subsequent commentators seem to have lost sight of this. Some of those who made the actual cuts may not have thought beyond the initial entry. Some probably were thinking in terms of an individual-tree selection system and development of all-aged stands.

Munger (1938) drew some clear distinctions:

> *Selective timber management is* a policy or program of forest management, dictated by economic considerations; it may imply any kind of silviculture—area, group, or tree selection; it is a principle that should be considered in all forest management plans. Selective timber management, however, is not synonymous with the selection system of silviculture or with all *selective logging,* as the term is now used.... Group selection, area selection, and strip cutting are really clear cutting in miniature and should have a large place in Douglas-fir silviculture.

Isaac's (1956) results certainly showed that an individual-tree selection system would not work in the very old and more or less even-aged stands. But the primary reason for failure was that these stands proved sensitive to disturbance, particularly when the cut was mainly from the largest sound Douglas-fir, with unavoidable damage to smaller trees, and the lower crown classes and cull trees were generally left. Silviculture was here driven by short-term economics, not by biology.

A further handicap was the blanket application of a particular practice across a wide range of sites, stand conditions, and geography. Both staffing limitations and the economic conditions of the Depression made difficult or impossible the detailed stand examinations and the flexibility and judgment in application that Kirkland and Brandstrom's ideas required. One can speculate on what might have happened under modern conditions of good markets and improved logging technology, which would allow defective trees, suppressed trees, some younger trees, and secondary species to be removed with less damage to the reserve stand and could take advantage of the within-stand variation in age and stocking common in old-growth (Tappeiner et al. 1997). The question is perhaps moot, since we in the US portion of the Douglas-fir region are no longer dealing primarily with old-growth stands, and "geriatric silviculture" is not currently a major management concern (though it may become so as the remaining old-growth stands decline).

The failure to obtain Douglas-fir regeneration would have been no surprise to Kirkland and Brandstrom; they explicitly recognized the need for group or patch cuts to obtain it. With knowledge then or shortly available (Isaac 1943; Worthington 1953; Franklin 1963), there is no question that such cuts—with appropriate site preparation and planting where required—would have provided ample regeneration. But trials never progressed to this point before the shift to large-scale block clearcutting.

Subsequent comment (Foster 1952; Isaac et al. 1952; Smith 1970, 1972) has focused on this episode as a misguided attempt to apply the selection system to a species and stand condition to which it was unsuited. As applied, it certainly was that. It is likely that many of the practitioners involved saw a transition to the selection system and creation of an all-aged forest as objecttives. This view provided a convenient rationalization for a practice that was really little more than highgrading, and which differed considerably from Kirkland and Brandstrom's proposals. The unfavorable results have sometimes been cited as proof that clearcutting is the *only* system suitable for Douglas-fir (Doig 1976).

An unfortunate result of this episode was the abandonment of efforts to develop alternative silvicultural systems (other than some limited trials of uniform shelterwood), only recently revived. If one ignores the difference in ages of the stands involved, Kirkland and Brandstrom's ideas have a strong resemblance to some recent proposals for management of second-growth stands through a combination of continued thinning on extended rotations, and regeneration in small even-aged patches placed to take advantage of the variations in within-stand conditions that develop as stands age (Curtis and Carey 1996). The experience and knowledge that

might have been gained from continuing small-scale exploratory trials of this and other alternative systems would have been very useful in meeting today's problems of minimizing conflict between timber, aesthetic, and wildlife values.

Ecosystem management and landscape management must utilize a range of possible regimes, tailored to local conditions and objectives. The history of the selective cutting episode is a striking example of the fact that administrative or regulatory attempts to specify a particular form of silviculture or specific silvicultural measures—often based on generalizations from very limited or incomplete information—can have unexpected and sometimes very undesirable results.

The hiatus in research on systems other than clearcutting, which extended from about 1950 to 1990, severely handicaps current efforts to meet changing objectives and public concerns. There is a great and continuing need for systematic long-term trials of alternative silvicultural regimes over a range of sites and geography, designed so that they can provide statistically reliable comparisons of economic and environmental gains and costs. These would also have great value as on-the-ground examples for public education. In the last several years a number of such studies have been begun in the Douglas-fir region of the United States and Canada, but they are limited in scope, and meaningful results will not soon be available.

In Conclusion

Forest management and silvicultural practices are basically determined by (1) forest biology, (2) economic forces, and (3) social attitudes and goals. Past and present changes in economic conditions and in social attitudes and objectives produce changes in silviculture. Conflicts often arise between political and social pressures, economics, and inherent biological limitations, and compromise is often needed, within the bounds of biological feasibility.

It seems appropriate to end this excursion into the past with comments from two prominent American silviculturists:

> This chapter of silvicultural history has a moral for the profession, especially since it is only one of three instances I might cite when foresters in the region plunged headlong into some new practice, impelled by the claims of its promoters, before making scientific appraisal of all aspects of the new proposal. Silviculture is an art that should base its practices on the proven findings of many sciences. It must be practiced consistently over a long term of years. It should not be swayed by considerations of passing expediency or popular appeal...let us keep research ahead of practice, so that untested innovations will not get ahead and get off the trail of nature's silvical laws.
>
> *—Thornton T Munger (1950)*

> …no silvicultural procedure is so universally applicable that it deserves to be viewed as anything approaching standard operating procedure. The history of silviculture in this country is long enough to reveal that there has been too much tendency for methods of cutting to vacillate between extremes that are partly fads and partly reactions to problems of a temporary nature.
>
> *—David M. Smith (1972)*

Those cautions are still relevant today.

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