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CANADA-BRITISH COLUMBIA PARTNERSHIP AGREEMENT ON FOREST RESOURCE DEVELOPMENT: FRDA II

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held June 7–8, 1995  
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Edited by:

**J.T. Arnott<sup>1</sup>, W.J. Beese<sup>2</sup>, A.K. Mitchell<sup>1</sup> and J. Peterson<sup>1</sup>**

<sup>1</sup> Pacific Forestry Centre, Canadian Forest Service, Victoria, B.C.

<sup>2</sup> Sustainable Forestry Division, MacMillan Bloedel Ltd., Nanaimo, B.C.

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For additional copies and/or further information about the Canada-British Columbia  
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Canadian Forest Service  
Pacific Forestry Centre  
506 West Burnside Road  
Victoria, B.C. V8Z 1M5  
(604) 363-0600

or  
B.C. Ministry of Forests  
Research Branch  
31 Bastion Square  
Victoria, B.C. V8W 3E7  
(604) 387-6721

## Foreword

The cooperative Montane Alternative Silvicultural Systems (MASS) research project addresses regeneration, wildlife habitat, and aesthetic concerns in managing forests at higher elevations on Vancouver Island. A series of integrated studies are examining the biological and economic consequences of alternative silvicultural systems. The costs and feasibility of harvesting these old growth forests using small Patch Cuts, Green Tree Retention and Shelterwood systems are being documented. Many long-term studies will evaluate the impacts on forest dynamics, soils, microclimate and biological diversity.

The objective of this workshop, held from June 7–8, 1995 in Courtenay, B.C., was to provide a forum in which the MASS project's initial findings were presented. Fourteen papers from all members of the research team were delivered to an audience of 100 participants from industry, government and academia, primarily from the Vancouver Forest Region. A field trip was also made to the MASS project site, located 20 km southwest of Campbell River in the Menzies Bay Division of MacMillan Bloedel Limited.

Jim Arnott and Bill Beese  
MASS Project Coordinators  
July 1, 1995

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# Montane Alternative Silvicultural Systems (MASS) Introduction and Objectives

William J. Beese  
Forest Ecologist  
MacMillan Bloedel Limited  
65 Front Street  
Nanaimo, B.C. V9R 5H9

## Abstract

The cooperative Montane Alternative Silvicultural Systems (MASS) research project addresses regeneration, wildlife habitat, and aesthetic concerns over clearcutting at higher elevations on Vancouver Island. Integrated studies are examining the biological and economic consequences of alternative silvicultural systems. The cost and feasibility of harvesting old growth using small Patch Cuts, Green Tree Retention and Shelterwood systems were documented. Long-term studies will evaluate the impacts on forest dynamics, soils, microclimate and biological diversity.

## Project Rationale

Concerns over high elevation regeneration performance in large clearcuts was the primary reason for establishing the Montane Alternative Silvicultural Systems (MASS) study. Coastal “montane” forests have a winter snowpack and are found between 700 and 1100 metres in elevation on Vancouver Island. Observations suggest that on some clearcuts at these elevations, regeneration of natural and planted trees may not be meeting current growth expectations because of patchy stocking or growth inconsistencies (Koppenaar and Mitchell 1992). The apparent growth problems may be related to environmental conditions on large clearcuts that create unfavorable microclimate, vegetation competition, nutrient availability or alterations to ecosystem processes affecting forest regeneration. There is little data on ecosystem processes in montane and subalpine forests on which to base silvicultural decisions. These predominantly old-growth forests represent about 30% of the land base on Vancouver Island. For MacMillan Bloedel, 25% of its future Allowable Annual Cut is dependent upon this resource. Silvicultural systems that provide for canopy protection to reduce microclimatic extremes may help regenerate the shade tolerant amabilis fir (*Abies amabilis*) and western hemlock (*Tsuga heterophylla*) that dominate these forests.

At the same time, greater regard for multiple forest values including wildlife habitat, biological diversity and visual aesthetics is prompting foresters to consider new approaches for managing coastal forests. There is growing public pressure on industry and government to reduce the size and extent of clearcutting in B.C. On the coast, there is very little experience with other silvicultural systems. Forest managers need to know where alternatives to clearcutting are feasible, economical and ecologically sound. This study provides an opportunity to address a variety of today's challenges.

The MASS cooperative is a multi-agency research effort between MacMillan Bloedel, the Canadian Forest Service, the Forest Engineering Research Institute of Canada (FERIC), the University of British Columbia and the University of Victoria.

## Objectives

The objectives of the MASS study are to:

1. Test alternative silvicultural systems for montane coastal B.C. forests;
2. Document the operational costs and feasibility;
3. Study the biological and silvicultural impacts.

A multi-disciplinary team is studying harvesting feasibility and economics, growth and yield, microclimate, soil disturbance and nutrients, forest floor decomposition, natural and planted regeneration, forest bird diversity, vegetation succession, seedling response to competition and nutrition, and forest health. Results of these studies will be used to develop guidelines for selecting silvicultural systems, species and management options for montane ecosystems to meet regeneration, aesthetic and wildlife objectives, without compromising worker safety.

## Study Area

The study is located on MacMillan Bloedel's private land south of Campbell River, B.C. within the Montane Moist Maritime Coastal Western Hemlock biogeoclimatic variant (CWHmm2) (Green and Klinka 1994). The study area ranges in elevation from 740 to 850 metres on a northerly aspect. Slopes are generally less than 20%.

The old-growth forest on the study area was dominated by western hemlock and amabilis fir, with varying amounts of western redcedar (*Thuja plicata*) and yellow-cedar (*Chamaecyparis nootkatensis*). Overstory trees ranged in age from 200 to 500 years. Tree ages, stand structure and the presence of charcoal at the mineral soil surface 10 to 40 cm under the forest floor suggest that the stand developed in the absence of fire disturbance or large-scale windthrow for at least 500 years, and probably much longer.

"HwBa-Pipecleaner moss" is the dominant site association on the study area. It occurs on well- to moderately well-drained slopes characterized as a "fresh" soil moisture regime. Alaska and oval-leaved blueberry dominate the shrub cover. The moist to very moist "BaCw-Salmonberry" site association occurs in depressions and seepage tracks, most often intermixed with the Pipecleaner moss association in a complex mosaic. Devil's club forms dense shrub cover in portions of this association. Minor amounts of the wet "CwSs-Skunk cabbage" site association are also present, mostly in small depressions.

Soils within the study area are predominantly Orthic and Gleyed Ferro-Humic Podzols. They are generally over one metre deep, but some areas have shallow soil over sandstone, shale or conglomerate bedrock. Well-drained to moderately well-drained soils occur on middle to upper slopes and hummocks. Moderately well-drained to imperfectly drained soils occur on lower slopes and in depressions. Many portions of the study area have a mosaic of well-drained and imperfectly drained soils in response to the hummocky topography. Soil conditions vary widely over short distances. Bogs have developed where a few pockets of poorly drained soils occur. Soils in the study area have high clay content (20 to 48 percent) in relation to typical Vancouver Island soils. Surface organic horizons (i.e., forest floor) are dominated by Mor humus forms (Humimors and Hemihumimors). The typical sequence of horizons is a thin (0.5 to 1.5 cm) litter layer, a 3 to 5 cm matted "F" layer, and a well decomposed humus layer of variable thickness. Decomposed wood is a predominant component of deeper humus layers.

## Experimental Design

The experiment includes three replicates each of silvicultural systems representing a range of overstory removal: a uniform shelterwood, and two variations of clearcutting—small Patch Cuts, and Green Tree Retention. Adjacent to these treatments is a 69 ha clearcut and an old-growth baseline monitoring reserve (Figure 1). Individual tree and group selection systems were considered, but were not deemed feasible for the stand conditions and equipment available.

Each replicate occupies an area ranging from 8.6 to 11.5 hectares. Most replicates were rectangular, approximately 250 m × 360 m. The three replicates of each of the three clearcut-alternative systems occupies an area of 94 hectares. Treatments were allocated to this area by dividing it into nine roughly equal blocks and three groups of three (west to east). Treatments were assigned randomly within each group. The group assignment ensured distribution of each treatment across the site. Because the intent of the Green Tree Retention treatment is to represent a small clearcut with residuals, a constraint was placed on random assignment to reject the occurrence of two adjacent Green Tree replicates.

The large Clearcut to which the alternatives will be compared was harvested during 1992 (58.5 ha) and 1993 (10.6 ha). The untreated old-growth “control” (20 ha) will remain between the conventional clearcut and alternative systems for a minimum of 20 years. The Clearcut treatment was assigned to a large neighboring clearcut rather than 9-hectare clearcuts interspersed within the other treatments in order to be representative of current and past practices. The old-growth control was also assigned to a single larger area, rather than three 9-hectare blocks, to minimize edge effects. Old-growth buffers to the north and south of the alternative systems block will remain for wind protection for the foreseeable future. Other areas surrounding the treatment blocks could be harvested any time in the future, though there are no immediate plans for development.

Experiments influenced by edge effects were located within a 1.6 ha “core” in the centre of each 9 ha treatment block. The treated buffer surrounding the core was defined as two to three tree lengths (85 m) from the block boundaries. All studies were referenced to a 60 m sampling grid with permanent metal markers established before harvesting. Forest cover and plant associations were mapped at 1:5000 scale before harvesting. Forest inventory was done at about three times the normal intensity for a commercial timber cruise, and included measurement of several additional stand attributes, such as coarse woody debris and advance regeneration. Pre-harvest monitoring to characterize the old-growth forest also included physical and chemical soil properties, above- and below-ground microclimate, vegetation cover, and breeding bird communities.

## Silvicultural Systems

The treatments represent a gradient of microclimatic conditions and residual forest cover for regeneration protection and wildlife habitat. Each was designed with specific objectives in mind.

### Clearcut

A 69 hectare area was harvested over a two-year period with two adjacent clearcuts to provide an example of clearcutting practices for comparison to alternative systems. The regeneration objective is to establish a mixed stand of conifers through natural regeneration from advanced stocking and seed-in, supplemented by fill-planting to achieve stocking targets and desired species composition.



Figure 1. Study area location and layout.

## **Patch Cut**

Small cutblocks were designed with alternating leave strips so that regeneration is within two tree lengths of an edge. This provides seed-fall and protects regeneration against snow, wind and temperature extremes. All trees were cut in three 1.5 to 2 ha patches (approximately 120 × 125 m) within each treatment block. Except for size, the concept is similar to a strip shelterwood. The remaining 50 percent of the stand will be harvested after regeneration reaches 10 m in height. This also spreads harvesting over a longer time period for aesthetic and wildlife habitat values. Regeneration will be achieved primarily through natural stocking, supplemented by planting as required.

## **Green Tree Retention**

The goal of this treatment—also known as clearcutting with reserves—was to leave 25 trees per hectare in small clearcuts to enhance the structural diversity of future stands for wildlife and aesthetics. The appearance is similar to a seed tree system, except that reserves are left for the entire rotation to meet other objectives. Trees were selected for relatively uniform distribution, windfirmness, safety and representation of the entire stand profile. Five snags per hectare will be created in future for cavity nesting birds. Natural regeneration is prescribed, supplemented by planting as required to achieve a mixed species composition.

## **Shelterwood**

This system provides protection for regeneration against snow, wind and temperature extremes, and enhances the structural diversity of future stands for wildlife and aesthetic values. Trees representing the entire stand profile and 30% of the basal area (approximately 200 stems per hectare over 17.5 cm DBH) were left throughout the stand. Reserve trees were selected for yarding feasibility, safety, windfirmness and residual stand structure. Although the approach is considered a uniform shelterwood, clumped distribution was necessary to facilitate harvesting and to protect smaller trees. If feasible and economical, a portion of the leave trees will be recovered when regeneration is established, leaving up to 25 wildlife trees per hectare. A second option identified in the stand prescription is to leave all residual trees for the entire rotation, creating a multi-aged “irregular” shelterwood. Regeneration will be achieved primarily through advanced natural stocking and seed-in.

## **Harvesting**

Roads were built in 1992, and harvesting was completed between May and November of 1993. The Workers' Compensation Board was involved during harvest planning to ensure safety requirements were met. Trees were marked to meet the specific silvicultural objectives established for each treatment. Several days of training occurred, with field input on marking from equipment operators, fallers, researchers and other operational personnel. Manual felling was used in all treatments. Where a marked tree could not be retained, fallers could choose an alternative tree of similar size. Trees were bucked to specified log lengths at the stump to maximize value recovery.

A hydraulic log loader was used to forward or swing the logs from stump to roadside. Hoe-forwarding is the method of choice for yarding timber on gentle slopes. Although this type of logging system has been employed in partial cut treatments of second growth stands, it had not been used before for partial cutting old-growth forests in coastal B.C. In the Shelterwood, access corridors up to 20 metres wide were placed perpendicular to main roads at a maximum spacing of 120 metres. Trees were felled and removed from corridors before felling trees toward them from the surrounding stand. Ground skidding was used in conjunction with hoe-forwarding in the Shelterwood to yard wood from corridors to the main roads.

## Application

Much experience was gained from the MASS study that will benefit future application of the systems tested. The study area has already served as an important demonstration area for others planning to implement alternative systems in coastal B.C. Crew involvement in the planning stage was a key element in successful implementation. Close on-site supervision was essential to ensure proper scheduling of harvesting phases for the multiple blocks.

Shelterwood, Green Tree Retention and Patch Cut treatments can be done successfully in old-growth forests under the conditions tested at MASS, but the biological and economic implications will determine whether or not these treatments should be applied elsewhere. Harvesting feasibility and cost results are not applicable to areas of steeper terrain that require different yarding systems.

This project has created a long-term research installation where multi-disciplinary projects can be undertaken in montane coastal forests with replicated alternative silvicultural treatments. The study area has already attracted several additional studies.<sup>1</sup> The experimental installation will be monitored for at least 20 years, at intervals determined by future funding arrangements among cooperators. Ideally, the project will extend to the entire forest rotation.

Project results will assist development of guidelines for forest practices in montane coastal B.C. forests. Challenges to those designing silvicultural systems to meet a variety of management goals include: ensuring that regeneration, tending and product objectives are met; balancing logistics, minimizing windthrow and protecting regeneration during multiple entries; meeting wildlife needs without compromising forest health; and thinking beyond the traditional definitions of silvicultural systems to create innovative approaches.

## Acknowledgments

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<sup>1</sup> This Workshop Proceedings presents initial findings from the research studies established in the original study plan; Beese, W.J. 1992. Montane alternative silvicultural systems working plan. Woodlands Services Div., MacMillan Bloedel Ltd., Nanaimo, B.C.