

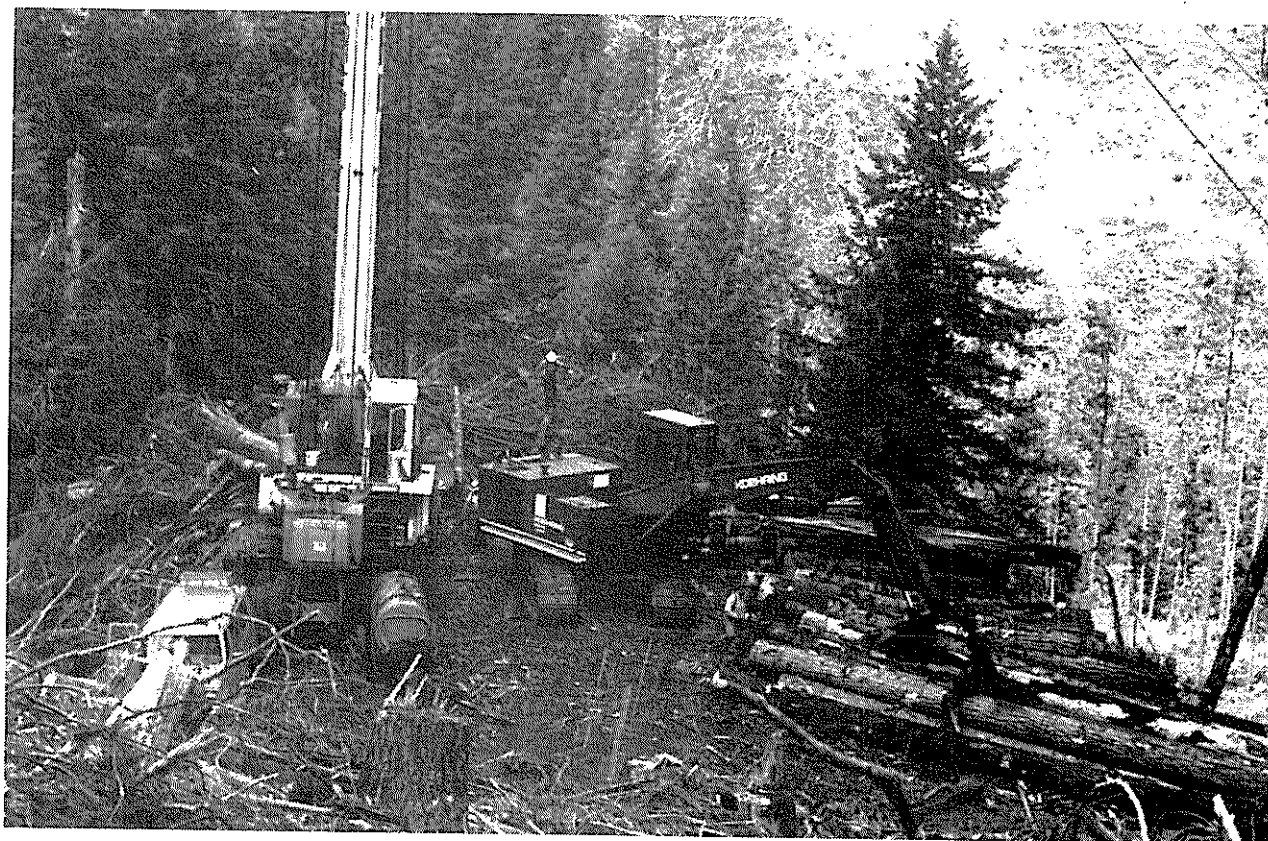


PROJECT REPORT

NEW ZEALAND

THE PACIFIC NORTH-WEST FOREST PRACTICE LEGISLATION HARVESTING OPERATIONS ON SENSITIVE TERRAIN HARVESTING RESEARCH

LINDSAY VAUGHAN



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Project Report

P.R. 43

New Zealand Logging Industry Research
Association (Inc.)
P.O. Box 147,
ROTORUA,
NEW ZEALAND.

**THE PACIFIC NORTH-WEST
FOREST PRACTICE LEGISLATION
HARVESTING OPERATIONS ON
SENSITIVE TERRAIN
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1989

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SUMMARYForest Practice Legislation

Forest practice legislation in Oregon and Washington was introduced in the 1970's to provide protection for streams, rivers and fish habitat. This legislation covered both private and state forest land; federal forests must meet or exceed these standards. The legislation has recently been revised to provide more protection for fish and wildlife values.

These rules place a major emphasis on riparian zones; these zones must be carefully managed to provide shading, stream bank stability and wildlife habitat. Careful selective logging of the outer margins is permitted.

A better understanding by fisheries biologists of the role of large logs in streambeds have seen a change in practice of cleaning out all debris from streambeds. Loggers are now required to leave some large logs as they significantly improve fish habitat.

In Oregon, the Forest Practice Rules are administered by the Oregon Dept of Forestry. In Washington, the agency is the Dept of Natural Resources. Industry personnel consider the Oregon system is more efficient, more realistic and more effective as they are dealing with the one representative. The Washington approach involves multi-disciplinary teams with representatives of other departments and agencies; it appears more unwieldly and complex. Industry personnel expressed frustration at the unrealistic expectations of some team members.

In British Columbia, the provincial government owns most of the forest lands. The BC Ministry of Forests is the administering agent. Crown forest land, leased to private companies, is managed

under a series of long term renewable leases. A rolling five year development plan is prepared, circulated to agencies for comments, modified, then submitted to the Ministry for approval. However, there are major differences between private companies and public agencies in their management of forest land with high landscape values. Foresters expressed real concern with the limited regeneration of the more valuable timber species and the management of those second rotation stands.

The US Forest Service own extensive areas of forest land in Oregon and Washington which are managed on a multiple use basis. Complex planning procedures have evolved with a high level of public participation. The objective of producing integrated resource management plans has become an increasingly expensive and frustrating experience as resistance increases to further harvesting of the remaining old growth Douglas fir forests. A comprehensive system of appeal procedures have meant the Forest Service has become more and more involved in litigation and in justifying its actions and decisions, with fewer and fewer resources to devote to management of the forest estate.

In New Zealand, the Resource Management Land Reform is well underway. There is considerable interest in the different legislative systems that are being used in the Pacific Northwest. However, there are important differences in New Zealand as most plantations lack many of the environmental values associated with natural forests. Approximately half of these plantations are privately owned and the cutting rights for the remainder, currently managed by the NZ Forestry Corporation, are being offered for sale. These plantations are clearly identified as

(ii)

being for timber production and any public debate is more likely to be over how these should be harvested rather than whether they should be. Thus, the complex strategic planning procedures that have evolved overseas are generally not applicable to New Zealand plantations. The planned Forest Code of Practice offers a more efficient means of providing a reasonable degree of protection to environmental values during harvesting and other forest operations.

- replacement of high lead machines with skyline systems in Oregon and Washington,
- replacement of high lead machines with grapple yarders on suitable terrain in British Columbia.

Most of these changes are relevant to future harvesting operations in New Zealand; a number of these are already being taken up, others are under investigation.

Harvesting Operations

Harvesting operations in the Pacific Northwest have moved onto increasingly difficult terrain. Production costs have increased and markets have been unfavourable. Environmental and economic pressures have seen major changes in harvesting techniques and in their productivity over the last 10 years.

The response by the forest industry has included:

- upgrading harvest planning skills,
- early identification of sensitive sites,
- locating roads and landings on ridges in coastal Oregon and Washington,
- acceptance of much steeper road grades
- replacement of crawler tractors with excavators for roadbuilding,
- use of a wide range of cable systems to match terrain and tree size.

Harvesting Research

Reducing the impact of harvesting operations continues to be a major component of the research programs in Oregon and British Columbia. In New Zealand, the Forest Research Institute has undertaken a variety of long term trials to examine these effects and to demonstrate the effects of some disturbance on site productivity outside the development of the Forest Code of Practices. Their early work into harvesting impact on water quality, yield and sediment loss has provided an excellent database for future planning. Their current work into harvest planning on steep terrain offers a means of assessing the environmental impacts and economic implications of different harvesting systems. LIRA will continue to play a monitoring and coordinating role in this field. It will continue to play a major role in the introduction and development of the more sophisticated cable systems.

The development of contacts with key overseas organisations has been important to LIRA's development. Future development must foster these linkages.

INTRODUCTION

STUDY TOUR OBJECTIVES

- To examine forest practice legislation in the Pacific Northwest and its implementation.
- To document the changes in harvesting practices and the reasons for these changes.
- To consider the implications for harvesting research and the planning and management of harvesting operations in New Zealand.
- To assist the development of a New Zealand Forest Code of Practice.

Background to Study Tour

Harvesting operations in the Pacific Northwest have moved onto steeper and more difficult terrain as the more accessible forests have been logged and regenerated. Roding and harvesting these steep terrain forests has been difficult and costly. The environmental impact of these operations were much greater than with operations on the easier terrain.

This transition coincided with a tide of environmental consciousness that swept through N. America, catalysed by events such as the discovery of high levels of DDT in the body fat of animals, far from the original areas of distribution, as a result of concentration in food chains. This saw the rapid growth of organisations such as the Audubon Society and the Sierra Club, committed to protecting the flora and fauna in the remaining areas of unmodified forest lands.

The forest industry was portrayed

as the major offender in the "destruction" of these areas; its credibility was in doubt as a result of the standard of some operations. The National Forests, managed under a multiple use concept by the USDA Forest Service, offered the best opportunities to challenge harvesting proposals; those in other forms of ownership could have their practices challenged in terms of their effect on the public resources of water, wildlife and fishlife.

These actions have resulted in:

- Increasing use of legislation to challenge proposals for harvesting publicly-owned forests.
- Increasing use of regulatory codes.
- Increasing emphasis on forward planning.
- Upgrading the skill levels of harvest planners.
- Modifying roding and harvesting practices.

There are some parallels with the New Zealand scene, where the early plantings of the 1920's and 1930's were mostly on easy terrain. Harvesting of these forests proceeded with little fuss in most regions. Problems arose in Nelson following the large-scale harvesting of plantations damaged by the Wahine storm in 1968. This led to the development of local harvesting guidelines, which formed the basis of the Forest Operation Guidelines (NWASCO, 1975). Since that time, most of the twenty catchment boards have invoked the use of Section 34 of the 1959 Soil Conservation and Rivers Control Act; this requires landowners to obtain approval from the board before logging commences.

As harvesting operations have moved onto steeper terrain, problems with debris avalanches and other forms of mass movement have occurred in Farnham Forest (Queen Charlotte Sound), Tairua Forest (Coromandel) and Glenbervie Forest (Northland).

Harvesting expansion in New Zealand over the next ten to twenty years will be on steeper and more difficult terrain. Road-ing and harvesting will be more costly; a higher proportion of the area will require cable systems for harvesting. One estimate was

for a six-fold increase in the area to be cable logged over the next twenty years. (Elliott and Levack, 1981).

Much of this increase will be in regions with limited experience in harvesting steep terrain e.g. Northland, Hawkes Bay, King Country, Marlborough and North Westland (Vaughan, 1982). There is potential for conflict where plantations adjoin state highways or popular resorts; and where downstream uses include rural water supplies, trout fishing, mussel farms or proposed marine reserves.

FOREST PRACTICES LEGISLATION

Oregon

Oregon has a Forest Practices Act and a set of Forest Practice Rules. The Act had its origin in the 1941 Oregon Forest Conservation Act, introduced to require reforestation of logged areas. Increasing public awareness of environmental issues in the 1960's led to the introduction of the Oregon Forest Practices Act in 1971. This Act addressed soil, water and air resources and set performance standards for the major forest operations. It emphasised education of loggers and landowners to prevent damage rather than punishing violaters and repairing damage, but there were provisions to penalise persistent offenders.

This Act covers both private and state forest land in Oregon, but not federal land. The remaining 56% of forest land is managed by two federal agencies, the USDA

Forest Service and the Bureau of Land Management. These agencies agreed to meet or exceed the requirements of the Forest Practices Act. A Board of Forestry, appointed by the Oregon State Governor, was set up to review rules and monitor their effectiveness. Regional committees were set up in each of the three regions to advise on forest practice rules for that specific region. The rules were administered by the Oregon Department of Forestry using Forest Practice foresters.

In practice, the old rules were primarily concerned with leaving riparian zones to protect streams and fish habitat. The rules allowed a fair degree of flexibility in their application. There were wide variations in practice and complaints of alleged abuse. The felling of a mile of riparian zone along a major trout and salmon stream had provided a lot of ammunition for environmental groups.

A new set of Forest Practice Rules were introduced in 1987; these provided more protection for fish and wildlife values. To overcome concern that the Board was industry-dominated, it was restructured to include a wider representation of public interest groups.

The landowner is required to give 15 days notice to the Oregon Dept of Forestry (ODF) prior to the start up of operations. The site may be inspected by the ODF Forest Practices Forester with the landowner or operator. Inspections concentrate on the high impact operations in or near sensitive sites.

The new rules have three classes of waters, depending on their importance for fishlife, domestic use and recreation.

Class I waters, the most important streams, lakes, estuaries and wetlands, require riparian zones three times the width (slope distance) of the stream to be left (minimum width 25 feet, maximum width 100 feet). There are approximately 20,000kms of Class I waters in Oregon.

Class II waters are subdivided into two groups: Class II Special Protection waters which have a significant impact on Class I waters downstream (mostly a summertime cooling influence), and Class II waters which are streams with a definite channel or bed.

The Rules subdivide riparian zones into a riparian area (adjoining the stream) and a riparian area of influence. (Figure 1).

No burning or logging or machinery is permitted in the riparian area (the area immediately adjoining the stream), but may be permitted in the riparian area of influence (the remainder of the riparian zone) if carried out with care to minimise its impact (e.g. trees must be directionally felled away from the waters). Logging in the riparian zone of Class I waters must leave 75% of the shade

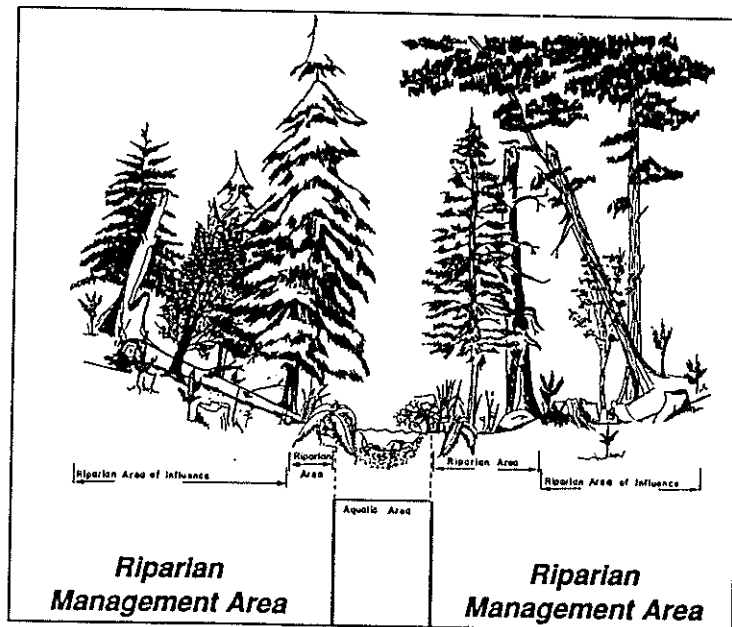


Figure 1 : Riparian zone classification in the Oregon Forest Practice Rules (from O.D.F. Forest Practice Notes No. 6)

in the riparian area, and 50% of the canopy in the riparian area of influence.

This is intended to maintain lower water temperatures in summer and protect sources of food (insects and organic material) for fish and other aquatic life.

Existing logs in streams must be left. The logs create pools, trap gravel, hold leaves and needles (food for aquatic insects) and provide cover for fish. To provide future supplies of logs, some live conifers must be left in the riparian zones close to the stream. The number of conifers and their minimum diameter is prescribed, according to the size of stream. Snags must be left in riparian zones, unless they are a safety or fire hazard. These will provide habitat for insects, birds and small animals.

Riparian zones are usually mixtures of conifers and hardwoods (mostly alders and maple). Windthrow after harvesting reduces their effectiveness.

These zones pose difficulties during harvesting (pulling over or through them with cable systems) and during subsequent burning off for restocking.

Wildlife issues continue to be major targets for environmental groups, who have effectively used rare species such as the bald eagle or spotted owl to stop logging of extensive areas of "old crop" Douglas fir.

Industry people feel that many of the rules designed to protect wildlife values have been drawn up with little or no evidence of the benefits and no understanding of the costs of compliance. One example was the previous requirement to remove all logs and debris (old and new) from streams after logging, whereas they are now required to leave all old logs and some new ones.

Olsen et al (1987) examined the economic implications of the new rules in a case study of a 540ha catchment. He suggested that landowners costs would range from \$280 to \$2400/ha, depending on restrictions on harvesting within the riparian zone.

Washington

Washington State have a Forest Practices Act that is similar to Oregon's and a set of Forest Practices Rules and Regulations. The Act was passed in 1974 and is administered by the Department of Natural Resources. It places considerably more emphasis on water quality, wildlife and fisheries and achieves this through careful management of riparian zones in order to provide shading and bank stability to streams, maintenance of bird habitat, thermal protection and travel corridors for migratory and resident mammals. The size and treatment of the riparian zone is determined by stream size and its importance for domestic use, fish and wildlife. It divides forest practices into 4 classes, depending on their potential impact. The forest practice

definitions are much more complex than in the Oregon Rules, as they depend on both the location and scale of an operation, as well as the type of operation.

There are similarities with the Oregon Rules, as would be expected in adjoining states with similar forests and similar climates. The Washington Rules:

- (1) apply to all private and state forest land. Operations on federal forest land must meet or exceed these requirements.
- (2) require landowners to apply for approval before commencing operations in or near important waterways. Formal plans are required for major operations near important streams.
- (3) allow careful harvesting of the outer section of riparian zones.
- (4) were revised in 1987 to provide increased protection for wildlife and fisheries.
- (5) have a Forest Practices Board set up to review their effectiveness.

There are a number of differences. The Washington Rules:

- (1) use a multi-disciplinary team to vet operational plans. This team can include representatives of agencies and organisations concerned with fisheries, wildlife, ecology, natural resources, soil specialists, geologists, engineers and Indian tribal groups.
- (2) have an Appeals Board to handle appeals by landowners against the requirements of the Department of Natural Resources.
- (3) have more complex requirements for the trees to be left in the riparian zone.

The number, size, species, and ratio of deciduous to coniferous trees, is determined by the water type, stream width and streambed material.

The Washington Forest Practices system appears to be much more bureaucratic than the Oregon one, mainly as a consequence of the number of government agencies involved (Departments of Natural Resources, Fisheries, Game and Ecology).

Industry members were concerned about the cost-effectiveness of this system. They estimated the opportunity cost to forest owners of maintaining riparian zones was between US\$20 and \$50 million, based on the stumpage value of the merchantable trees.

British Columbia

In British Columbia, 94% of all forest land is owned by the Government and administered by the British Columbia Ministry of Forests (MOF) through a variety of long term renewable leases. The two major types are Tree Farm Licences (TFL) and Forest Licences (FL) for harvesting timber supply areas (TSA).

Forest management is the responsibility of the leasee on TFL's and is shared between the leasee and MOF on FL's.

The 1980 Forests Act required the coordinated and integrated management of forests and their resources of timber, livestock, fisheries, wildlife, water, recreation and scenic values. These multiple use considerations are still being incorporated into planning. Practices seem to vary considerably between different regions. Careful planning of patchwork logging to minimise the effect on water quality near Vancouver (Figure 2), or on scenic values on forests in interior British Columbia visible only



*Figure 2 :
Patchcutting near Vancouver*

from secondary roads, contrasted with extensive clear felling on Tree Farm Licence forests alongside a major scenic highway on Vancouver Island (Figure 3).



*Figure 3 : Clearfelling alongside
a major scenic highway,
Vancouver Island.*

The Ministry of Forests require long term working plans and management plans to be prepared by registered professional foresters for the leasees of provincial forest land, a consequence of the limited resources of MOF.

These are submitted to MOF for approval. MOF will review the plans, set standards and monitor operations. A higher standard of practice is required for TFL's. MOF also make extensive use of registered professional foresters on contract to monitor operations and review plans. This system is considered to be rather bureaucratic and inefficient by some industry members; its lack of success in achieving the goals of restocking and management is attributed to inadequate resources.

Long term harvest planning is carried out by the leaseholders. This will involve preparing a rolling 5 year "Development Plan" which contains detailed harvesting plans for the first two years, less detail for the 3rd year and broad indications (roads and harvesting boundaries) for the 4th and 5th year. Copies are sent to the relevant federal and provincial agencies; these will include the Federal Department of Fisheries and Oceans, the provincial Ministries of Forests and Environment, and other groups as required. Up to 12 agencies may be involved. These agencies return the plan to the leaseholder with comments and suggestions. The modified plan incorporates these comments and is resubmitted to MOF.

Detailed 2-year plans (Cutting Permit Plans) are required to obtain approval for roading and logging. These include site preparation treatments, species selection, initial stocking rates, silvicultural treatment and detailed harvesting plans. They identify the areas unsuitable for harvesting; reasons include slope stability, insufficient deflection, or inaccessibility. They are required to protect fisheries, wildlife and scenic values.

Riparian strips are left along streams that are important for game fish and are usually 20m wide with the larger trees removed to minimise windthrow problems. Fisheries biologists recommend leaving larger logs in streams to improve fish habitat, but require logging slash to be removed.

Utilisation standards are tight for old over-mature forest. The minimum log size is 3m by 15cm with a maximum residual volume of 35m³/ha on the cutover.

Landscape constraints, fire hazard reduction and the requirements for natural regeneration (where appropriate) have tended to encourage a move to patch logging. Logging of adjoining areas are deferred for 10 to 15 years until there is sufficient greenup on the logged areas (growth rates are much slower than in New Zealand). Setting boundaries will be modified to blend with existing topographical features.

A stream classification system was jointly developed by the Canada Department of Fisheries and Oceans, B.C. Ministry of Forests and Lands (now BCMOF), B.C. Ministry of Environment and Parks (now BCMOE) and the Council of Forest Industries (BCMOFL 1987).

Streams are classified according to the type of fish present; indirectly this is a reflection of the size of stream. There are 4 classes:

- (1) Salmon present
- (2) Trout present
- (3) No game fish present
- (4) No fish present.

The responsibility for fish is split between provincial and federal agencies. Trout and other non-migratory fish are now the responsibility of the BC Ministry of Environment (Fish and Wildlife branch) while salmon and other migratory fish are now the responsibility of the Canada Department of Fisheries and Oceans.

Increased protection for the fisheries resource involves:

- riparian zones along the lower reaches of Class 3 and Class 4 streams,
- increased care with stream crossings,
- more attention to the timing of logging across certain streams,
- an increase in the size of riparian strips around Class 1 and Class 2 streams.

Fisheries concerns relate to the movement of fine sediment and small organic debris down steep side valleys onto spawning grounds where streams enter larger streams, lakes and estuaries. In some situations, debris dams have been built to catch the smaller mobile debris after logging.

Wildlife concerns involve keeping logging activity away from known nesting sites for birds such as the bald eagle during nesting time.

National Forest Land

The USDA Forest Service own extensive areas of national forest in Oregon and Washington. These forests are managed on a sustained yield multiple use basis. Proposals for harvesting are becoming more and more strongly opposed by environmental groups who are concerned with the impact of harvesting on wildlife and fisheries values. In the Pacific Northwest, the issue has focused on protecting the remaining old crop stands in the national forests.

The most recent legislation, the National Forest Management Act, requires the Forest Service to go through the following procedure before operations commence:

- (1) Scoping (identification of the key issues)
- (2) Preparation of scenarios
- (3) Draft Environmental Impact

- Statement (EIS) prepared
- (4) EIS distributed for public comment
 - (5) Submissions received
 - (6) Submissions processed
 - (7) Final plans produced
 - (8) Final plans appealed
 - (9) Further negotiations with appellants (if needed)
 - (10) Into the legal process with lawsuits (if needed).

This procedure is intended to provide a means of producing an integrated resource management plan that has received public scrutiny and incorporated public comments. Increasing concern over environmental issues have resulted in the US Forest Service adopting a philosophy of greater responsiveness to the wishes of the public. In 1988, they adopted the slogan "Caring for the land and serving the people". Despite their increased responsiveness to public concerns, resistance to logging old growth Douglas fir stands in national forests is increasing. One recent environmental impact statement received 110,000 submissions, mostly of the mail order variety. These submissions are processed at the forest level but decisions made at this level can be appealed at each of 5 levels within the Forest Service and then through three levels within the legal system. Industry people see this as democracy being subverted by a small group of environmental activists. Like Gulliver in Lilliput, the Forest Service is being increasingly tied up in litigation. It is possible the Forest Service could run out of current timber sales areas as new areas run the gauntlet of appeal provisions. Most of the appeals claim that the Forest Service has failed to satisfy the requirements of current legislation e.g. the National Environmental Protection Act, the Clean Air Act, the Roadless Areas Act or the Scenic Rivers Act.

There is an enormous planning effort put into the preparation of planning reports by the US Forest Service. Teams of specialists are located in the districts to assist

the planning officer in the preparation of Environmental Impact Statements and Environmental Assessments.

The Environmental Impact Statement for 80,000ha of forest land in Siuslaw National Forest, Coastal Oregon, had required approximately 50 man years to prepare. It weighed 8 kilograms,

was approximately 12cm thick and presented 5 scenarios for public comment.

For operational plans, the USDA Forest Service are required to produce an Environmental Assessment. These would be a 50-60 page document and would require approximately 30 man weeks to prepare an assessment for a 200ha catchment.

HARVESTING OPERATIONS IN ENVIRONMENTALLY SENSITIVE AREAS

Oregon

Siuslaw Forest, a 250,000ha forest in the Oregon Coast Range, is characterised by steep slopes, high rainfall and unstable soils. (Figure 4). They harvest approximately 2 million m³/year and maintain over 6000km of road. Harvesting operations in the late 1960's and early 1970's moved onto steeper and less stable terrain. High intensity rainstorms in 1975 led to extensive landsliding and a great deal of adverse publicity. This triggered a rash of lawsuits from environmental groups who were concerned with inadequate protection of wildlife and fish habitat.

Virtually all harvesting operations on this forest are cable operations. Most are ridge to ridge systems involving partial suspension (slack line, running skyline, conventional skyline or slack pulling carriages). Suspension is needed to minimise the effect on riparian areas, head wall leave areas and wildlife trees.

Most of the roading within the forest is ridgetop roading with grades up to 27%. Midslope roading has been abandoned because of its high costs and subsequent problems with slope stability.

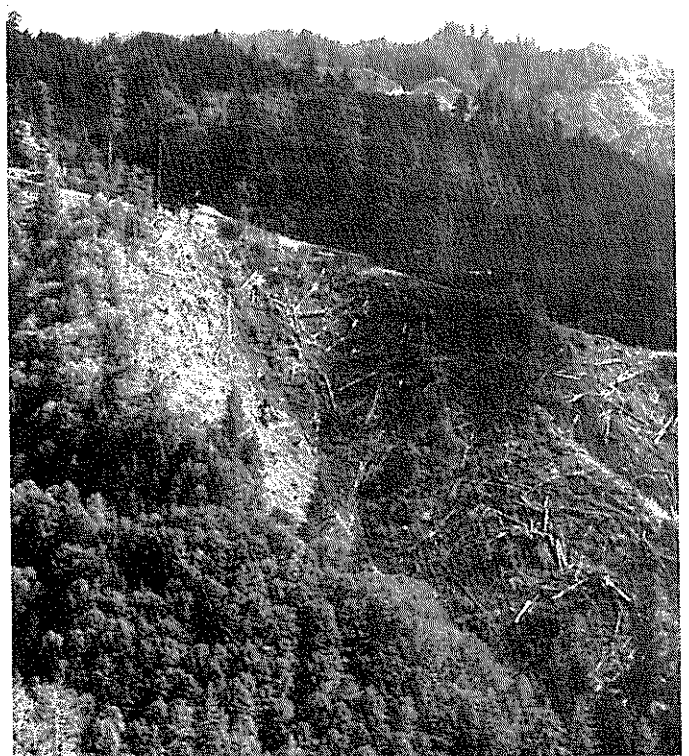


Figure 4: The rugged terrain of the Oregon Coast Range

A prototype central tyre inflation system was under trial on the forest. Results to date indicated substantial savings on maintenance costs with the road improving with use. The improvements were similar to those achieved using a vibrating rubber-tyred roller. The benefits of lower tyre pressures were improved traction, improved ride and higher travel speeds on rough roads.

One ridgetop logging operation involved a Skagit BU739 hauler with 20m tower using a Danebo Skycar (fitted with a 150hp diesel motor) and a gravity return system. Felling and bucking had been done on the slopes; the carriage was picking up 3 logs/turn. Average log size was 1.25 tonnes. They were achieving cycle times of 3-4 minutes/turn aided by pre-stopping. The landing was small, about 20m x 20m and a Koehring 6688 hydraulic loader sorted longs and shorts and loaded trucks. A steep ascent (22%) from the land-

ing required a secondary machine to assist the loaded logging truck to climb to the secondary roading network on the ridgetops (Figure 5). Daily production averaged 350 tonnes/day.

A balloon logging operation was seen in Smith Creek, a tributary of the Umqua River, just outside the southern boundary of Siuslaw National Forest on federal land administered by the Bureau of Land Management (BLM). The balloon was rigged in a standard "Yo-Yo" setup with 2 Smith-Berger single-drum haulers at each end and a pull-down block which could be moved around the setting to direct the balloon. The setting was a difficult one because the landing was located alongside a riparian strip and a long tag line was required to land the logs. Their target was 10-12 loads/day and their prices were comparable with those of the skyline logging (Figure 6). Further information can be found in the LIRA library.

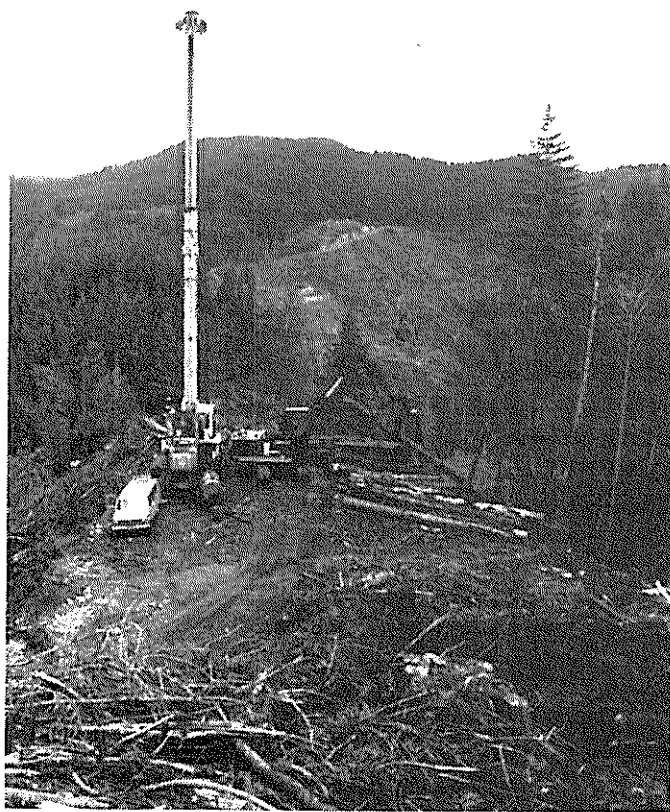


Figure 5: A Skagit BU739 hauler with a Danebo Skycar operating off a small landing in Siuslaw National Forest



Figure 6: Balloon logging on BLM land, Oregon Coast Range.

Vancouver Island

MacMillan Bloedel Limited have a Tree Farm Licence covering 450,000 ha of heavily glaciated forest land on southwest Vancouver Island. Their annual cut has averaged 2.4 million m³/ha over the last 30 years. As in mainland British Columbia, the old crop stands on the accessible valley floors and lower slopes have now been logged. High cost roads provide access to previously inaccessible valleys. Climbing roads zigzag up long steep slopes to provide access to ridges above the valleys.

Soils are generally shallow, rainfall is high and there have been problems with mass movement on steeper slopes.

Most harvesting is done with cable machines. High leading has been traditionally used but grapple yarding is now widely used.

Large machines such as the Washington 118 and the Madill 144 are used for grapple-yarding, to handle the very large and valuable logs that occur throughout the old-growth stands. Manpower shortages, improved safety, greater versatility, increased mobility and faster set-up and moving times led to the introduction of grapple yarders to replace the traditional high lead systems. This initially led to problems in areas that had been planned for high leading where there was insufficient deflection. A lift of 4m is needed to close the grapple. Old backhoes are often used as mobile back spars to improve lift and reduce line-shift times. Cross-slope felling and processing into specified lengths is common practice, carried out 3-6 months in advance of extraction. Good operator visibility was the key to high levels of production. If a hook tender or spotter was needed to help the operator position the grapple, production dropped dramatically.

In a roadside operation near Tofino Inlet on the west coast of



Figure 7: A Madill 144 grapple yarder Vancouver Island



Figure 8: The Esco grapple used by the grapple yarder

Vancouver Island, a Madill 144 with a 20m tower was grapple yarding downhill over a 300m slope distance in a running skyline configuration (Figures 7 and 8).

Daily production averaged 250m³/shift. The operation involved 3 men; 1 hauler operator, 1 loader operator and 1 utility man to rig blocks, skylines and unhook chokers when extracting very large logs (above 1.5m diameter). Very small landings (Figure 9) were used and it was common to stockpile logs below the road, frequently stacking across the slope and using stumps to hold the logs.



Figure 9: Logs stacked below the road by the grapple yarder

Experienced operators would frequently move the yarder around the landing to avoid outcrops and minor ridges. On steep faces, it was usual to start at the back of the block and work forward. This minimised surface disturbance and avoided the need to go back and pick up dislodged logs from areas that had already been worked.

Despite limited log suspension, there are few signs of soil erosion as the logs are usually extracted over other logs, soils are shallow and rock outcrops are common. The main concerns relate to debris avalanches and the potential for the formation of log jams in gullies during periods of high intensity rainfall.

Much of the responsibility for protection of the fisheries resource has now been taken over by logging engineers as they have developed their skills and experience. Local knowledge and on-site inspections identify specific problem areas. Terrain mapping is now mostly used by resource specialists and long term planners as a general indication of problem areas. The major environmental concerns of 10 years ago were dealt with in a "top-down" approach. The approach now is much more specific with issues being dealt with on the ground by local planners.

A particularly successful operation in a sensitive area was being



Figure 10: Patch cutting in the Vancouver District Domestic Water Supply Catchment

carried out in the domestic water supply catchments of the Greater Vancouver Regional District. Two haulers produced 120,000m³/year, each working approximately 8 months per year in old crop stands. Snow prohibits winter logging. Roading is done 2 to 3 years before logging, using hydraulic excavators. These are graded and compacted with a vibrating roller just prior to harvesting. Where necessary, the road may be capped with aggregate. Logging involves patch cutting in 15 ha blocks on stable slopes. (Figure 10). Small landings are used to extract processed logs. (Figure 11). A hydraulic loader



Figure 11: A small roadside landing ready for use in the Vancouver District Domestic Water Supply Catchment

stacks and loads out. Riparian strips are left and great care is taken to control runoff and minimise sedimentation. The provision of "portaloos" on landings was a visible sign of District's commit-

ment to maintaining water quality. This operation was a good example of how carefully planned and supervised logging operations can be undertaken in environmentally-sensitive areas.

HARVESTING RESEARCH

Oregon State University

The Forestry Department at Oregon State University also undertake research for the state of Oregon. There is a strong commitment to obtaining industry support and oversight of their research programme which is focused on improving forest productivity, improving international competitiveness, improving marketing information and protecting the environment.

The COPE Program was initiated in 1987 because of concern expressed by many community and government officers, public and private land managers, and natural resource associations, over the future of integrated resource management in the Oregon Coast Range and the ability to meet the needs of resource users. COPE is administered by the USDA Forest Pacific Northwest Research Station and Oregon State University's College of Forestry. Scientists working in this program are focusing their research and technology transfer efforts on two broad management issues:

- Riparian Zone Management, and
- the Reforestation of Oregon Coast Range Forests.

Wherever possible, OSU research attempts to quantify issues. One

example was the analysis by Olsen et al (1987) who examined the implications of the new Forest Practice Rules.

Funding for the Forestry Department at Oregon State University is supplemented by a state Harvesting Tax which brings in approximately \$400,000 a year. There is a similar input from federal agencies, principally the USDA Forest Service. Outside contracts generate some additional revenue. Within the Forest Engineering Department, research has been focused into 7 major areas.

1. Cable Systems
2. Mechanisation
3. Safety, Training and Incentives
4. Harvesting and Silviculture
5. Planning and Cost Benefit Analysis
6. Environmental Issues
7. Operational Efficiency

At present, the Forest Engineering Department has a faculty of 14 plus 6 research assistants. Their present low student intake and light teaching load is a reflection of the difficult times the forest industry has undergone in recent years. They have mounted a strong drive to improve undergraduate recruitment. The Head of the Forest Engineering Department, Bill Atkinson, was

keen to maintain liaison with LIRA and had asked Loren Kellogg to oversee this. The existing publication exchange assisted ongoing contact and he was keen to pursue a joint project, possibly in the human resources area.

FERIC Western Division

FERIC have just gone through a major structural reorganisation to handle their intended expansion over the next 2 to 3 years. In the West, this has involved the appointment of Vern Wellburn as Vice President, Alex Sinclair as Manager, Marv Clark as Research Director and a number of senior researchers as group supervisors. FERIC Western Division will eventually shift into a new building on the University of British Columbia campus. This will be shared with Forintek, an industry-funded research group for wood products manufacturing. Much of FERIC's recent and future research is described in recent publications (FERIC 1987, 1988); these notes describe the results of their recent work in the environmental area.

(1) Queen Charlotte Islands

FERIC have been involved with co-operative trials in the Queen Charlotte Islands since 1980. The issue was primarily related to the effect of harvesting operations on fisheries through accelerated landsliding.

There are two recent reports of particular interest on this work. The first involves an engineering analysis on 102 landslides on the Queen Charlotte Islands (Krag, Sauder and Wellburn, 1986). The major factors appeared to be overloading of steep slopes with fill or sidecast material and inadequate control of road drainage. Severe soil dis-

turbance at critical points from poor deflection may have accelerated landslide activity.

The second is a comparison of different yarding systems undertaken by Sauder and Wellburn (1987). This included production levels and logging costs. They also looked at the effect of each logging system on soil disturbance and its contribution to landslide initiation.

(2) Interior British Columbia

In interior BC, there has been concern over the level of detrimental soil disturbance from conventional ground-based harvesting systems (rubber-tyred skidder and medium-sized crawler tractor). A comprehensive comparison of their relative economic and environmental performance was undertaken over a one year period to compare with small crawler tractor and cable yarding systems (Krag and Webb, 1987).

(3) Vancouver Island

FERIC have also undertaken trials with wide-tyred skidders on easy terrain on Vancouver Island. Previous trials with conventional groundbased systems on easy terrain had created excessive soil disturbance on soft ground.

MacMillan Bloedel Limited

To deal with environmental issues on their lease areas on Vancouver Island, the Queen Charlotte Islands and the Mainland Coast, MacMillan Bloedel Ltd set up an in-house planning team to provide an independent evaluation of environmental issues. This Land Use Planning and Advisory Team (LUPAT) contain their own specialists on soils, geology, fisheries and

wildlife. They use consultants for advice on marine biology, hydrology and recreation. Large scale mapping has not been successful in identifying the less stable areas because of the highly variable nature of this terrain. Infinite-slope analysis techniques are unsuitable because of big variations in key factors such as moisture content and co-efficients of friction.

They have attempted to predict future instability from evidence of slips throughout the area using a series of polygons (terrain units). This function of probability is linked with a hazard rating which assesses the extent of damage arising from slipping and incorporates aspects of safety, landscape values, effect on wildlife and effect on roads. This is well described by Roller-son and Sondheim (1985).

RECOMMENDATIONS

Environmental Legislation

There are important differences between the Pacific North-west and New Zealand. In New Zealand, plantations lack many of the environmental values associated with natural forests. About half of New Zealand's plantations are privately owned; the other half were established by the New Zealand Forest Service and are now being managed by Timberlands, the forest management arm of the New Zealand Forestry Corporation. Cutting rights to these plantations are expected to be put up for tender in 1989. These plantations have been clearly identified as being managed primarily for wood production. Any public debate is more likely to deal with how harvesting should be carried out rather than whether it should be done.

A variety of elaborate planning procedures have evolved overseas to meet local environmental needs and national legislative requirements. Some of these procedures could be incorporated in the planning of areas with high environmental values. However, most are not applicable to the majority of

our "new crop" stands. Local issues are best handled at a local level. The Review of Resource Management Legislation is well underway but the outcome of the process and implications for the industry are uncertain.

A Forest Code of Practice offers the most cost-effective means, for both the forest industry and the general public, of providing a reasonable degree of protection to environmental values during forest operations. The Working Group with representatives from industry, research and catchment boards, will play a major role in steering the development of the Code.

Recommendation 1

That development of the Forest Code of Practice continues to be a high priority.

Environmental Awareness

The experience of the forest industry in the Pacific Northwest has been one where changes in

forest operations to provide better protection for environmental values have usually followed the introduction of legislation. If the New Zealand forest industry can take the initiative in identifying environmental values, and be seen to be taking reasonable steps to protect these values, it will be more difficult to justify the introduction of new legislation. However, if a cavalier attitude is adopted by some members of the forest industry and genuine public concerns are ignored, the media will be quick to portray the forest industry as an arrogant and irresponsible landowner. If this coincides with one or more major environmental failures, it will provide an ideal opportunity for environmental groups to attack the credibility of the forest industry. Little sympathy can be expected from the public, deeply suspicious of the activities of big business.

Maintaining public acceptance of responsible forest operations will be a challenge for the industry that must be recognised and worked on. For the New Zealand public, harvesting and transportation will be the forest operations with the greatest visual impact. For the forest industry, they will be the most costly operations. For the environmentalists, they will be operations with the greatest environmental impact. Training of logging planners and managers will be a key issue in the development of safe, profitable and productive harvesting operations. The early identification of locally important environmental values and their incorporation into the planning process will be critical to achieving public acceptance.

Company commitment to balancing environmental and commercial values will be reflected in the attitudes of staff and supervisors. With well thought out plans, supervision of contractors will be the key to success in logging of environmentally-sensitive areas. Many of the environmental problems in the Pacific Northwest can be attributed to inadequate

supervision rather than poor planning.

Recommendation 2

That high priority be given to the ongoing training of forestry staff in the planning, management and supervision of harvesting operations, with special emphasis on the strategic importance of protecting environmental values.

Public Image of Plantations

Photographs of plantations often portray scenes of peace and tranquility besides clear running streams surrounded by a variety of ornamental trees. Future publicity must place a stronger emphasis on the industrial nature of plantations by emphasising the range and scale of forest operations that occur. The public must be confronted with the reality that plantations established for wood production will be harvested in the future.

Recommendation 3

That a stronger emphasis is given to publicising the range and scale of industrial activities that occur within plantations.

Recommendation 4

That the forest industry develop strategies on a regional level to highlight the local benefits of well-managed plantations, as part of a long-term campaign to develop and enhance public acceptance of forest operations, particularly harvesting and transportation.

Harvesting Research

In New Zealand, research into the environmental impact of harvesting operations has been undertaken by the Forest Research Institute. Long-term catchment studies were carried out by the (then) South Island Geohydrology Group on the effects of harvesting on water yield, water quality and sediment movement. They have also completed some very useful work on the role of trees in improving slope stability and the implications of harvesting. They have been heavily involved in monitoring the movement of earth flows at Mangatu Forest and assessing the effects of reforestation and harvesting.

The Harvest Planning Group in Rotorua have undertaken work on the effects of compaction and site disturbance on site productivity. Both groups are currently involved in assessing the effect on harvesting in the Marlborough Sounds under various levels of environmental constraints, and both are involved in contract work for Timberlands in harvest planning on Whangapoua Forest (Coromandel) to meet local environmental constraints.

The Soils group in Rotorua are leading a project into the environmental impacts of intensive harvesting, looking specifically at the effects on soil structure, nutrition and site productivity. This is a cooperative project with participation from other overseas countries under the auspices of the International Energy Agency.

Catchment authorities in New Zealand are often required to define constraints for operations affecting soil and water values. In many cases, the justification for doing this lacks quantitative data. There is increasing interest in cooperative trial work with forestry organisations to allow data collection and ongoing monitoring.

Recommendation 5

That the industry support research in these areas by the Forest Research Institute and the Forest Research Centre and encourage closer coordination of their work programmes.

Recommendation 6

That extension of the results of this research to end-user is improved by use of the popular LIRA Technical Releases and FRI Whats New Series.

Recommendation 7

That the direction of future research work include input from forest-owners, LIRA and bodies such as catchment authorities.

LIRA's early work focused on techniques for harvesting trees from riparian areas and assessing the impact. This was followed by a comprehensive review of research findings and practices (Vaughan, 1984) and an illustrated booklet on Logging Operations Guidelines (Spiers, 1986). Current work involves the development of a Forest Code of Practice. The target is a draft Code in 1989.

Future areas of work which will have LIRA involvement include management of riparian areas during harvesting (and other forest operations), and documentation of successful operations on sensitive terrain.

In general terms, LIRA will:

- monitor developments, becoming actively involved when appropriate

- collect and disseminate relevant results and information
- identify opportunities for applied research
- encourage coordination of research activities
- provide input into training and education

harvesting systems suitable for sensitive terrain.

The formation of contacts with overseas research organisations has been one of the key factors in the development of LIRA's technical resources. This must be fostered by encouraging regular contact between staff through travel, participation in joint and cooperative research projects and researcher exchange. Publications exchange has assisted in building up LIRA's technical resources and should be continued and extended where appropriate.

Recommendation 8

LIRA's main role in environmental aspects of harvesting research will remain with monitoring developments, communicating results, coordinating activities and cooperating in work of importance to the industry. It should continue to play a major role in training and the development of new

Recommendation 9

That closer contacts be fostered with the key research organisations in the Pacific Northwest.

BIBLIOGRAPHY

- B.C. Ministry of Forests and Lands (1987) : British Columbian Coastal Fisheries - Forestry Guidelines.
- Elliott, D.A.; Levack, H.H. (1981) : "N.Z.'s Plantation Resource - Area, Location and Quantities" 1981 Forestry Conference Paper.
- FERIC (1987) : 1987 Work Program.
- FERIC (1988) : Stretching the Research Dollar through Cooperation. 1988 Work Program.
- Krag, R.K.; Sauder, E.A.; Wellburn, G.V. (1986): A Forest Engineering Analysis of landslides in logged areas on the Queen Charlotte Islands, British Columbia. FERIC Special Report No. SR-39.
- Krag, R.K.; Webb, S.R. (1987): Cariboo Lake Logging Trials : a study of three harvesting systems on steep slopes in the central interior of BC. FERIC Technical Report No. TR-76.
- NWASCO (1975) : Forest Operations Water and Soil Management Guidelines No. 5. Water and Soil Division, MOWD, Wellington.
- Olsen, E.D.; Keough, D.S.; La Course, D.K. (1987) : Economic Impact of the proposed Oregon Forest Practice Rules. Oregon State University Research Bulletin 61.
- Rollerson, T.P.; Sondheim, N. (1985): Predicting post-logging terrain stability: a statistical-geographical approach. In Proceedings of a Symposium on Improving Mountain Logging planning, techniques and hardware, FERIC.
- Sauder, E.A.; Krag, R.K.; Wellburn, G.V. (1987): Logging and Mass Wasting in the Pacific Northwest with application to the Queen Charlotte Islands, B.C.: A Literature Review. FERIC Special Report SR-45.
- Sauder, E.A. (1986): Logging System Capabilities and their potential to reduce mass wasting: a Literature Review. B.C. Ministry of Forests and Land Management Report (in press).
- Sauder, E.A.; Wellburn, G.V. (1987): Studies of yarding operations on sensitive terrain, Queen Charlotte Islands, British Columbia. FERIC Special Report SR-43.
- Spiers, J.J.K. (1986) LOG : logging operations guidelines. LIRA handbook.
- Vaughan, L.W. (1982): 1981 Forestry Conference Review. LIRA Report 7(3).
- Vaughan, L.W. (1984): Logging and the Environment - a review of research findings and management practices. LIRA.