Chapter 1

The Place of Nutrition in Forest Management

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ABSTRACT. Reduction in the commercial forest land base on federal lands seems inevitable as a result of public demand for wildlife habitat protection and other noncommodity resource values. At the same time, population growth in the United States and worldwide is increasing the demand for forest products. Forest fertilization offers an opportunity to produce more wood from the Pacific Northwest's remaining commercial forest land, thereby maintaining the region's comparative advantage as a supplier of forest products to U.S. and international markets.

It is both timely and appropriate to focus attention on the place of nutrition in forest management in the Pacific Northwest for several reasons. First, it is virtually certain that during the 1990s, the historical dependence on harvest of commercial timber from natural old-growth stands will be significantly reduced on federal lands throughout the Northwest. Second, the land base available for future commercial forest management is being steadily reduced as a result of recent National Forest Management Act planning decisions, habitat reservations for species such as the northern spotted owl, protection of additional old growth, and the urban expansion that is a direct result of population growth in the I-5 corridor from Vancouver, B.C., to Eugene, Oregon. In addition, there has been a recent trend, primarily on federal and state lands, toward less intensive even-aged management, or toward uneven-aged management, and acceptance by some organizations of reduced stocking, increased brush competition, reduced growth rates, and ultimately reduced yield at time of harvest. These less intensive silvicultural prescriptions, which are generally referred to as New Forestry, have as their principal objective the perpetuation of the wildlife habitat characteristics of an unmanaged forest.

While improving wildlife habitat is an important forest management goal, and the New Forestry practices are a means of achieving that goal on some lands, most of the suitable commercial forest lands in the region will have to continue to be managed with per hectare productivity as a primary management objective. Foresters, from the earliest days of the profession, have recognized a responsibility to address all the needs that society expects to have provided from its forests. For the first half of this century, professional attention was focused on the development of efficient harvesting and manufacturing systems, fire protection, and regeneration methods. Since the 1950s, most foresters, whether they were responsible for public or private land management, have worked toward achieving the principles of multiple use to satisfy a growing population's demand for all resources. This, of course, includes commercial timber as well as clean water, wildlife and fish habitat, and, in many regions, range forage for livestock. As we approach the end of the century, the public is placing increased value on the amenities that forests provide; but that same public also requires affordable housing, a great variety of paper products, and all of the other products that are provided from harvest of commercial timber.

As foresters, we have the challenge of reserving more of the federal land for noncommodity uses, improving wildlife habitat on all ownerships, and at the same time providing for the future forest product needs of a U.S. population that is forecast to reach 333 million by 2040 (Haynes 1990) and a world population that is expected to increase from 5.3 billion today to 10 billion by the middle of the next century (Bulatao et al. 1990).

If as a society we continue to reduce the land base available for commercial forestry, the citizens of the Northwest, their elected officials, and we, as foresters, are faced with two distinct prospects: (1) accept the undesirable social, economic, and unemployment consequences of reduced regional timber harvest; (2) use

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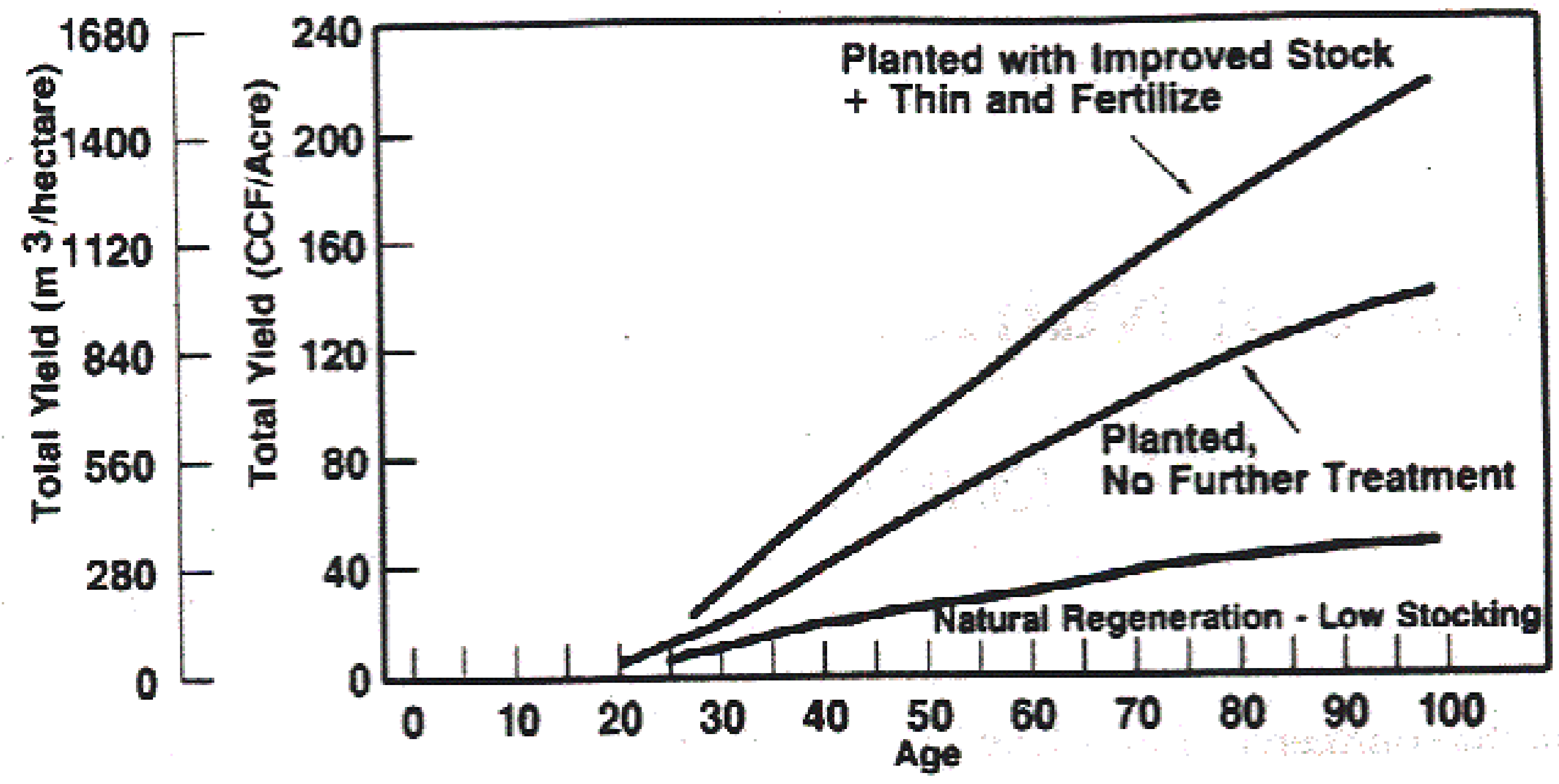

Figure 1. Effect of management intensity on Douglas-fir yield for a single hectare, site III (site index 32 m). Volumes in gross merchantable timber produced by DFSIM model (14.2 cm + dbh, 10.2 cm top diameter).

the knowledge that we have gained over the last 50 years to increase the annual productivity of the remaining forests to maintain the combined regional harvest at near current levels on suitable federal lands, state and other public and Indian lands, and both industrial and nonindustrial private lands.

Some might say that these prospects are not compatible, that we cannot maintain our historical timber output in this region because we are required to allocate too much land to nontimber uses. Most foresters, however, know that we have not begun to fully practice all that we know how to do, and that there remains vast potential in this region to improve the productivity of all of our renewable resources.

This is nowhere more clearly demonstrated than in a comparison of the yields, using DFSIM (Curtis et al. 1982), of a typical hectare of site III (site index 32 m) Douglas-fir timberland west of the Cascades under different levels of management intensity (Figure 1). If we accept the uncertainties of natural regeneration with Douglas-fir yielding 40% of fully stocked natural stands, and perform no further silvicultural treatments, we can expect a yield of about 174 m^3/ha at the end of a 50-year rotation. If, instead, we plant to ensure full stocking, but perform no further treatments, the expected yield at the end of the rotation will be 427 m^3/ha. Or if that same hectare is planted with genetically improved stock (assumed in this example to increase DFSIM yields by 10%), thinned periodically to maintain optimal spacing, and fertilized two times during the rotation, the expected cumulative yield can reach 643 m^3/ha. The difference in yield between the plant-only hectare and the thinned and fertilized hectare in this example is 216 m^3, or an increase of 51% over the 50-year rotation.

While this is a general example of the difference in yield that can result from changes in the level of management intensity (and investment), such differences are not at all theoretical. They have been demonstrated in practice in the Douglas-fir region, in the southeastern United States, and in several other countries, including Finland, Sweden, Australia, and New Zealand.

In the previous example, fertilization, or the application of nutrients, accounted for approximately 42% of the yield increase between the plant-only and the intensive prescription over the full rotation. It is not well known by the public, nor well understood by all foresters, that the application of specific nutrients can significantly improve our ability to produce more wood from most types of commercial forest land.

In the Douglas-fir region, the results of over 25 years of cooperative research, most of which has been conducted under the auspices of the Regional Forest Nutrition Research Project, have given us a tremendous amount of useful data, and the ability to predict with confidence the response that will be obtained on various sites (Chappell and Opalach 1984). While much has been learned from research, there has also been a tremendous amount of operational experience gained over the last 25 years. In that time, approximately 1.3 million hectares of federal, state, and private land in the Douglas-fir region have been fertilized. Since we first began fertilization on an operational scale in 1966, my own company, Weyerhaeuser, has fertilized over 774,000 hectares west of the Cascades, plus 30,000 hectares in eastern Oregon.

While fertilization on an operational scale has become an established silvicultural practice in the Douglas-fir region, we are capturing the benefits of fertilization on only a fraction of the region's commercial forest lands that could respond to supplemental nutrients. With over 4.8 million hectares of private forest land in western Washington and Oregon, plus 2 million hectares of state, other public, and Indian land (Waddell et al. 1989), and, conservatively, at least 1.3 million hectares of suitable national forest land west of the Cascade crest that could benefit from fertilization, we have the potential to significantly increase aggregate mean annual growth if more forest landowners and managers took advantage of the opportunity that fertilization presents (McMahon 1991).

Our experience indicates that with only two applications of nitrogen in the form of urea, a typical site III Douglas-fir stand will produce approximately 90 m^3/ha of additional volume during a 50-year rotation. For every 100,000 hectares that receive this prescription, an additional 9 million m^3 of usable wood fiber is produced. The multiplier effect is tremendous when applied to a large number of hectares, and can substantially offset the reduction in the region's potential annual harvest resulting from allocation of additional federal lands to noncommodity uses. Thus once regeneration is fully established, the addition of nutrients is an important means of increasing per hectare gross cubic volume over the rotation. Thinning and competition control will generally redistribute growth to selected crop trees, but additional nutrients on nutrient-deficient sites will add volume that would not otherwise be produced.

In highlighting the opportunity to fertilize many more hectares in the region than have previously been treated, I am not suggesting that anyone begin indiscriminately spreading fertilizer without doing the essential advance planning. The prerequisites to any operational fertilization project include: first, having the basic soil-site, stocking, and species data that would indicate a high likelihood of response to the additional nutrients (this is where the RFNRP data base is invaluable); second, having a conviction about what the additional cubic volume will be worth in real terms at time of harvest, because the decision to fertilize is fundamentally an investment decision, and return on that investment depends on the cost of the treatment, plus the volume and value of additional wood produced, and the holding period in years between time of application and time of final harvest.

In our experience, the return on fertilization as an investment, including multiple applications on many hectares, has been more attractive than most other silvicultural treatments, provided that the site and species response variables are understood, and the application itself is accomplished in an efficient, cost-effective manner.

Other important operational considerations include planning the project to meet forest practices or environmental requirements, particularly with regard to keeping fertilizer from directly entering flowing streams. Our record as an industry has been good with respect to any measurable adverse impact on water quality resulting from fertilization, but we need to continue to monitor water quality and ensure that any additional constraints on forest fertilization are based on objective research data, not on the unfounded fears too often associated with the application of other forest chemicals.

In addition to the normal environmental and operational considerations inherent in any large-scale fertilization project, the increased use of New Forestry prescriptions on federal lands, as well as more snag and green-tree retention on state and private lands, introduces a new complexity in conducting safe and efficient fertilization operations. In areas where fertilization will be an expected future silvicultural practice, it will be necessary to provide for snag and green-tree retention in riparian zones and long corners, or other designated areas where these obstacles will not impede either flight safety or uniform distribution of fertilizer within the new stand.

If we accept the premise that fertilization response in the Douglas-fir region is largely predictable based on the results of the research conducted over the last 25 years, that the return on the investment is attractive, and that the operational know-how and delivery systems are available within the region, then we can readily conclude that fertilization can become an integral part of the silvicultural prescriptions that make it possible to produce more wood from a reduced commercial forest land base in the years to come.

Fertilization, either alone or in combination with genetically improved planting stock, competition control, and spacing control, provides the key to producing the wood and paper products that society needs from lands where timber production is the primary management objective—thereby making it possible to reserve a greater proportion of our national forest lands for low intensity forestry in order to meet wildlife habitat or other noncommodity management objectives. This offers a potentially better solution than our less-than-successful efforts in satisfying competing multiple-use demands from the same forest area. The alternative of attempting to satisfy the growing world demand for wood products from a larger land base managed with less intensity does not appear to be realistic, given the public's demand to have more federal land reserved for other uses.

Using our ability to produce more wood from fewer tive forest soils, several million hectares of well-stocked, thrifty young stands, and the technical know-how in both forest management and manufacturing to remain competitive with anyone as producers of the forest products that the world needs.

As forest managers we have a responsibility to use our technical expertise to contribute to the economic needs of the world's people and our nation, and to meet the that forests can provide. Putting our accumulated knowledge of forest fertilization to work is one proven means of meeting that responsibility.

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