Reafforestation in the U. S. Pacific Northwest

by

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INTRODUCTION

The Pacific Northwest, as I define it for our present purposes, comprises those parts of the States of Oregon and Washington that are commonly obscured on satellite photos by a blanket of clouds. Residents have, on less cloudy days, found that this corresponds with the region between the Pacific Ocean Coast and the crest of the Cascade Mountains (cf. Fig. 1). Visitors originally came to the area by boat, and this is still probably the safest means of all-weather access. The people, like the climate, are inhospitable in that they have an 'ark', rather than 'lifeboat', philosophy towards those who immigrate.

How is it that these people, whose economic survival depends upon the exploitation of their forest, fields, and water, choose to restrict their future use of the land and slow the growth of population? In part, it is because some are emigrants from States in which the results of exploitation are apparent, and who came to this area to preserve something of what has been lost elsewhere. In part, also, it is because their economic base rests on renewable resources which, if such resources are to persist, can only be harvested at a rate not exceeding that of growth. The questions with which I shall now deal are: what exactly are these resources in regard to forests, what are their capacities for renewal, and what must be done to maintain the whole system?

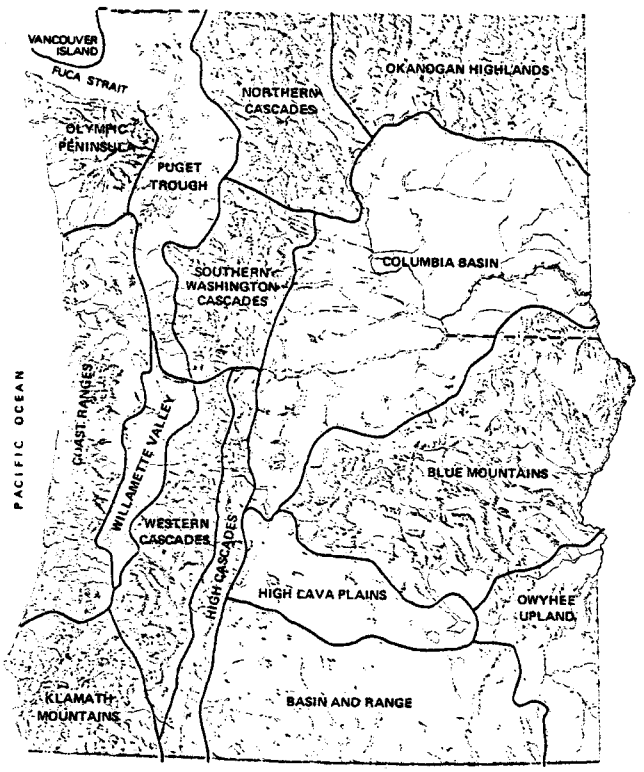

FIG. 1. *The Pacific Northwest forest region lies to the west of the crest of the Cascade Mountains in Oregon and Washington and represents about 40% of the total land-area (after Franklin & Dyrness, 1973).*

THE BASIC FOREST RESOURCE

Except in places in the valleys and on mountain crests, most of the region was originally forested and today it still produces more than 30% of the nation's softwood timber supply. As the average hectare can grow trees worth $35,000 to $50,000 in less than 100 years, there is considerable interest in where precisely the commercial forests of the future will be situated.

There are two extremes in commercial forest lands. One meets the minimum growth potential of a 'quarter-of-a-ton of wood per acre' (561 kg/ha) per year and is typical of much of the land that comprises wilderness areas. At the other extreme are some lands in the Coast Range that can grow an average of more than 15,000 kg of wood per hectare per year over a 50-years rotation (Fujimori, 1971; Fujimori *et al.*, in press).

There is widespread concern that the more productive forest-lands should remain in ownership that will

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favour intensive forest management, the conflict being not so much over the scenic coastal beaches or sub-alpine forest zone as over the steep, erosion-prone intermediate area. This area represents the commercial forest-lands whose management affects the salmon fisheries, the wild game populations, and the economic vitality of the whole region.

Recent economic analyses (Beuter *et al.*, 1976) suggest that, even with intensive forest management, a reduction by nearly 25% in the rate of cutting on all lands in western Oregon will be required by 1985 unless Federal lands are logged and regenerated at an increased rate to make up the shortfall in foreseeable needs. Needless to say, such a reduction would have a profound impact upon most of the local communities, both human and otherwise. So it is suggested that older stands on Federal land which are not growing rapidly might be harvested at an increased rate, followed by reafforestation more or less immediately.*

Reafforestation

Private and public lands have been found to be understocked in the matter of desired softwoods—a realization which has been reflected in major efforts to grow more seedlings than formerly and to improve the success of planting. The general concern has also been reflected in Forest Practice acts, recently passed by both the Oregon and the Washington Slate Legislatures, that require successful establishment of conifer regeneration within 5 years following removal of more than 75 per cent of the forest canopy.

Nurseries produce the main bulk of regeneration stock and have improved cultural practices, genetic selection, and seedling storage (Cleary *et al.*, in press). For harsh sites and those with persistent snow-cover, container-grown seedlings are favoured. The environment of container-grown seedlings can be better controlled than that of those grown in nurseries. Seedlings may be tailored for the kind of environment in which they will be planted. Because the root systems of such greenhouse-raised seedlings remain in soil, those of sensitive species such as Western Hemlock (*Tsuga heterophylla*) and Noble Fir (*Abies procera*) survive better when greenhouse-raised than when they are lifted from nurseries without soil around their roots.

Western Hemlock is replacing Douglas Fir (*Pseudotsuga menziesii*) as a favoured species on some of the best Coast Range sites, where it grows well and is less prone to animal browsing; Douglas Fir seedlings on such sites must be protected by tall plastic-mesh tubes or repellents to reduce animal damage.

On steep lands, planting must be done by hand, thus involving a major effort to secure establishment. To reduce compaction and disturbance of the soil, use of herbicides is generally favoured over mechanical operations to reduce brush competition during the first year of reafforestation. Helicopters are used to apply herbicides, as they can dispense the material with reasonable accuracy and also leave buffer strips along streams or lakes as required by the forest practice laws.

Erosion control

In any region with steep mountains and more than about 250 cm of annual precipitation, erosion is an ever-present phenomenon; consequently much of the most productive land in the Pacific Northwest is a direct result of the movement of soil from one place and its deposition in another. The relatively recent actions of glaciers and volcanic activity supplement the natural weathering processes. Thus in many areas the natural rate of erosion is far greater than the rate at which soil is being formed through weathering of the native rock. Fire, logging, or road-building, may increase the erosion rate still further.

It is the forester's particular responsibility to maintain the productive capacity of the land and thus, in such country, a long-range perspective is essential. Geomorphologists and soil specialists are aiding foresters by mapping the landscape in terms of its erodibility. In some cases access to good forest land on relatively gentle slopes cannot be effected by conventional roads. Such unstable land can be recognized by slanting trees growing on inclines and bark-scars initiated by movement of soil.

Road construction

For foresters the most important long-range decision is often the location of a road or much-to-be-used track through the forest. When major roads or highways are involved, their existence and position may also determine the location of future skiing resorts, access to wilderness, and the very survival of communities. In addition they decide the future of forest management, and altogether are a very necessary evil. Thus although they may occupy only a very small percentage of the total landscape, they often contribute to greatly increased erosion over a long period of time (Fredriksen, 1970; Swanson & Dyrness, 1975). Improvements in road construction and maintenance have been made, but the cost of a forest road now averages $50,000 per kilometre and in particularly unstable areas it may exceed $250,000 per kilometre for construction alone.

In addition to trying to avoid extremely unstable areas—thus extending the length of road—the following practices are now being implemented: hauling cut material to stable sites rather than casting it over

* In approving our pre-editing suggestions hereabouts the Author commented (*in litt.* 11 Nov. 1976): 'I assume readers understand [that] wildlife populations require a certain proportion of timber lands be converted to temporary grass or shrub cover if present population structures are to be maintained.'—Ed.

the side or using it for fill material near a stream; placing large rocks in drainage ditches to prevent soil from filling culverts; installing debris racks to catch material before it damages the road; and using storm-watch crews to travel the roads and clear culverts during major storms. All of these practices, and others, are expensive but necessary investments if roads are to be satisfactorily placed in the forests.

NEW LOGGING TECHNIQUES TO REDUCE ROAD CONSTRUCTION

On steep land of more than 20% gradient, cable-logging systems have been developed which do not require a special mid-slope road but only one road along the ridge-top. Cable-logging involves a movable steel mast positioned at various points along a ridge-road. Cables strung through pulleys on the mast permit logs more than 1,500 m away to be winched uphill to the loading area*. Recently these systems have been modified to permit the thinning of young forests, using a herringbone pattern of extraction along a corridor less than 20 feet (6.1 m) wide (Aulerich *et al.*, 1974). Balloons, flown in the manner of kites, also are used to transport logs, but are adapted at present only to clear-cutting. Helicopters have been successfully employed in terrain where the physiography makes roads undesirable, but their cost is commonly around ten times that of more conventional methods of transport (Dykstra, 1974).

PROTECTING THE STREAMS

The small streams may not support salmon or trout, but accelerated erosion from them can destroy the productive capacity of intermediate-sized streams and affect whole drainages. For this reason, laws controlling forest practice pay special attention to the smaller streams. So far as possible, the felling of trees into such streams should be avoided, and cables are often attached to trees to insure that they fall uphill.

Forest materials which get into streams should normally be cleared out, though this may lead to over-zealous removal of large logs that were previously embedded in a stream. For such fallen trees may constitute check-dams that reduce the energy of the stream and its erosive power. Further, sediment is often trapped behind embedded logs whereupon the whole stream system may become alive with biota that utilize organic matter and nutrients which otherwise would quickly be exported downstream to larger streams and reservoirs. Whether buffer strips will be necessary to protect these small streams is uncertain, but their importance is now fully recognized (Logging Debris in Streams Symposium, 1975).

* In response to our request for further information the Author explained (*in litt.*) that 'The tall mast enables logs to be lifted so [that] one end is high in the air. The cable is thus not likely to hang up on stumps or other debris.'—Ed.

FIRE PROTECTION—A NEW CONCERN

On both managed and unmanaged lands in the Pacific Northwest, fire prevention has been the general policy since the turn of the century, though in recent decades the cost of fire fighting has increased dramatically. Also, the amount of fuel has increased very widely as dead branches have accumulated and shade-tolerant species have become established in the understorey of the forests. Moreover, ecologists have come to believe that nutritional stress, related to slowed decay of the woody material, may lead to the trees being weakened and susceptible to attacks of insects and diseases (Mattson & Addy, 1975).

Recently, debris left after logging has been hauled away or scattered. But these practices create an obvious fire-hazard and may induce additional nutrient stress, for throughout much of the area it appears that fire is required to maintain an adequate rate of nutrient cycling (Wright, 1974; cf. Parsons, 1976).

These practices may reduce fire hazard but can also remove valuable minerals that were previously returned to the soil when the debris decomposed or was burned *in situ*. In fact, throughout much of the area, fire may be required periodically to reconcentrate nutrients (Grier, 1975) and maintain an adequate rate of mineral cycling (Wright, 1974). The mineral-rich ash is quickly leached and nutrients are made available to nitrogen-fixing plants. Such plants may add more than 1,000 kg of nitrogen per hectare over a decade (Zavitkovski & Newton, 1968). This nitrogen is in a relatively available form and can supply the new-grown forest at a time when its requirements are high. For a variety of reasons, accordingly, the use of controlled fire is gaining support in the management of both commercial forests and wilderness areas (cf. Parsons, 1976).

THE FUTURE POTENTIAL

As forests in the Pacific Northwest have very dense canopies, which are commonly from 3 to 5 times as dense as those of southern pine forests (Gholz *et al.*, 1976), it may take 30–50 years for the canopies to develop fully. Over a period of 100 years, however, more wood products may be grown in the Pacific Northwest than in other regions of the United States. The dense canopies take up carbon dioxide throughout the mild winters that characterize the Pacific Northwest. In fact, in this region more than 50% of the total carbon assimilation may occur during the dormant season (Emmingham & Waring, in press)*. Stored carbohydrates are utilized in the spring to

* A referee comments that, whereas this may well be 'true in the region concerned' [and, we would add, must surely be if our distinguished Author says so!], if would 'certainly [be an] unwarranted generalization'.—Ed.

promote height-growth that often exceeds a metre per year.

Most of the forests are located on steep lands and, in order to perpetuate them, special logging techniques, road building, and cultural pratices, are necessary. These are expensive but are now required by State laws. The Federal forests are of special concern because they represent the major source of supply of wood over the next 25 years. Increased harvest from them must be accompanied by management practices that assure the maintenance of the land and adjacent aquatic resources.

Because nearly half of the forests are in Federal ownership, and in recent decades have been less cut-over than private lands, citizens from throughout the nation will have a role in deciding how present and future resources will be allocated in the Pacific Northwest. This is a large responsibility—one requiring full knowledge of the problems and potential in the 'wood basket' of the nation.

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SUMMARY

The Pacific Northwest is economically dependent upon its forest resources, which at present represent about 30% of the nation's softwood supply. Predicted decreases in the available supply have encouraged more intensive forest management, and new methods of planting, harvesting, and transport, have been developed.

Even with these improvements, problems exist in reducing erosion and accommodating other uses of forest lands and streams. With adequate planning and effort, however, most of these problems can be solved. But costs are high, and State laws controlling all forest practices are forcing Federal, State, and private, landowners to cooperate in planning for the future. Decisions that must soon be made should reflect an ecological understanding that could ensure the economic future of the Pacific Northwest.

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