processing and wood and paper product use. Over the longer term extending through a number of rotations, fast-growing, short-rotation plantations and their wood products may be less effective as immobilisers of carbon than assumed by some policy makers.

Simon Upton's decision also poses an interesting divergence away from the policy of voluntary reductions of industrial emissions. This may lead to the removal of the control of CO_2 emissions from the Resource Management Act.

Colin O'Loughlin

Alternative species revisited: categorisation and issues for strategy and research

R.D. Burdon and J.T. Miller[1]

Abstract

For the issue of alternative species to Pinus radiata in New Zealand to be addressed satisfactorily, the various purposes that such species might serve must be properly defined. Accordingly, three main categories of plantation-forestry species are proposed, on the basis of their purposes: (1) ***Special-purpose species****, to occupy utilisation niches for which P. radiata is not well suited; these cover a spectrum ranging from very high-value timbers to fuelwood or special-purpose industrial wood such as short-fibre pulpwood; (2)* ***Extreme-site species****, which can perform satisfactorily on sites that are unsuitable for P. radiata; and (3)* ***Contingency species****, which might replace P. radiata should it encounter serious problems within its existing range. Various species of interest are reviewed briefly in relation to this categorisation, to illustrate the conceptual approach, rather than to attempt full or definitive coverage. Some species belong in more than one category, notably Douglas fir (Pseudotsuga menziesii) in all three. Disturbingly, there appear to be large areas particularly in the north of the country for which the first-choice contingency species are not clearly identified, let alone adequately researched or preparations made for their being needed. In some 'extreme-site' species appropriate provenances for such sites remain unconfirmed.*

Introduction

The issue of plantation forestry species that are alternatives to *Pinus radiata* is topical. There is now a surge of international concern over biodiversity, which, with the signing of the International Convention on Biodiversity, is placing New Zealand, as a signatory, under specific obligations. This reinforces (1) a long-standing concern over our dependence on *P. radiata*, which is so difficult to avoid when it is so much more economically attractive than other species in such a wide range of situations and (2) the emphasis on sustainability in the Resource Management Act.

In the area of public policy this concern is now being addressed through increased funding by the Foundation for Science and Technology (FRST) of research on alternative species (FRST 1993). Among the forest growers, individual companies have pursued alternative species where they perceived profitable or strategic niches for such species, although corporate perceptions have tended to fluctuate. There is, however, sufficiently broad interest to support two FRI/Industry Cooperatives concerning Douglas fir and a few eucalypt species. In addition, action groups have been formed for *Cupressus macrocarpa* and *Paulownia*.

In other respects, public policy has effectively carried through from the days of the Forest Service (c.f. Burdon 1982, Sweet and Burdon 1983). Pre-emptive diversification of species came to be rejected as an option in the light of past experience; planting 'insurance' species had incurred formidable opportunity costs yet eventually incurred worse forest health problems than were encountered with *P. radiata*. Potential vulnerability of *P. radiata* was therefore addressed in later years by a combination of measures including silvicultural practices, maintenance of genetic diversity within the species, and propagation technology that allows both breed specialisation and rapid deployment of new selections. Thus the front-line genetic defences against biological hazards in plantation forestry lie in maintaining genetic variability within *P. radiata*. Use of other species has been viewed primarily as a fall-back genetic defence.

To go right back to basics, we should consider what features are required for a species to succeed in plantation forestry:

- availability and acceptable germination behaviour of seed, unless easily propagated vegetatively;
- amenability to transplanting;
- rapid growth rate and good productivity;
- tolerance of a range of site conditions;
- satisfactory resistance to pests and diseases;
- acceptable tree form, possibly with the help of genetic improvement;
- failing one or more of the above, producing wood of special value; and
- value of wood not being dependent on trees being very old.

Given this set of requirements, *P. radiata* inevitably provides a yardstick by which any alternative species must be judged, in view of its growth rate, tree form, general amenability to cultivation, site tolerances, general health, and versatility of the wood.

Discussion of alternative species has continued sporadically over the years. However, we consider that, in order to give it proper focus, it needs to be based on an appropriate categorisation of species. We propose that a set of partly overlapping categories be recognised, based on the actual or prospective roles of species concerned. For a species to be a contender for a role in commercial plantation forestry in New Zealand it must merit a place in at least one of these categories. For information as such, we do not purport to supersede the article of Wilcox (1993).

The Categories

The categories we propose are:

1. Special-purpose species

These are species that fill wood utilisation niches for which *P. radiata* is not well suited. They represent quite a broad spectrum, ranging from very high-value furniture or veneer timbers, at one end, to specialty industrial wood (e.g. for short-fibred pulp) or fuelwood, at the other end. This broad category is already well recognised.

2. Extreme-site species

This category comprises species for forestry sites that are unsuitable to *P. radiata*, because it will not perform or at least

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will pose undue risks. Snow damage is the most prevalent and the least avoidable hazard on a large area of high-altitude sites that are potentially productive and of acceptable terrain. An historical problem has arisen in that the altitudinal zone of 600-900 m in the South Island was left for many years as a 'no-man's land' between the Rotorua and Rangiora arms of the Forest Research Institute. Also involved are low-altitude sites, mainly alongside rivers, of widely varying fertility, with high or fluctuating water tables that are unsuitable for *P. radiata* and almost all other conifers.

3. Contingency species

This comprises a group of species which, between them, might be called upon to fill the niche of *P. radiata,* should problems be encountered with *P. radiata* that are so serious as to lead to its use being discontinued in a significant portion of New Zealand's forest estate. The ideal 'contingency' species should, apart from remaining healthy, grow consistently well on a wide range of sites, be easy to establish and tend, and be suitable for a wide range of end uses with minimal problems of processing and utilisation – in short have the virtues of *P. radiata* but not the problems. No one species seems to meet all these requirements to the extent that it could be a complete replacement for *P. radiata.*

The Species Themselves

A suggested categorisation of actual species is shown in Table 1. Several points should be noted.

1. It does not purport to be definitive. Rather, it stakes out positions that can provide the focus for analysis, debate and research. The list of species, and their roles, is in some parts wide open to revision.
2. Some species belong in more than one category. In particular, Douglas fir belongs in all three main categories, reflecting its several-fold role.
3. Within the special-purpose category, some species have a dual listing, e.g. some eucalypts which are of interest as potential furniture or interior finish timbers as well as sources of short-fibre pulp.
4. The table does not attempt to be definitive, either, about the relative importance of the different main categories. In particular, the importance of extreme-site species will depend on whether growers opt to practise much plantation forestry beyond the range of *P. radiata.*
5. We have largely excluded from consideration species that primarily serve other purposes such as soil conservation, shelter, or amenity, which can be combined in varying degrees with wood production. However, we have included poplars and willows whose pre-eminent roles at present are erosion control or shelter, because of their potential significance as wood producers. Note that *P. radiata* also has a very important role in soil conservation.
6. Not included in the Table are 'sub-commercial' species, e.g. *P. strobus, Larix* spp, *Cedrus* spp, many of which perform in New Zealand very well according to the norms for their natural habitats, but which are not competitive with various alternatives for commercial forestry.

TABLE 1: Suggested roles of alternative species to *Pinus radiata.* Number of asterisks denotes approximate strength of the species as a contender for the particular role.

	Contingency	Non-radiata sites	Special-purpose: Very high value	Special-purpose: mid-value†	Special-purpose: industrial /fuelwood
Douglas fir					
Pseudotsuga menziesii	***	***	–	**	–
Eucalyptus					
Eucalyptus regnans	*	–	–	*	**
fastigata	**	–	–	*	**
nitens	**	–	–		***
saligna	–	–	–	**	–
muelleriana	–	–	–	**	–
Cypresses					
Cupressus macrocarpa	–	–	–	***	–
lusitanica	–	–	–	***	–
Other Pines					
Pinus contorta	*	***	–	–	–
muricata	**	*	–	–	–
patula	**	–	–	–	–
taeda	**	–	–	–	–
nigra	–	**	–	–	–
pseudostrobus	*	–	–	–	–
pinaster	*	–	–	–	–
attenuata (as hybrid)	–	**	–	–	–
Acacias					
Acacia melanoxylon	–	–	***	–	–
dealbata	–	–	–	*	**
Coast redwood					
Sequoia sempervirens	*	–	–	**	–
Firs					
Abies grandis	*	–	–	–	–
religiosa	*	–	–	–	–
Black Walnut					
Juglans nigra	–	–	***	–	–
***Paulownia* spp.**					
Paulownia tomentosa	–	–	**	–	–
Robinia					
Robinia pseudoacacia	–	–	–	*	–
Poplars					
Poplars spp.	–	**	–	*	–
Willows					
Salix spp.	–	**	–	–	**

† Alignment of asterisks indicates approximate gradations within the 'mid-value' range.

Notes on Individual Species or Genera

The following notes are intended to illustrate further the application of our categorisation, and outline the position for the various taxa listed in Table 1.

Douglas fir *(Pseudotsuga menziesii):* Its presence in all categories squares well with its status as our No. 2 plantation species. Its special-purpose status stems mainly from the inherent stiffness of the timber and its potentially fine branching, which commend it to structural uses. Its resistance to snow damage would make it the first choice of the extreme-site species in significant areas in eastern South Island which are potentially very productive on account of rainfall, sunshine and soil depth. As a contingency species, it must be a leading contender for many sites, particularly in areas where it already merits consideration.

Douglas fir, however, has significant limitations in its site tolerances compared with *P. radiata*. It is very vulnerable to late spring frosts, and to salt winds, while very little success has been reported north of the volcanic plateau. It can be very expensive to establish where weed growth is heavy, and it has at times been severely attacked by *Phaecryptopus* needle cast and larvae of geometrid moths.

Eucalypts (with no attempt at exhaustive treatment):

(i) Ash group – notably *Eucalyptus regnans, E. fastigata* and *E. delegatensis*. Of these, only the first two are of much commercial interest at present. All are currently of prime interest for pulpwood. *E. regnans* and *E. fastigata*, however, are still of some interest as sources of quality sawn timber with good surface hardness, although with eucalypts generally, recoveries of such material tend to be low.

(ii) Gums – *E. nitens* is of major interest for pulpwood and possibly fuelwood as well, being less site-sensitive than most other eucalypts, but it has so far shown disappointingly for sawn timber in New Zealand. *E. saligna* is of more interest for producing sawn timber, on warm sites, despite sawing difficulties.

(iii) Naturally durable eucalypts – including *E. muelleriana* and *E. pilularis*, although they may be of much more interest for farm woodlots.

E. fastigata, E. nitens and *E. regnans* rate as potential contingency species, although *E. regnans* is more site-sensitive.

Eucalypts are the only species that can challenge *P. radiata* for growth rates and productivity on ordinary plantation forestry sites. Nevertheless, they do not challenge the current pre-eminence of *P. radiata*, and even the most promising ones must be viewed with some caution as contingency species. Although they can do well on certain soils of quite low soil fertility, they are often very site-sensitive, and they require higher standards of site preparation than are practicable in many situations. Moreover, New Zealand proximity to Australia leads to an ever-present risk of new pests arriving, out of the biotic context whereby natural control mechanisms operate on their populations.

Cypresses (primarily *Cupressus macrocarpa* and *C. lusitanica*):

Both these species are of interest in plantation forestry for producing stable, high-quality joinery and finishing timbers. Like most producers of quality timbers, they tend to be more site-sensitive than *P. radiata*. Other cypresses (*Cupressus* and *Chamaecyparis*) are reviewed by Miller (NZ Forest Research Institute Bull. No. 124/9).

Pinus muricata (Bishops pine): As a contingency species, its status is problematic. It is very close to *P. radiata* in its silviculture and utilisation characteristics, and the provenances of interest show much better resistance than *P. radiata* to *Dothistroma* (after the first year or so) and *Cyclaneusma* needlecasts and to the feared western gall rust (*Endocronartium harknessii*), which has not yet reached New Zealand. Its taxonomic and geographic closeness to *P. radiata*, however, makes it likely to be susceptible to many of the same diseases and pests. Provenance choice is paramount, but even in quite recent years bad mistakes have been made in seed collection. Despite early hopes, no clear niche as an extreme-site species has emerged, since it has proved susceptible to snow damage and out-of-season frosts. Nevertheless, the northernmost Californian provenance (Humboldt County), or its interprovenance hybrids, may yet have a high-altitude niche, and the species' resistance to *Dothistroma* and tolerance of certain poor soils may give it a role.

P. taeda (Loblolly pine): This species can grow very well, and be far more productive (Jackson, 1955) than in its native habitat on a range of warmer sites in New Zealand. It clearly has a very different spectrum of resistance to diseases and pests, compared with *P. radiata*. Wood properties and tree form tend to be disappointing, although overseas supplies of improved seed may alleviate the tree-form problem.

P. contorta (Lodgepole pine): This species is clearly suited to large areas that are too high and cold for *P. radiata*, but its strong tendency to invade surrounding land has branded it as an environmental hazard. As a contingency species it has the advantage of not being very closely related to *P. radiata*, and it must be a leading contender where out-of-season frosts are a significant hazard.

Mexican pines: The most likely contenders are *P. patula* and *P. pseudostrobus*, strictly as contingency species. Their summer rainfall origins would give them markedly different spectra of disease resistances, e.g. to *Dothistroma* needle cast. *P. patula* is better proven as a plantation species, although *P. pseudostrobus* is more attractive in some respects.

Abies grandis **(left) and** ***A. religiosa*** **(right) aged 27 years, NZFRI Headquarters. These are two fir species of differing site requirements, but whose growth rates place both in contention as contingency species. (Photo: J. Barran)**

Wood properties in New Zealand seem unexciting.

P. pinaster (Maritime pine): This species is very site tolerant, it clearly has a very different spectrum of resistance to diseases and pests, and has good basic wood properties, while improved strains should have satisfactory tree form. Its productivity, however, is decidedly modest.

Corsican pine (*P. nigra* var. *laricio*): A reliable performer in the drier parts of the semi-continental central South Island where *Dothistroma* is not a problem, which can give quite valuable produce despite the small log sizes obtainable within any reasonably short rotation.

P. attenuata (knobcone pine): This species is of interest, not in its own right, but for its ability to hybridise with *P. radiata.* Using an appropriate provenance of *P. attenuata* (presumably from the north-east of its natural range) the species hybrid (*P. x attenuradiata*) should improve substantially on the tolerance of *P. radiata* to cold and snow damage while retaining a good growth rate and tree form. As a bonus, the potential to invade surrounding land should be minimal, which could be important on sites for which it might be considered. In hindsight, most of the past testing effort was misdirected, largely because it was undertaken on North Island sites where *Dothistroma* blight was eventually catastrophic.

***Abies* spp:** Two true firs that seem worth considering are *A. grandis* and *A. religiosa. A. grandis* can certainly be formidably productive. *A. religiosa* shows a comparable or faster growth rate, although it would be confined to warmer North Island sites. While they would both be utility softwoods, their wood has significant limitations, notably in preservative treatment, and their establishment and silviculture would doubtless require considerable research and development.

Sequoia sempervirens (coast redwood): The disease resistance is excellent and insect attack is minimal, the species can be highly productive, and its wood can be valuable, while it can regenerate very satisfactorily from coppice shoots. On the other hand, it requires very careful establishment in the first rotation, or else it is extremely site-sensitive, and the logs have very modest value unless the trees are large and old, even though it has a quite narrow band of sapwood. While it may tolerate extremely moist climates, such conditions will be conducive to very troublesome weed growth. The closely related *Sequoiadendron giganteum* (Sierra redwood or Wellingtonia), while it has performed well in New Zealand as a specimen tree or in shelterbelts, even in quite harsh climates, is quite unproven as a plantation species.

Mature 62-year-old stand of *Pinus muricata* ("blue strain" from Mendocino Co, California), Kaingaroa Forest. This provenance is easily mistaken for the closely related *P. radiata,* which it seldom quite matches in performance. It does have some features that commend it to contingency-species status, but no extreme-site niche has yet been established. (Photo: H. Hemming)

Juglans nigra (black walnut): It belongs at the top end of the scale for wood value. However, modest productivity, susceptibility to wind and animal damage, and extreme site-sensitivity virtually relegate it to farm woodlots or even small group plantings.

***Paulownia* spp:** The situation closely parallels that for *J. nigra,* except that it is still more speculative for New Zealand conditions.

***Acacia* spp:** Tasmanian blackwood (*A. melanoxylon*) is an exception to the rule that top-value species are highly site-sensitive. Its modest growth rate would be acceptable in this light, but tree form is a real problem, evidently due to attack by psyllids and possibly leaf miners. Chile, where this tree-form problem often does not appear to exist, should have a major advantage as a grower, if they choose to exploit it. Silver wattle *(A. dealbata)* is much faster growing, and is relatively site tolerant, which would commend it to use for fuelwood or even pulpwood. Also it can have relatively good form, while it is known to have shown up very well as a sawn timber.

Robinia pseudoacacia (black locust): It potentially has a specialty niche for its timber, but would probably be in farm woodlots as a multi-purpose species. Some clones of superior tree form have been imported in recent years.

Poplars (*Populus* spp): As 'extreme-site' species poplars have the advantage of being able to tolerate high but well-aerated water tables. Thus, in addition to their role for controlling hillside erosion, they could be grown in significant areas (including some very fertile soils) alongside rivers to combine timber production with erosion control. Their wood, while of only moderate value, has some special-purpose features, and can be produced very quickly in straight, good-sized logs.

Willows *(Salix* spp): Willows can tolerate even wetter conditions than poplars, and much poorer root aeration, so the potential land area for combining wood production with river control is considerable. However, their wood holds promise mainly for 'industrial' uses or biomass fuel.

Some issues for Research and Strategy

Special-purpose species

This category is currently the subject of ongoing research in several Research Programmes at New Zealand Forest Research Institute. However, the development of a satisfactory wood-hardening process, to which *P. radiata* is eminently amenable, may require some rethinking of the list, particularly the non-durable eucalypts. Such revision, however, may entail writing off past effort on uncompleted research. An official short list of special-purpose species was promulgated by the NZ Forest Service (1983). Although this list has effectively been evolving, it has never been formally revised. Having already placed this category in the broader perspective, we do not propose to comment further, except insofar as some of the species also belong in other categories.

Extreme-site species

With some of the extreme-site species there remain unanswered questions as to what are appropriate provenances. With Douglas fir, for instance, we know what provenances to grow on the milder sites, where the species might be grown for its special-purpose values, but it is still uncertain what provenances are appropriate for the high-altitude, snow-hazard sites. Much the same applies for *P. ponderosa* (not listed earlier) which, if used at all in the future just for producing wood, might be largely on sites of much higher altitudes than those where provenance testing has been done. With *P. contorta*, however, there seems little doubt that good coastal provenances are suitable for any likely upper altitudinal limit for commercial forestry.

As indicated earlier, *P. muricata* is problematic. Its fastest-growing provenance is from Sonoma County, California, but the best for extreme sites may even be that from Humboldt county, or hybrids thereof.

Suggested priorities therefore include:

- fresh provenance testing of Douglas fir on high-altitude sites;
- evaluation of existing provenance trials, and other high-altitude plantings, of *P. muricata;*
- further and more broadly-based trials in Central South Island of *P. x attenu-radiata.*

Contingency species

This group requires special consideration, partly because of its status in our defences against potential biological problems, and partly because it is an area with some outstanding gaps in our knowledge and

Stand of *P. contorta*, 24 years old, at 900 m altitude, Craigieburn Forest, planted on bare subsoil. This species can perform very respectably by world standards, and is much at home on many high-altitude sites beyond the present range of commercial forestry in New Zealand. It is definitely a contingency species for certain 'frost-flat' sites where *P. radiata* is currently grown. (Photo: N. Ledgard)

preparations. As mentioned earlier, the contingency species represent a fall-back genetic defence against a build-up of biological problems, which could range from severe epidemics of fungal pathogens or insect pests to unacceptable climatic damage, and which might eventually make *P. radiata* uneconomic to grow.

For some forest owners, the fall-back position might be to quit plantation forestry, either converting to an alternative land use or, say, abandoning a lease. Standing against such extreme steps, however, are several considerations:

1. Some growers are already growing significant areas of alternative species, notably Douglas fir, on sites where *P. radiata* could be grown. This implies that they would not see a reinforced shift from *P. radiata* as necessarily crippling the economics of their operations.
2. The Resource Management Act, with its emphasis on sustainability, would put pressure on forest owners to make provision for unpleasant contingencies, and be seen to do so.
3. The provisions of the International Convention on Biodiversity, to which New Zealand is a signatory, are also relevant, in enjoining nations to maintain biodiversity both in its own right and as an underpinning of sustainability.

The list of potential contingency species is quite long, partly because no one species would be the preferred replacement for *P. radiata* over anything like the full range of sites where it is now used. A disturbing gap in our knowledge concerns which species would be the frontrunners on which site categories, even though we may have a very clear picture of what are the preferred provenances of the species concerned if they are to be used within the present range of *P. radiata.* There are some situations where the replacement of choice seems clear-cut, e.g. *P. contorta* for the worst frost flats of Kaingaroa, or Douglas fir where snow damage is an appreciable if still acceptable risk for *P. radiata,* but they are the exception. Indeed, there are very large areas in the North Island and warmer parts of the South Island where the choice is much less straightforward. There are many sites within this zone where the choices between Douglas fir, *P. muricata, P. taeda* and *P. patula* (or even *P. pseudostrobus*) would be far from clear-cut on present knowledge. A complication is, of course, that the preferred contingency species could depend very much on what problem might affect *P. radiata,* since any species that was similarly affected would be counted out. Moreover, some contingency species may come to be ruled out through developing serious problems of their own.

An attempt to have a contingency species issue placed on the research agenda was rebuffed by forest grower representatives in 1980. Since then the main research effort on alternative species has effectively been directed at special-purpose species. Some problems of climatic damage to *P. radiata,* mainly snow damage in South Otago, have tended to be addressed either by recourse to Douglas fir or by no recent afforestation of such sites. In the present climate of legislation and the attentions of organisations like the Greenpeace movement, and while the forestry sector is financially buoyant, it seems appropriate to reopen the issue of contingency species. If contingency species are not to be researched as such, then such a decision should be seen to have been based on due consideration of the underlying issues.

Addressing contingency species will be a complex task. Available information on the performance of various candidates will need to be researched and evaluated, to see which candidates can be eliminated, and to identify as far as possible which species are in contention for what site categories. Such an exercise will also identify needs for experimental work, which will include researching appropriate establishment practice in some cases, and field tests, of which at least some will need to reflect performances as actual plantations. This will require follow-through studies of silvicultural requirements. For species that are in contention appropriate seed supplies will need to be located or actually provided. In the longer term utilisation properties would need to be researched, although it is likely that lead time would be adequate between the onset of extensive planting and significant utilisation. This agenda may appear daunting. It must be realised, however, that much of it can only be addressed well in advance, and not at short notice when a need is already upon us.

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References

Burdon, R.D. 1982: Monocultures – How vulnerable? NZ Forest Service, Forest Research Institute. What's New in Forest Research? No. 115.

FRST 1993: Research Strategy for the Public Good Science Fund 1993/94 to 1997/98. Plantation Forestry, Wood and Paper Processing. Foundation for Research, Science and Technology, Wellington.

Jackson, D.S. 1955: The *Pinus radiata/Sirex noctilio* relationship at Rotoehu Forest. NZ J. For. 7(2): 26-41.

New Zealand Forest Service 1981: Policy on exotic special purpose species. Govt Printer, Wellington.

Sweet, G.B., R.D. Burdon. 1983: The radiata pine monoculture: an examination of the ideologies. NZJ. For. 28:325-6.

Wilcox, M.D. 1993: Priorities for research on alternative tree species for wood production in New Zealand. NZ Forestry 38(3): 9-12.

General References

Miller, J.T. (Ed). Introduced Forest Trees in New Zealand: Recognition, role and seed source. NZ Forest Research Institute, Bulletin No. 124 series: 1 – *Pinus nigra*; 2 – *Pinus contorta*; 3 – The larches; 4 – *Pinus mugo*; 5 – *Pinus attenuata*; 6 – The spruces; 7 – The silver firs; 8 – *Pinus pinaster*; 9 – The cypresses; 10 – Ponderosa and Jeffrey pines; 11 – *Eucalyptus nitens*; 12 – Radiata pine; 13 – The redwoods; 14 – Douglas fir; (continuing).

Weston, G.C. 1967: Exotic trees in New Zealand. NZ Forest Service, Forest Research Institute Bull. No. 13.

What is the Montreal process?

Don Wijewardana
Ministry of Forestry

There have been three major directions in which international action towards sustainable management of forests has developed since the Earth Summit of 1992. These are activities under the UN umbrella itself – for example, the setting up of the Intergovernmental Panel on Forests (IPF) under the aegis of the Commission on Sustainable Development (CSD) – initiatives at international and regional levels (such as the Helsinki and Montreal Processes), and measures by the NGOs and industry to develop timber certification schemes (Forestry Stewardship Council, ISO standards etc).

New Zealand has been working on all three fronts to ensure cohesion between international initiatives and our own approaches to sustainable management. In this context we want to look closely at the Montreal Process.

The Montreal Process is a non-binding agreement between ten non-European temperate countries on a set of criteria and indicators of conservation and sustainable management of their forests. The ten countries are Australia, Canada, Chile, China, Japan, Mexico, New Zealand, the Republic of Korea, the Russian Federation and the United States of America. The criteria agreed, following two years of negotiation, are intended to address how countries protect the major values derived from forests. There were seven major areas identified. These were:

- conservation of biological diversity
- maintenance of productive capacity of forests
- maintenance of forest ecosystem health and vitality
- conservation and maintenance of soil and water resources
- maintenance of forest contribution to global carbon cycles
- maintenance of long-term multiple socio-economic benefits, and
- appropriate institutional framework.

A wide range of indicators was also developed as the measurement relating to each of the criteria. For instance, the indicators of conservation and maintenance of soil and water resources criterion include information on area of forest land with significant soil erosion, area of forest land managed primarily for protective functions, and area of forest land with significantly diminished soil organic matter. Such indicators, measured over time, will provide a view of how a country is progressing towards improving performance in each of the areas.

Each criterion has a number of similar indicators or measurements, but a single criterion, taken **in isolation**, cannot form a measure of sustainability: **taken together,** they can form a definition of sustainability and be used as a measure of whether a country is managing its forests in a sustainable manner.

There are other important points worth noting. The Montreal Process criteria and indicators are aimed at the national level. As such, they cannot be used to determine whether a particular log is derived from a sustainably managed forest. But under the criteria a statement such as "this wood is produced in New Zealand which manages its forests in a sustainable manner" is perfectly feasible. If we need a label to identify a particular piece of timber then we have to rely on a timber certification scheme. The industry is currently working towards that.

The essential point is that the initiatives such as the Montreal Process and industry/NGO pioneered certification schemes are at different points in the same spectrum of sustainable management. They complement each other and they have an important role in ensuring our wood is sustainably managed.

The next meeting of the Montreal Process will be held in New Zealand from October 30 to November 4, 1995. The main purpose of the meeting is to use individual country experiences to assess the feasibility of the indicators for general application.

If you need further information please contact Don Wijewardana, Ministry of Forestry, P.O. Box 1610, Wellington; phone 04 4721 569 or fax 04 4722 314.

A useful bulletin outlining the Montreal Process and each of the criteria and indicators in detail has been produced by The Canadian Forest service. Their address is 351 St Joseph Boulevard, Hull, Quebec, Canada K1A 1G5. Ed.