

not diminished.

In any event, change is occurring and those manufacturers remaining in the native timber and timber products market place will need to take this into account and plan accordingly. The changes are:

- prompting more owners of private native forest to seek to manage their forests sustainably;
- providing an incentive for improved processing and recovery practices;

- increasing the prominence of beech and other hardwoods in the native timber market.

Forest owners also have to make a great change in their understanding of how the forests can be managed for greater long-term economic benefit. Those who make this challenging transition successfully should find the forthcoming era of sustainable management of native forests rewarding.

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# Beech Forest Management: Advancing the State of the Art

## Report on a Workshop held at the School of Forestry April, 1998

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A workshop, Beech Forest Management: Advancing the State of the Art, was convened at the School of Forestry, University of Canterbury, April 17, 1998. The purposes of the workshop were to identify problems in beech forest management and potential remedies for those problems and to bring together researchers, academics, policy makers and others who see a cross-section of the indigenous forestry sector with practitioners such as foresters, timber merchants, logging contractors, and forest owners, who experience first hand the difficulties and opportunities for improving management. The aim was cross-fertilisation and a shared action programme to advance the state of the art of sustainable beech forest management.

Many of the 65 participants brought the potential through their own actions to contribute to improved sustainable beech forest management. Among the participants were two former Directors-General of Forests, representatives of five CRIs, two universities, three central government departments, two regional councils, three Maori authorities, four NGOs, five production beech forests, seven other businesses trading in beech including two sawmills, and 14 private consultants. The workshop was not advertised because it was intended to be small.

### Workshop Development

The list of persons invited and the specific areas of focus within the workshop were developed through consultation. Fifty people identified as particularly knowledgeable, leaders in their subject areas or at the forefront of their businesses, were asked to identify the key bottlenecks to successful, genuinely sustainable, beech management. Within those broad problem areas, they were asked to name specific topics to be addressed by the workshop. These key informants represented a cross-

section of the indigenous forestry sector, ranging from environmentalists to harvesting contractors. The survey was followed by additional consultation with stakeholders including forest owners, relevant ministries such as DoC, MoF (now MAF) and MoE, and businesses dealing with beech products.

Survey responses were scored by frequency of mention of problem areas and topics and by the importance value that respondents assigned to them. The individual topics mentioned by respondents



Helen Hughes, Chair of the final plenary session, and Nora Devoe, workshop organiser, at the podium. (Photo: Karl Schasching.)

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were distilled into five major constraints to improving beech forest management. Scored from highest to lowest priority, these were:

- (1) Return on stumpage is too low to provide a reasonable margin on state-of-the-art beech management, especially for smallholders or those with poor site access, poor market access, or low-grade/less-favoured species.
- (2) Harvesting practices must be improved in ecological and economic terms; beech continues to pose processing difficulties.
- (3) Insect pests reduce the value and productivity of standing forests; these effects may be exacerbated by forest management. Wind, weather and fire pose risks to sustainable beech forest management.
- (4) Current knowledge is inadequate to compare the performance in ecological or economic terms of the various silvicultural systems now considered sustainable. Knowledge to evaluate the economic and ecological performance of thinning and other tending operations is inadequate.
- (5) Ecological and environmental effects of management are poorly defined. Sustainability cannot be secured without ecosystem-level understanding of management effects.

Each of these five areas then became the focus for a working group. The workshop day was divided into whole-group (plenary) and working-group sessions. The five working groups met simultaneously, with participants joining the group of their greatest interest.

#### Workshop Discussion and Findings

The day's first session was a plenary intended to orient and focus the participants. They received the results of the survey, and another view of the state of the art of beech forest management as seen by the Indigenous Forestry Unit of the Ministry of Agriculture and Forestry. This unit has reviewed the applications for the 99 plans and permits granted to date, which cover an aggregate alleviable cut of 53,500 m<sup>3</sup>/yr. MAF is responsible for vetting permit and plan applications and for monitoring operations under them. In summarising the weakest points in plan applications, Alan Tinnelly (MAF) commented that inventories varied in quality and sometimes failed to justify proposed harvest rates, which were therefore judged to be too high. Extraction plans were sometimes poorly developed or inappropriate to the sites in question. Pest management and domestic stock control were frequently insufficient. Finally, applica-

tions were typically focused only on harvesting timber, and must be broadened to include management activities throughout the term of the plan.

The **working group on marketing, co-operatives and certification**, chaired by Dr Alf Leslie, debated whether returns could be improved through expansion of domestic and international markets. They produced figures to suggest that at a maximum, the domestic market can absorb only about 20% of the beech scheduled to be produced in the next five years if the Timberlands West Coast Ltd. beech scheme proceeds. Currently, furniture-making takes only 20,000 m<sup>3</sup> of indigenous timber per year, and this is declining. Decorative and flooring markets are the most likely new domestic customers for beech, but volumes now taken are very small. It is clear that most of our beech must be exported. The group concluded that a coordinated marketing approach by New Zealand producers, processors, and traders is needed and has good potential in the medium term. An initiative along these lines is underway but needs to be broadened to include all those trading in beech. The School of Forestry beech management research programme will begin assisting smaller producers to co-ordinate production in order to achieve greater scale, supply continuity, and access to overseas markets.

The marketing working group addressed the role of certification in marketing. The consensus was that certification could significantly expand New Zealand's share in the international hardwood market. One participant noted that SGS certification is needed to enter the European market. Another remarked that it costs about \$30,000 to certify an operation. The working group and the larger meeting recommended that national-level certification be pursued for sustainably produced beech products and that the potential to rationalise Forest Stewardship Council criteria with those required under a revised Forests Amendment Act 1993 (FAA) be investigated.

Among the important points raised in relation to developing a strategic marketing plan for beech was the idea that it must be positioned within the luxury cabinet woods. Sustainably managed beech cannot compete on price with cheaper tropical hardwoods, but it can compete on quality. "Beech has basically the same characteristics as mahogany and could easily replace it", said one participant. "There is considerable scope for upgrading", agreed another. "European beech is in the low end of their top grades. Cherry is in the top end of their top grades. Our beech closely resembles cherry, so can we position it to take advantage of this?",

remarked the chairman. The conclusion was that the steps to be taken in marketing were identified, but that considerable funds are needed to execute them. It was noted that *Pinus radiata* was launched by government, but that current political trends are away from any form of public assistance. However, two agencies that might consider assisting with beech marketing for export were identified and will be approached.

The **harvesting and processing working group**, chaired by Alastair Riddell (LIRO), addressed configurations of locally available harvesting and extraction equipment appropriate for silvicultural systems such as small coupes, shelterwood, and single-tree selection. They concluded that many suitable options for pulling through standing trees are available; those that work particularly well must be publicised. The area where perhaps the greatest gains in cost efficiency and reduced environmental impact can be achieved lie in up-skilling those involved in harvesting, particularly in harvest planning, to ensure that the best system is chosen for any particular site and silvicultural regime. It was suggested that the next edition of *Indigenous Forestry: Sustainable Management Handbook* (1998) include sections on harvesting systems and costing.

The discussion on processing dovetailed with a number of points raised in the marketing group. Among the inherent problems with beech is the fact that a small production volume is spread over three species, five grades, and mixtures of colours, plus each species shows variations with geographic area. Strength, density (but see Wardle 1934, *The New Zealand Beeches*, p 339), and elasticity do not vary too much among species and all have excellent gluing properties. Drying problems are being tackled by the Wood Technology Research Group at Canterbury University, but drying degrade continues to reduce recovery within higher-end grades. All of this adds up to difficulties with supplying timber to the exacting specifications of an export market. Grading must be adapted to the target markets, and product supplied in desired lengths, widths, and moisture contents. While customers prefer long lengths to reduce handling of individual pieces, beech suffers from rot and borer, rendering long clears a small part of the available volume. "The people we are trying to sell beech to want timber without defects", noted one beech trader, while another remarked that he had found a niche market for borer-affected wood as 'character timber'. The participants concluded that although considerable work on beech utilisation was done by the New Zealand

Forest Service, more is needed.

The **forest protection working group**, chaired by Dr. Ken Hobson (School of Forestry) discussed natural levels of pests such as pinhole borer, manuka longhorn beetle and puriri moth and pathogens such as *Armillaria* and *Cytaria* in beech forests. Many natural factors affect these levels. Forest management changes the dynamics of pests and pathogens, but the mechanisms are poorly understood. It was noted that pests such as possums and wasps are having profound impact in some areas, and that the conservation estate is badly affected. Many of the pest and pathogen risks to indigenous production forests are shared by conservation forests, and both must be managed to reduce risks and impacts of pests. DoC is under-resourced to meet its responsibilities in this area, exacerbating costs of control and of damage for private landowners.

The current means of borer control, slash reduction, is crude, expensive, and unproven. More sophisticated means include competitive fungal interference and use of pheromones. These have been developed for other pests and could be developed for pinhole borer with additional research. Greater returns from forest management and policy changes to allow sale and export of what are now waste products (chipwood) are needed to finance effective forest hygiene.

Biosecurity concerns were raised in the protection working group and in plenary sessions. It was noted that timber imports carry biosecurity risks for indigenous forests. Two entomologists commented that surveillance is presently inadequate and that techniques in use miss certain species. Because native invertebrates are so incompletely known, it is impossible to determine whether some species are introduced. Risks to native biota were judged to be high, and it was recommended that government increase funding for research and monitoring.

The **silviculture working group**, chaired by Dudley Franklin, noted that there were no major constraints to beech regeneration. All silvicultural systems, clearfelling, seed tree, shelterwood, and selection, can be used successfully in beech forests provided that site and stand conditions and age structures are appropriate to the chosen technique. Grazing and the introduction of grasses, fire, and extreme soil compaction are inimical to beech regeneration. The flexibility to match management to site and market conditions is important to improving the quality of management. It was concluded that no matter how slight, management does affect forests, and that silviculture should be directed at the continual

improvement of forests, not maintaining the status quo as required by the Forests Amendment Act (FAA). This is particularly important for the management of previously exploited forests.

This group was divided in its opinions of the most desirable systems for beech management, with some members advocating further investigation of the less-known selection techniques and others stating that these techniques were unduly conservative and expensive. There was consensus on desirable thinning treatments, to the effect that thinning should begin early or not at all, be gradual, and clearly results in higher sawtimber outturn than in unthinned stands. Some thought that pruning should accompany thinning.

The silviculture working group recommended that the Ministry of Agriculture and Forestry be funded to provide increased services to facilitate sustainable indigenous forestry, especially in the dissemination of information and the monitoring of operations under sustainable management plans. This recommendation was independently formulated by the ecological effects working group and echoed by still others in plenary sessions. The silviculturists called upon research providers and the NZ Farm Forestry Association to provide more field days and other forms of forestry extension to assist forest owners to recognise and exercise sound, economic stewardship and sustainable management of forests for commercial products and for long-term ecosystem health.

The **working group on ecological effects of forest management**, chaired by Dr Rob Allen (Landcare), evaluated the aspects of management posing the greatest ecological risks to sustainability. It was noted that information on management effects, particularly from previously modified ecosystems, was very scarce. Main effects were thought likely to be related to changes in dominant species composition and regeneration dynamics and faunal assemblages. Nutrient cycling might be altered by the removal of sizeable fractions of organic matter. The group concluded that negative impacts can be reduced by taking a precautionary approach and practising adaptive management.

The ecological effects working group recommended that formal research to develop and monitor management practices additional to that already underway by the School of Forestry be established. Indicators of ecological sustainability relevant to management practices and standard measurement methods should be promulgated now. Information transfer from formal research to monitored management operations must flow through to

policy makers, concerned professionals, and the general public.

All five of the working groups felt that prescriptive sections of the Forests Amendment Act were unduly restrictive and counter-productive to delivering sustainable management. The majority felt that apart from the prohibition on large clearfells, which should remain, management decisions for specific sites are best made by those persons responsible for the results: owners, foresters, and other advisors.

Opposition to the existing wood chip export prohibition within the FAA was vehement. Provided that forests are managed sustainably in accordance with the other parts of the FAA, no constraint should be placed on use, sale, or export of the outturn. The forest protection group noted that costs for slash reduction are high, so landowners tend to leave slash whole, potentially boosting pinhole borer populations. Access to the chip market would encourage slash removal. The silviculture group noted that timber stand improvement by the removal of defective trees is effectively precluded by the chip export ban because access to the main market for defective elements is barred. The marketing group noted that the loss of the chip market increases pressure for higher sawtimber prices and reduces the management input needed to obtain defect-free timber. The harvesting group noted that without the chip market, harvest costs per unit volume are elevated and extraction is further complicated. The ecological effects group suggested that if management effects are not significant and long-lasting, then the FAA is too constraining.

The meeting as a whole noted that forest management will improve only when the returns to management are improved, and that restoring access to the chip market is an important route to boosting returns to sustainable management. The silviculture group emphasized that it would be folly to manage beech forests for chip alone, however, and representatives of Forest and Bird and Greenpeace dissented from the otherwise unanimous support for removing the chip export ban. Their reasoning was that removing the ban would engender distrust of sustainable forestry operations among the public, who have yet to forget the wholesale chipping of beech forests.

A draft of the resolutions and recommendations arising from the workshop has now been returned to the participants for their revision and comment. Following ratification, these will be forwarded to relevant Ministers, public bodies, research providers and other organisations for action. Further followup will include

encouragement of the networking among those trading in beech, development of a short course in indigenous forest harvesting, and expanded field days for forest owners and managers.

The sense of the meeting was that management of beech forests for timber, other products, and environmental benefits and services is in the interests of the nation as a whole and should be encour-

aged on public and private lands. In her beech forests New Zealand possesses a renewable natural wealth, whose potential has yet to be realised. The workshop has provided pointers for the way forward.

# An Efficiency Evaluation of the Global Positioning System under Forest Canopies

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## ABSTRACT

*The Global Positioning System (GPS) is commonly used to provide coordinates for updating forest maps. In open situations, i.e. where the signals are not influenced by tall trees, buildings and hills, the coordinates can usually be obtained in an accurate and timely manner. When used under a forest canopy, however, the extent to which the canopy may reflect or block GPS satellite radio signals has not yet been determined.*

*The effectiveness of two models of GPS receiver in defining point locations and roads, was compared in the open and in or near areas of radiata pine, Douglas-fir and indigenous forest. These types of tree canopy were found to affect signal reception and hence the efficiency of both receivers.*

*Used in both static and roving mode, for mapping point locations and forest roads in the open, both instruments performed well. However, when used under forest canopies both receivers were less efficient, either because communication with the satellites was temporarily lost or because, in some instances, it could not be established at all over a 10 minute data collection period.*

## KEYWORDS

Forest mapping, GPS.

## INTRODUCTION

Forest maps have traditionally been derived from ground or aerial survey data. Many New Zealand forestry companies are currently investigating the role of GPS as an alternative means for updating their maps because the technique is potentially easier to use. Manufacturers of GPS equipment often recommend the technology for this application, (e.g. Trimble, 1994). Given an unobstructed view of the sky, a suitable satellite constellation (resulting in a low PDOP<sup>2</sup> value), and differentially corrected data, the positional accuracy of the points recorded should comply with receiver performance specifications. In forestry applications, however, trees and hills will often restrict the antenna's view of the sky and this may affect the operational

efficiency of the receiver and the positional accuracy of the data recorded.

Jalinier and Courteau (1993) assessed the effect of forest cover on the quality of topometric survey data obtained using a GPS. They found that surveys in the vicinity of dense hardwoods yielded questionable results but dense softwoods presented less of a problem. Lachapelle and Henriksen (1995) carried out tests of various GPS receivers while driving along avenues of deciduous and coniferous trees. Their results indicated that, contrary to expectation, receiver characteristics and signal processing techniques had more effect on accuracy than canopy characteristics. Jasumback (1995) used a GPS in a conifer stand and found that the canopy had almost no effect on the operating efficiency of the receiver. His results indicated that the horizontal error of the coordinates could increase if the canopy was wet because of an increased likelihood of multipath reflections (Jasumback, 1996). Rempel *et al.* (1995) compared the performance of GPS under spruce, pine and mixed-wood sites and showed that there was almost no relationship between measured canopy characteristics (canopy cover, spacing, basal diameter and height) and location error. However, these authors did note that as canopy closure increased, signal interference caused a decrease in observation rate. Petersen (1990) found that tree canopies could seriously affect the accuracy of GPS data and considered that the performance of an older two-channel receiver under canopy was limited.

It might be concluded from the papers cited above that, provided a suitable multichannel GPS receiver is used and the data is processed in an appropriate way, little difficulty would be experienced in using GPS under a coniferous tree canopy. However, D'Eon (1995) tested a five-channel GPS receiver in 61 conifer and deciduous stands representing a diversity of cover types, canopy heights and crown closure. On his first visit to the study site, a GPS position was obtained in only 35 of the stands. A subsequent visit a few hours later yielded data in a further 10. Positions for the remaining 16 stands were only obtained when the leaves had fallen from the deciduous trees six months later. Firth and Brownlie (1994) used a six-channel receiver for updating a forest map in the Marlborough Sounds and found a marked deterioration in accuracy of the coordinates when the instrument was used under a mature radiata pine tree canopy. In many instances, no data could be collected at all. Lawrence *et al.* (1995) had similar difficulties using a GPS to measure the

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<sup>2</sup> Position Dilution Of Precision (a number related to the probable accuracy of the coordinates derived from the GPS).