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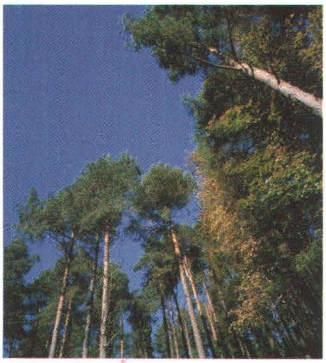

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IRISH FORESTRY

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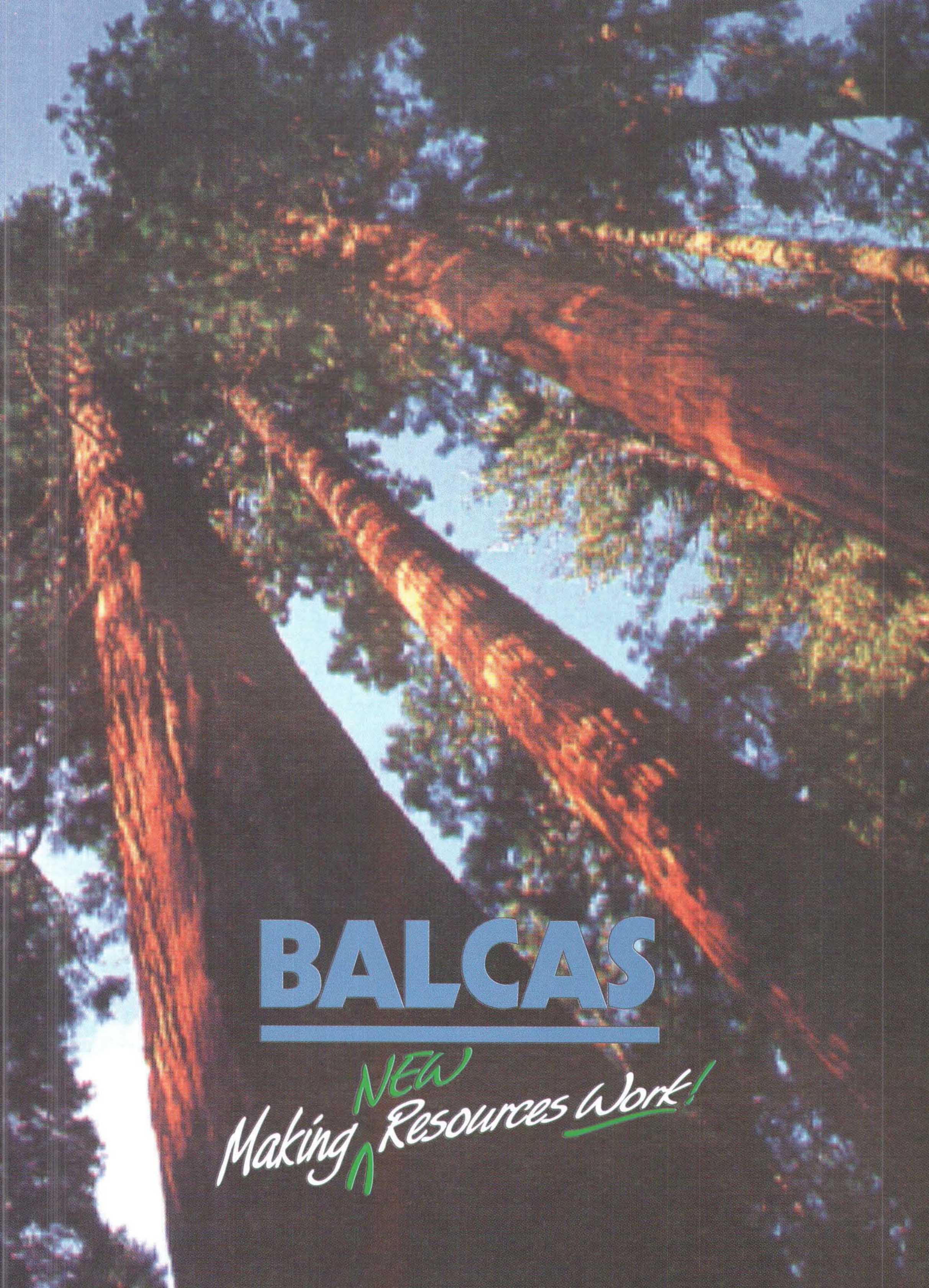
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The main activities of the Society include the organisation of symposia, field meetings and study tours on forestry topics, and the publication of *Irish Forestry*, the Society's journal, and *The Irish Forester*, its quarterly newsletter. The Society also organises forestry shows and exhibitions, and has published *The Forests of Ireland* and *Forest Images – Father Browne's Woodland Photographs*.

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Authors should use the following guidelines when submitting material for publication in *Irish Forestry*:

1. Only original material, unpublished elsewhere, will be considered for publication in *Irish Forestry*. Authors must indicate if the material has been submitted for publication elsewhere in the past.
2. Two complete hard copies of the paper, double spaced with numbered lines should be submitted to the Editor, *Irish Forestry*, together with an electronic version, in Microsoft Word. Electronic submission is also acceptable to sif@eircom.net.
3. Correct spelling, grammar and punctuation are expected. Nomenclature, symbols and abbreviations should follow established conventions, with the metric system used throughout. Dimensions should follow units with one full space between them, for example, 10 kg.
4. Subject to editorial decision submitted papers will be peer reviewed. Papers must include an abstract (maximum 250 words) and a list of up to six key words before the main body of text. Authors are advised to keep papers as concise as possible and no more than 25 pages long (double-spaced, including tables and figures).
5. Where Figures are embedded in an article the originals should always be included, along with information regarding software used to create them. Figures should preferably be saved as graphic files (.eps, .wmf where possible). Avoid .tif, .bmp files and Word picture format. Word Excel formats, embedded in documents, are acceptable for Figures. However, an original hard copy of the Figure must also be submitted.
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7. Tables should be created using tabs, not with Microsoft Word Table Editor.
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   Lavender, D.P. 1984. Plant physiology and the nursery environment: interactions affecting seedling growth. In *Forest nursery manual: production of bareroot seedlings*. Eds. Duryea, M.L. and Landis, T.D., Martinus Nijhoff/Dr W Junk Publ., The Hague/Boston/Lancaster, pp 133-141.
9. Journal titles may be abbreviated in conformity with Biological Abstracts.
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The above guidelines are designed to facilitate the speedy processing of material submitted for publication in *Irish Forestry*. Inadequate adherence to these guidelines may result in material being returned to the author for redrafting.

EDITORIAL

Lodgepole pine – time to think again?

Almost twenty years ago a task force was set up by Eolas (now Enterprise Ireland) to examine the end-use potential of lodgepole pine. This was against the background of considerable planting of the species from the 1950s right through to the early 80s, when it rivalled Sitka spruce as the main exotic conifer used in Irish forestry. After much research and testing, the task force reported and concluded that lodgepole pine could be successfully used in the manufacture of joinery, and more than matched imported red deal (Scots pine) in several important properties, including gluing and screw holding. While some sawmills showed interest in developing added-vale products this failed to develop any significant scale.

Why then has the species failed to live up to its potential? First and foremost it is a question of poor stem form, resulting from a combination of provenance choice, site and incorrect soil preparation. These factors also predispose crops to lean and windthrow, and add to harvesting and conversion costs. But of all the factors that have disfavoured the continued planting of lodgepole pine, incorrect provenance choice is the one that stands out. The abysmal performance of Lulu Island and inland provenances is well known. They were followed by their geographic cousins from the south coast of Washington and northern Oregon. These gave good growth rates, considering the inhospitable sites crops were established on, but they had poor stem form, with a great deal of basal sweep.

Times have moved on since the heydays of lodgepole pine. Today farmer planting predominates, with the result that better sites, more suited to Sitka spruce and broadleaves, are being planted. Certainly lodgepole pine will not do well on wet gley sites, the home of Sitka spruce. Marginal lands of low fertility continue to be planted however, and Coillte has a considerable reforestation programme on blanket peat and old red sandstone sites. On many of these sites fertiliser application is needed for crop establishment and growth, particularly when demanding species are used.

Yes, it is time to think again about lodgepole pine. An increase in planting is justified using improved hybrids that combine vigour and stem form, and in pure plantations, not just in mixture with Sitka spruce. Seed of the hybrids is now available in sufficient quantities to support a planting programme. Sites where lodgepole pine is the best choice are still coming-on-stream. Its timber is suitable for a range of value-added end-uses, such as panelling and flooring - the conclusions of the task force are still true and valid today – and most importantly the end-use profile of lodgepole pine complements that of Sitka spruce. There is potential to increase such uses over time, particularly if straight-grained, knot-free (pruned) timber from the new hybrids comes on–stream.

It is time to dust off the old reports and listen to our geneticists. We should learn from the mistakes of the past, but not to throw the improved provenances and hybrids out with the south coastal bathwater. Lodgepole pine has a clear role in the future of Irish forestry.

Submissions to *Irish Forestry* are welcomed and will be considered for publication.
The attention of contributors is drawn to *Guidelines for Authors*.

Submissions to be addressed to:

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What is the best lodgepole pine seed origin for Ireland? Results of 30 years of provenance research

David Thompson[1], Michael Lally[2] and Alistair Pfeifer[3]

Abstract

Because of its large natural range, lodgepole pine (*Pinus contorta*) provides a wide range of provenances for use on a range of sites. Unfortunately no one provenance of lodgepole pine combines good stemwood production with acceptable stem form. For this reason compromises must be accepted. South Coastal types provide rapid volume production with poor stem form, while North Coastal types provide good stem form with reduced volume production. Natural hybrids between coastal and interior provenances from the lower Skeena River in British Columbia and artificial interprovenance hybrids between South Coastal and Skeena River sources combine good stem form with acceptable wood production rates. Both are available in commercial quantities either from registered seed stands (lower Skeena River material) or seed orchards (interprovenance hybrids). Provenance recommendations for specific site types and end uses are provided.

Keywords: Lodgepole pine, *Pinus contorta*, provenance, interprovenance hybrids.

Introduction

Lodgepole pine (*Pinus contorta*) is an important species in Irish forestry. It currently occupies about 70,000 ha, about 21%, of the Coillte (Irish Forestry Board) estate. However, its planting has decreased dramatically over the past decades, from over 40% of the total planting programme in the 1950s to just 3% by the late 1990s. Nevertheless, it will continue to be an important species, because on some sites it remains the best species option.

Following its introduction to Ireland (see below), and from its performance in plantations and trials it was found that the South Coastal group of provenances (from the coast of southern Washington and northern Oregon) grew more vigorously in trials than the better formed, but slower growing, North Coastal origins (from British Columbia and Puget Sound). Consequently the South Coastal group became the preferred selection.

However, as experience was gained and crops reached merchantable size it quickly became apparent that while South Coastal types were highly productive, its lack of stem straightness considerably reduced the volume of higher value assortments that could be obtained. Unfortunately there is a strong genetic negative correlation in lodgepole pine between growth rate and poor stem form. No one provenance combines a good growth rate with an acceptable stem form, so compromises need to be made. For this reason it is opportune to consider the origins of the lodgepole pine we grow in this country.

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The purpose of this review is to summarise seed origin research carried out with lodgepole pine over the last 30 years in Ireland and to make recommendations on the best origins for current use.

Natural distribution and site requirements

Lodgepole pine is one of about 100 species of pines worldwide, and one of 19 found in North America.

It has the largest natural distribution range of all North American pines (Figure 1) extending in latitude from south-eastern Alaska (64^0 N), along the Pacific coast, through British Columbia, Washington and Oregon and south as far as Baja California in Mexico (31^0 N). From the Pacific coast it extends eastwards as far as South Dakota. The full range covers approximately 26 million ha. Its elevation range extends from sea level to 3,900 m.

Figure 1. *Lodgepole pine seed origins referred to in the text.*

Rainfall ranges from 280 to 4,100 mm $year^{-1}$ over its distribution. In response to these distributional and site influences lodgepole pine has developed local varieties adapted to a wide range of climatic conditions.

Lodgepole pine is a pioneer species which has relatively undemanding soil requirements, provided there is an adequate supply of phosphorus in the soil. It grows on a wide range of soil and site types including deep acid peats, upland heaths and hard boulder tills.

Historical background, introduction to Ireland and performance

Lodgepole pine was first reported by the Lewis and Clark expedition to the northwestern US in 1805 but was not scientifically described until 1825 by David Douglas. It was introduced to Britain about 1855 and was first planted in Ireland about 1884 at Ashford Castle, Cong, Co Mayo (Fitzpatrick 1966). Following the establishment of a state forestry programme in 1904 it was planted mainly to provide shelter for other species, or as a pioneer on the poorest sites, in the expectation that it would improve conditions for more demanding species in the second rotation.

The first large-scale planting took place at Ballyhoura Forest in Co Cork from 1918. Because the species showed the potential to produce pulpwood and perhaps commercial timber its role changed over time from a pioneer species to a commercial species in its own right. Mooney (1957) expressed the optimism of the time when he wrote "...if home grown *Pinus contorta* can be proved a tree of average utility value both as a timber and a pulpwood – and that can be put to the test in the immediate future- then the Irish forester can do something really big for the economy of this country, because these ground types which so far over the centuries have proved hard and unrelenting to men and agriculture will be theirs for the taking."

As a result of the cultivation practices (open furrow ploughing) and the seed sources used in the 1950s, problems with basal sweep and instability arose and became apparent from the late 1960s. Because no satisfactory silvicultural solution was found to these problems, serious doubts about the ability of the species to produce sawn timber were raised. Its use began to decline dramatically from the early to mid 1980s However today with increasing demands on timber production, especially on nutrient poor, exposed sites and the fact that lodgepole pine can serve as a nutritional nurse species on sites where supplemental fertilisation is no longer possible, the species may experience a revival in Irish forestry.

Seed origin, provenance trials and tree breeding

Provenance variation is apparent to greater degree in lodgepole pine than in any other commonly planted coniferous species in Ireland. Variation occurs not only in appearance, but also in growth rate and habit, stem form, ability to withstand exposure, fertility requirements, ability to suppress competing vegetation and cone characteristics (Lines 1996). Differences between coastal and interior origins are the most obvious

As early as 1916, A.C. Forbes, Director of Forestry, established the first provenance trial in Ireland at Avondale which compared coastal and interior sources. After ten growing seasons coastal provenances were 50% taller than interior sources (O'Driscoll 1980). In 1957 a survey of plantations of lodgepole pine concluded that Washington coastal origins were the most suited to Irish conditions. From the 1960s the poor performance of inland and Lulu island provenances was clear to all with the result that the fast growing South Coastal type was increasingly used, and by the early 1970s almost to the exclusion of all others.

Coastal lodgepole pine can be divided into South Coastal (SC) and North Coastal (NC) types (see definitions in the Introduction). South coastal types devote most of their resources to above ground biomass (stemwood, branches and needles) at the expense of root development (Table 1). Trees typically develop a large canopy (sail-area) on a poorly anchored stem. The stem becomes bent at the base (basal sweep) which contributes to later instability. Site factors such as soil type and moisture content, exposure and cultivation method are also important.

The faster growth of SC types adversely affects stem form (Table 1). On the other hand NC types devote more resources to below ground biomass (roots) which leads to good stability, but at the expense of stemwood production (Table 1). This results in a productivity reduction of at least one yield class (2 $m^3 ha^{-1} year^{-1}$).

Table 1. *Average growth rate, branching habit, root/shoot ratio and stability of SC and NC lodgepole pine types.*

Type	*Average growth rate*[1]	*Branch length*[2]	*Branch diameter*[2]	*Root/shoot ratio*[3]	*Damage by wind*[3]
	$m^3 ha^{-1} yr^{-1}$	*cm*	*mm*		*%*
SC	11	127	20.6	0.38	26
NC	9	87	16.6	0.66	8

1. Coillte inventory data, assessed as yield class
2. Pfeifer (1993)
3. Lines (1980)

As discussed above, it was apparent from a very early stage that coastal provenances of lodgepole pine grew best under Irish conditions. In spite of this realisation there was a lack of appreciation of the precise importance of provenance which resulted in the importation of some seed origins in the 1950s that led to very poor crops. In order to address this situation the first formal lodgepole pine provenance trial was established in 1962. This compared ten provenances and was followed by trials in 1966 and 1967 comprising 14 and 16 provenances, respectively. These trials did not, however, include a full range of sources. It was only in the early 1970s, following a comprehensive lodgepole pine seed collection covering the western part of the species range, made under the auspices of the International Union of Forrest Research Organisations (IUFRO), that a thorough investigation of the influence of provenance began. Of 143 provenances collected, 58 were considered the most promising for Ireland. These were used to establish a series of provenance trials, planted in 1972, at widely separated locations in Ireland.

As well as addressing the form of lodgepole pine from the provenance perspective work also began in the 1960s on plus tree selection and tree improvement. One of the first steps was the selection and testing of plus trees from superior Irish stands. Four seed orchards were established, comprising mainly South Coastal selections. It is ironic that, despite lodgepole pine having the most advanced tree improvement of any species in Ireland, very little of this material is used today.

In the early 1970s a programme was begun to develop a hybrid to combine the vigorous growth of the SC material with the good stem form of the NC sources. Interprovenance hybrids were produced and several trials were established around Ireland.

Results

Provenance trials

The results from a selection of provenances in the IUFRO trials grown at three locations are presented in Table 2. Petersburg, Mayer Lake and Garibaldi are typical NC origins with relatively slow growth rates and poor volume production but with good stem form. Long Beach and Newport are typical SC origins with good growth rate and high volume production but with poor stem form. As one moves from northern to southern origins growth increases but stem form deteriorates. Material from Sooke, Port Orchard and John's Prairie appears to be the best compromise between growth rate and stem form.

Table 2. *Growth and stem form (1= poor to 4= good) of a selection of lodgepole pine provenances after 25 growing seasons, averaged over three IUFRO trial locations (Lough Ennel 03/72, Co Westmeath, Crossmolina 01/72, Co Mayo and Kilworth 05/72, Co Cork).*

Provenance and location	*DBH*	*Top height*	*Basal area*	*Commercial wood volume (7 cm top diameter)*	*Yield class*	*Form*
	cm	*m*	$m^2\ ha^{-1}$	$m^3\ ha^{-1}$	$m^3\ ha^{-1}\ yr^{-1}$	
Petersburg (A)	13.8	10.5	35.07	151	8	3.3
Old Telkwa (BC)	13.3	11.0	28.27	129	10	3.0
Mayer Lake (QCI)	16.1	11.5	40.83	200	10	3.2
Campbell R. (BC)	14.0	11.0	32.24	149	10	3.3
Garibaldi (BC)	16.4	12.0	41.77	215	10	3.0
Tofino (VI)	15.7	12.0	38.64	192	10	3.2
Sooke (VI)	17.4	12.0	46.33	240	10	3.1
Port Orchard (W)	18.2	12.0	49,56	258	10	3.0
John's Prairie (W)	17.5	12.5	45,27	243	10	2.9
Vail (W)	17.6	12.0	50.45	261	10	2.9
Long Beach (W)	19.7	13.5	51.65	309	12	2.5
Newport (O)	19.9	13.5	54.97	305	12	2.5

Locations: (A) Alaska, (BC) British Columbia, (QCI) Queen Charlotte Islands, (VI) Vancouver Island, (W) Washington and (O) Oregon.

The financial value of the standing crop in the different provenances was estimated for the Lough Ennell trial (Table 3). Although none of the provenances contained saw-log-sized material, the results show the effect of provenance on standing value even at an early age. In spite of greater volume production (Long Beach and Newport origins) the increase in pulpwood is at the expense of more valuable pallet wood. Thus the provenances that produced the greatest volume did not produce the most valuable crops. Similar to the results from the three sites combined (Table 2) the standing value suggests that provenances from the Puget Sound area of northern Washington (John's Prairie and Port Orchard) and southern Vancouver Island (Sooke) are a compromise between volume production and stem form.

Table 3. *Value of the standing crop after 25 growing season of a selection of lodgepole pine provenances at Lough Ennell 03/72, Co Westmeath.*

Provenance and location[1]	*Commercial wood volume (7 cm top diameter)* $m^3\ ha^{-1}$	Pallet $m^3\ ha^{-1}$	*Stake* $m^3\ ha^{-1}$	*Pulp* $m^3\ ha^{-1}$	*Value*[2] € ha^{-1}
John's Prairie (W)	308	135	41	132	3064
Port Orchard (W)	307	113	50	144	2830
Sooke (VI)	281	126	20	135	2617
Long Beach (W)	364	123	–	241	2339
Mayer Lake (QCI)	225	69	70	86	2303
Newport (O)	350	119	-	231	2261
Vail (W)	309	74	35	200	1953
Garibaldi (BC)	281	59	50	172	1888
Tofino (VI)	198	40	83	75	1859
Campbell River (BC)	161	8	96	57	1580
Old Telkwa (BC)	152	18	25	109	754

1. Locations as in Table 1.
2. Prices for top diameter assortments: pallet €17.78 m^{-3}, stake €14.60 $m^{-3}$and pulp €0.63 m^{-3} (prices date from 1996 and have not been adjusted for inflation). Typical top diameters of the three assortments are: pallet 14-19, stake 11-13 and pulp 7-10 cm.

Unfortunately most of the stands that provided material for the IUFRO trials no longer exist in the wild and commercial quantities of seed from sources such as John's Prairie, Port Orchard and Sooke are not available. Therefore, alternative sources of seed need to be found.

Natural hybrids

Although no one provenance combines good volume production with good stem form and while the Puget Sound origins appear to provide a compromise, seed is simply not available. Some NC origins from the Skeena and Fraser River Valleys of British Columbia do combine the good stem form of interior sources with the good volume production of coastal sources, as result of natural hybridisation (Lines 1996).

Work by the Forestry Commission in Scotland has identified several sources of NC lodgepole pine (from the lower Skeena River valley in British Columbia) with superior stem form. This material is intermediate between the more vigorous coastal material and the slower growing, but better stem form interior origins. Unfortunately only a limited number of trials including this material have been established in Ireland. One was planted near Roundwood in Co Wicklow in 1969, with three more planted in 1982-83. Results from these trials are presented in Tables 4 and 5 respectively.

Table 4. *Growth and stem form (1= poor to 4= good) and extent of basal sweep in lodgepole pine provenances at the Roundwood 05/69, Co Wicklow trial, assessed after 29 growing seasons.*

Provenance and location[1]	*DBH* *cm*	*Top height* *m*	*Yield class* $m^3\,ha^{-1}\,yr^{-1}$	*Form*	Basal sweep *% stems*
Terrace- Kalun Lake (SK)	18	12.7	10	2.68	0
Terrace- Naas Valley (SK)	19	13.0	10	2.59	7
Hazelton (BC)	18	12.8	10	2.17	15
Rainier (W)	19	13.5	12	2.17	54
Hoodsport (W)	18	13.5	12	2.41	46

1. Locations: (SK) Skeena River Valley, (BC) British Columbia and (W) Washington.

Table 5. *Growth and stem form (1= poor, 4= good) and extent of basal sweep in lodgepole pine provenances at the Castleisland 07/82 Co Kerry, Doolough 08/82 Co Mayo and Bangor Erris 04/83 Co Mayo trials (all on blanket peat soil), assessed after 14 or 15 growing seasons.*

Provenance and location[1]	*DBH* *cm*	*Top height* *m*	*Yield class* $m^3\,ha^{-1}\,yr^{-1}$	*Form*	*Basal sweep* *% stems*
Terrace-Kalun Lake (SK)	8.6	4.3	8	2.7	6
Hazelton (SK)	8.2	4.4	8	2.0	37
Rainier (W)	8.7	5.6	10	1.6	81
Hoodsport (W)	8.2	3.8	6	1.7	64

1. Locations as in Table 4.

The Terrace-Kalun Lake, Terrace-Naas Valley and Hazelton represent the Skeena River material that is intermediate between the costal and interior provenances. Rainier material is the origin that is closest to a typical SC type. Hoodsport is a Washington SC origin, but it is from a sheltered location, which did well at the Roundwood site, but not on the more exposed sites presented in Table 5. About one yield class (2 $m^3\,ha^{-1}\,yr^{-1}$) separated the Skeena River hybrids from the Rainier material, but Skeena River had better stem form and less basal sweep. This better form and stem quality will increase its value compared with the Rainier material.

The Forestry Commission has recognised the value of these sources and has established seed stands incorporating them. Because of the reduced planting of lodgepole pine in the UK this material is available for commercial use in this country.

Interprovenance hybrids

As has been shown, the strong genetic inverse correlation in lodgepole pine between growth rate and poor stem form in lodgepole pine, referred to in the Introduction cannot be overcome simply by provenance selection. The natural hybrids from Terrace- Kalun Lake, Terrace- Naas Valley and Hazelton offer one option, while artificial hybrids are another. These artificial "interprovenance" hybrids combine the good stem form of the NC types with the high volume production of the SC types (Table 6).

Table 6. *Diameter growth, stem form (1= poor to 4= good), extent of basal sweep and stem forking in lodgepole pine interprovenance hybrids and the parental provenances at the Ossory 03/83 Co Offaly and Glenamoy 50/83 Co Mayo trials, assessed after 14 growing seasons.*

Provenance and location[1]	*DBH* *cm*	*Form*	*Basal sweep* *% stems*	*Forking* *%*
Naas Valley (SK)	9.05	3.17	19	24
SC X Naas Valley (HYB)	12.54	2.54	38	47
Kalun Lake (SK)	10.01	2.99	21	21
SC X Kalun lake (HYB)	13.20	3.04	29	22
Hazelton (SK)	10.09	3.05	29	32
SC X Hazelton (HYB)	12.65	2.85	42	40
Hoodsport (SC)	11.06	2.54	46	29
SC X Hoodsport (HYB)	13.48	2.60	55	37
Rainier (SC)	11.30	2.36	45	44
Long Beach (SC)	13.80	1.76	82	62

1. Locations and hybrids (SK) Skeena River, (HYB) interprovenance hybrid. (SC) South Coastal and SC X is an interprovenance hybrid between a SC source and a named provenance.

In most cases the diameter growth of the interprovenance hybrid was superior to that of the original NC provenance, but with a slight reduction in stem form and an increase in both the incidence of basal sweep and forking (Table 6). Of the crosses examined the SC X Kalun Lake appears to be one of the best compromises, with good diameter growth combined with a small loss of stem form and a minimal increase in basal sweep and forking.

The results suggest that interprovenance hybrids offer the best compromise between wood production and stem quality. They also provide a more vigorous option than the natural hybrids (Tables 4 and 5).

The Forestry Commission established a series of seed orchards in the 1980s designed to produce seed of interprovenance hybrids on a commercial scale. Three seed orchards were established using a SC source crossed with a Skeena River (Terrace and Burns Lake) source. Specific crosses were made between 75 Skeena River trees and 75 SC Washington trees, with each family represented by 25 trees. In addition, plants of the same crosses were planted on three sites. The families with the poorest height growth and stem form were rogued from the seed orchards. The best 20 to 30 families remain in the orchard to cross and produce seed.

Conclusions

The main problem with using lodgepole pine as a plantation species is that no one single seed source combines good wood volume production with acceptable stem form. Results from the IUFRO trials have identified several provenances that do provide a compromise, but these stands no longer exist or cannot provide commercial quantities of seed. Mayer Lake from the Queen Charlotte Islands is one origin known to tolerate exposure well, but its productivity is one yield class less than SC types (Table 2). Tofino, from the west side of Vancouver Island, also has good volume production with a good stem form, if grown on more sheltered sites. Material from the lower Skeena River valley in British Columbia (Terrace, Kalun Lake and Hazelton) provides natural hybrids combining the good volume production of coastal sources with the better stem form of interior sources, but has a lower yield class than SC sources. This material is available from seed stands established by the Forestry Commission in the UK.

Similarly, interprovenance hybrid crosses between SC and NC origins is another option. This material is available from rogued seed orchards established by the Forestry Commission and provides the best genetic material currently available for lodgepole pine.

Recommendations

As a result of over 30 years of provenance research the following seed source recommendations can be made for lodgepole pine (Table 7).

Table 7: *Recommended seed sources of lodgepole pine for Irish sites.*

Crop and site type	*Recommended seed source*
In mixture with Sitka spruce	Alaskan (if available), NC (Including QCI and Vancouver Island) origins
Pure lodgepole pine plantations, on exposed, infertile sites	QCI, Vancouver Island or interprovenance hybrids
Pure lodgepole pine plantations, on less exposed, mineral soils	Interprovenance hybrids, lower Skeena River (Terrace, Kalun Lake Burns Lake and Hazelton) and Irish SC seed orchard material

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An analysis of the effect of shelterwood, seeding density and scarification on the regeneration of Sitka spruce on a forest site in Co Wicklow

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Abstract
An experiment to measure the effect of shelterwood, scarification and seeding rate on the regeneration and survival of Sitka spruce was established in a mature stand of Sitka spruce in Co Wicklow. Two levels of shelterwood and a clearcut control were randomly assigned in a randomised block design. The shelterwood treatments were established by thinning the plantation to retain 150 or 300 stems ha^{-1}. Within the shelterwood treatments sub-plots were established comprising three seeding rates and two soil scarification treatments in factorial combination. The effect of the treatments on the establishment and survival of seedlings after one growing season was determined. Results showed that survival in the 300 stems ha^{-1} shelterwood treatment plots was significantly higher than in the other treatments. The benefit of soil scarification on seedling survival was only evident in the 300 stems ha^{-1} treatment plots. Seeding rate did not result in a significant difference in the number of seedlings surviving after the first growing season.

Keywords: Sitka spruce, regeneration, shelterwood, soil scarification, seeding rate.

Introduction and literature review
In recent years, in both Britain (Yorke 1995, Kerr 1999) and Ireland (COFORD 1994, Ní Dhubháin et al. 2002), there has been increasing interest in the use of silvicultural systems other than clearfelling for harvesting and regeneration. This is a response to criticisms of clearfelling harvesting practices and their impact on many non-wood forest resources, such as scenic values, habitats, biodiversity and recreation (Jull and Stephenson 2000). Society increasingly demands that forest products originate from sustainably managed forests, where biodiversity is conserved, and environment-friendly forest practices are used.

Traditionally, the use of silvicultural systems alternative to clearfelling was to assist the process of natural regeneration for the reforestation of forest sites. Countries and regions without a tradition of natural regeneration are now turning to it as a means of achieving a range of resource management objectives (Farnden 1994, Yorke 1995, Hollsteadt and Vyse 1997, Vyse 1997, Kerr 1999), and those associated with sustainable forest management.

The shelterwood system plays a vital role in the success of natural regeneration by influencing the environment of emerging tree seedlings (Skoklefald 1989 & 1992, Holgen 1999, D'Anjou 2000). In its use part of the forest canopy is retained and this provides shelter and a suitable microclimate for the germination and development of seedlings (Holgen 1999). The role of the shelterwood system is thought to be in regulating the light, soil moisture, and soil and air temperature that are critical to the development of seedlings. Studies investigating natural regeneration indicate that the survival of seedlings is also

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enhanced by the provision of canopy cover (D'Anjou 2000 & 2001). It has also been shown that the number of established seedlings increases with the density of the shelterwood at low altitudes in central Sweden (Hagner 1962, Hannell 1991, Holgen 1999).

Studies of seeding density and the effects of seedbed condition have implications also for the potential of natural regeneration in reforestation. Scarification can improve the likelihood that tree seeds will germinate and become established (Hagner 1962, Valtanen 1988, Zasanda and Wurtz 1990, Skoklefald 1989 & 1992). The disturbance of the seedbed to expose mineral soil improves the establishment of seedlings (Feller 1996, D'Anjou 2001, Jull and Stephenson, 2001).

Adequate seedfall is essential for natural regeneration (D'Anjou 2001) and is a limiting factor in some years (Eremko et al. 1989, Young and Young 1992, Leadem et al. 1997, Nixon and Worrell 1999). To reduce the probability of seedfall becoming the limiting factor, direct seeding may be needed on some site types (Jull and Stephenson 2001).

It has been shown that some factors are more critical to regeneration success than others. Burton et al. (2001) indicated that germination of four conifer species responded more strongly to seedbed treatment than to canopy treatment. Jull and Stephenson (2001) found that direct seeding increased the number of Engelmann spruce (*Picea engelmannii*) seedlings in clearcut treatments, regardless of whether the seedbed had been screefed during seedbed preparation. Feller (1996) indicated that the optimum treatment for encouraging regeneration in Engelmann spruce was to provide partial shade and expose mineral soil. Holgen (1999) recommended that in order to regenerate sites effectively the number of shelterwood trees should be more than 200 stems ha^{-1} to provide adequate protection for natural regeneration. The growth of seedlings is greater for light demanding species such as Engelmann spruce (*Picea engelmannii*) and Douglas fir (*Pseudotsuga menziesii*) in clearcuts than under a forest canopy (Feller 1997, D'Anjou 2000 & 2001, Jull and Stephenson 2001). Willen (1996) found that seedling height increment increased with light intensity up to a certain point, corresponding to 65% of that on open ground. He also found that maximum dry matter production was under open, full light conditions. Holgen (1999) found that a higher percentage of seedlings reached a height of 100 cm after eleven growing seasons in a sparse, compared to a dense, shelterwood treatment.

Materials and methods

In November 1998, a project to examine alternative silvicultural systems to clearfelling was initiated by Coillte and UCD. A trial to evaluate the potential of the shelterwood system in Sitka spruce was established as a part of the project.

Site and stand characteristics

The experiment was located in a 42-year-old stand of Sitka spruce at Djouce woods near Enniskerry, Co Wicklow, a Coillte (Irish Forestry Board) property (Figure 1). The site was at an elevation of 309 m, had an easterly aspect and a slope of 5°. The soiltype was a moderately- to well-drained brown podzolic, with a thin surface organic layer.

The crop was stable with no evidence of windthrow. Crop mean diameter at breast height (dbh) was 32.4 cm, with a top height of 22 m. Stocking was 459 stems ha^{-1}, with a standing volume (over bark, to 7 cm top diameter) of 386 m^3 ha^{-1}.

Shelterwood treatments and experimental design
Three shelterwood treatments were investigated:

1. removal of all standing and dead trees;
2. shelterwood felling to 150 stems ha^{-1} (150 sph)
3. shelterwood felling to 300 stems ha^{-1} (300 sph).

Felling took place in February 1999. In the shelterwood fellings, sufficient co-dominants were felled to arrive at the required stocking level.

Mean post-harvest stocking in the shelterwood treatments was close to the experimental requirement. Basal area was reduced by 61% and 28% and stem numbers from 466 to 158 stems ha^{-1} and from 446 to 303 stems ha^{-1} in the 150 and 300 sph treatments, respectively (Table 1). The mean dbh increased slightly following thinning. This is attributable to the removal of trees of smaller diameter than the mean (low thinning).

Table 1: *Pre- and post-felling stand structure by shelterwood treatment.*

Treatment	*Mean stocking*		*Basal area*		*Mean dbh*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*
	stems ha^{-1}		*m^2 ha^{-1}*		*cm*	
Clearcut	467	0	38.1	0.0	32.4	0.0
150 sph	466	158	37.2	14.5	31.8	34.2
300 sph	446	303	38.6	27.6	33.1	34.1

Mean canopy cover in the 150 and 300 sph shelterwood treatments was 67.1% and 79.9%, respectively (Table 2).

Table 2: *Mean canopy cover by shelterwood treatment.*

Treatment	*Canopy* %
150 sph	67.1
300 sph	79.9

In all treatments the harvesting debris was moved into windrows, leaving just a light covering. To protect seedlings from browsing a 2 m high deer fence was erected around the entire experiment site before seeding.

Treatments were laid down in a randomised block design, with three replications. Treatment plots were 0.5 ha in area. Within each main plot six sub-plots (1 x 1 m), representing a factorial combination of three seeding rates and scarification/no scarification, were randomly assigned, giving a total of 54 plots.

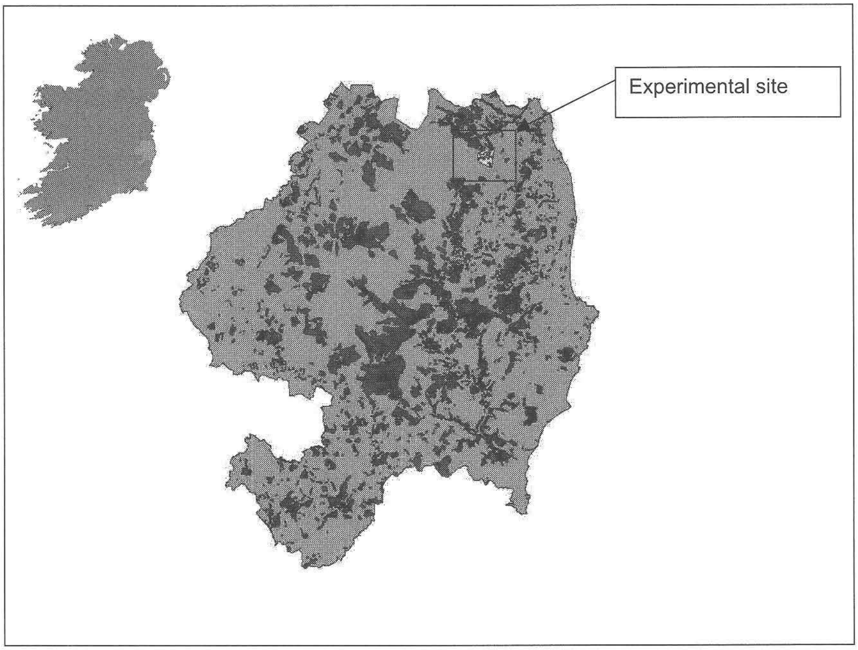

Figure 1: *Location of experiment site in Co Wicklow.*

Seeding rates (1.08, 2.17 and 4.34 g plot^{-1}, corresponding[4] to 5, 10 and 20 million seeds ha^{-1}) were based on seed fall densities reported in Nixon (1998 & 1999). The seed (viability 95%), which had been stratified, was obtained from Coillte's Ballintemple nursery. Seed was evenly spread over each sub-plot from a height of 1.3 m, taking care to avoid any spread outside the plot boundary. Scarification was carried out by manually raking off the humus layer to expose the underlying mineral soil. The no scarification control plots were left untouched.

Measurement and statistical analysis

Diameter breast height (dbh) of all trees over 7 cm dbh in each shelterwood plot was measured, from which stocking, mean dbh, basal area/ha were computed (Table 1). Post-harvest stand measurement was undertaken directly after harvest. Canopy cover in the shelterwood plots was calculated by categorising each intersection point of a 1 x 1 m grid as 0 or 1, depending on the absence or presence of canopy (see Jennings et al. 1999 for a description of the technique used). Both the dbh measurement and the canopy cover assessment were undertaken in April and May 1999.

Seedling density was determined in September 1999, after the first growing season, by placing a 20 x 20 cm grid (400 cm^2) over the centre of each sub-plot and counting the

4 Based on an average weight of 2.17 g/1000 for Sitka spruce seed (Brown & Neustein 1974).

number of seedlings within the grid. In addition, the height of the tallest seedling in the grid was measured to the nearest 0.5 cm.

The effect of the treatments on seedling density and seedling height was determined using an analysis of variance.

Results

Seedling germination and survival

The mean density of seedlings after one growing season ranged from 550,000 to 10,700,000 ha^{-1} (Table 3). The density in the 300 sph shelterwood plots was almost double the density in the 150 sph treatment plots and triple the number in the clearfell plots. The difference in density between the 300 sph treatment and the two other treatments was highly significant ($p \leq 0.01$) while the difference between the 150 sph and clearfell treatments was not significant.

The mean density of seedlings in the moderately (10,000,000 ha^{-1}) and heavily (20,000,000 ha^{-1}) seeded plots was similar, while the density in the lowest seed application although considerably lower (Table 3), was not statistically different from the other two.

On average the seedling density in the scarified plots was higher than in the unscarified plots. However, there was a significant interaction ($p \leq 0.05$) between scarification and shelterwood treatment. In the 300 sph shelterwood, scarified plots, the mean number of seedlings was almost three times greater than the mean number in the unscarified plots ($p \leq 0.01$). In contrast there was little or no difference between the scarified and unscarified treatments in the other shelterwood treatments (Table 3).

Table 3: *Effect of shelterwood, scarification and seeding rate on seedling density.*

Seeding rate	*Shelterwood treatment*						
	Clearcut		*150 sph*		*300 sph*		
	Scarification						
	US[1]	*S*[2]	*US*	*S*	*US*	*S*	*Seeding rate mean*
seeds ha^{-1}	*seedlings ha^{-1}*						
5,000,000	550,000	550,000	2,325,000	1,875,000	1,500,000	4,125,000	1,825,000
10,000,000	2,325,000	1,050,000	3,300,000	4,075,000	3,575,000	5,800,000	3,350,000
20,000,000	1,250,000	3,125,000	2,050,000	2,250,000	2,675,000	10,700,000	3,675,000
Scarification x shelterwood mean	550,000	550,000	2,325,000	1,875,000	1,500,000	4,125,000	
Shelterwood mean		1,575,000		2,725,000		6,875,000	

[1]Unscarified
[2] Scarified

Early growth

The mean height of the tallest seedling in the clearfell plots was 3.7 cm after one growing season (Table 4) while in the 150 sph and 300 sph shelterwood plots it was 2.9 cm and 2.2 cm respectively. The difference was not statistically significant. Furthermore, scarification and seed density did not significantly influence seedling height at the end of one growing season.

Table 4: *Effect of shelterwood, scarification and seeding rate on seedling height.*

	Shelterwood treatment						
	Clearcut		*150 sph*		*300 sph*		
Seeding rate	*Scarification*						
	US[1]	*S*[2]	*US*	*S*	*US*	*S*	*Seeding rate mean*
Seeds ha^{-1}	*cm*						
5,000,000	3.5	3.3	3.5	3.2	1.7	2.0	2.9
10,000,000	3.5	4.7	3.2	2.3	2.2	2.5	3.1
20,000,000	3.8	3.8	2.3	2.7	2.8	1.8	2.9
Scarification x shelterwood mean	3.6	3.9	3.0	2.7	2.2	2.1	
Shelterwood mean	3.7		2.9		2.2		

[1]Unscarified
[2] Scarified

Discussion

The removal of trees in the shelterwood treatments resulted in relatively small reductions in canopy cover but corresponding large reductions in basal area. Canopy cover of 79.9% in the 300 sph plots equated to a basal area of 27.6 m^2 ha^{-1}. This represents a reduction of 28.5 % of the original pre-harvest basal area. The effect of reducing stem numbers from 300 sph to 150 sph in the shelterwood treatments resulted in a reduction in basal area from 27.6 m^2 ha^{-1} to 14.5 m^2 ha^{-1}, a reduction of 50%. However, the corresponding decrease in canopy cover was just over 12%. As only co- and sub-dominants were removed (low thinning) it is unclear whether the reduction in canopy cover would have been greater had larger diameter trees been removed in thinning. It would be expected that the removal of larger trees with larger canopies would result in a greater decrease in canopy cover. Overall the removal of co-dominant trees had very little effect on the level of canopy cover. These results are similar to those reported for Douglas fir (*Pseudotsuga menziesii)* by Burton et al. (2000). They found that removal of up to 30% and 50% of the basal area resulted in light levels that were only 20% and 38%, respectively, of levels in clearfell treatments. This indicates that when fewer trees are retained they can still provide relatively high degrees of shade.

The trends in seedling density agree with those of Hagner (1962) and Hannell (1991) where the density of seedlings increased with the density of shelterwood. Seedling density was significantly greater in the 300 sph than in the 150 sph shelterwood and clearfell plots. It is clear that the retention of canopy cover in the shelterwood treatments had a positive impact on the number of seedlings surviving. Similar results were reported by D'Anjou (2000 & 2001).

Seedling density in the 150 sph shelterwood plots was intermediate between that in the clearfell and 300 sph shelterwood plots. This suggests that retaining some degree of cover results in greater seedling densities.

In all treatments the density of seedlings after one growing season exceeded by two orders of magnitude what is currently the normal planting density for spruce. While the analysis showed that there was no significant difference in the number of seedlings surviving in relation to the weight of seed sown, the data suggest that higher seeding densities, equivalent to 10,000,000 and 20,000,000 seed ha^{-1}, resulted in higher seedling densities compared with the lowest seeding rate. Considerable seedling mortality can occur during the first two years (MacNeill and Thompson 1982, Clarke 1991 and Nixon and Worrell 1999). It is also important to remember that seeds used in this study had a high viability; under natural conditions this viability might be considerably lower.

Scarification increased seedling density, confirming the findings of Hagner (1962), Valtanen (1988), Zasanda and Wurtz (1990) and Skoklefald (1989 & 1992). Germination is more rapid on mineral soil than on litter, especially so when seeds are pressed into the soil rather than scattered on the surface (Scarratt 1968, Feller 1996, D'Anjou 2001, Jull and Stephenson 2001). However, the results from this study show that the benefits of scarification were only evident in the dense shelterwood with almost three times the seedling density in the scarified compared with the unscarified plots. In contrast, in both the clearfell and 150 sph shelterwood plots scarification had little impact.

Conclusions

The results suggest that maintaining a dense canopy cover for at least the first year after germination increases the likelihood of seedling survival, perhaps at the expense of height growth. The results further suggest that scarification will not improve seedling density on clearfelled sites or under relatively sparse shelterwood, but will do so under a denser canopy. The optimum treatment for the successful establishment of regeneration in Sitka spruce therefore seems to be to provide partial shade and expose the mineral soil. Feller (1996) and Holgen (1999) have reported similar results. Retaining significant proportions of the final crop can provide this shelter.

As indicated forest operations can play a significant part in the preparation of stands for regeneration by carrying out silvicultural and site preparation operations. Indications are that seeding rate is a less important factor once the quantity sown is above a certain threshold, suggesting that satisfactory stocking levels in good seed years using similar methods may be achieved. The results reported here, were, however, achieved with seeding rates greater than expected rates in an average seed year. It is also anticipated that the number of seedlings will considerably reduce over time. Furthermore, observations suggest that the spatial distribution of regeneration will be considerably more uneven under natural conditions, from that achieved in this study.

In order to provide more information on the long-term survival and development of seedlings further research is necessary. The use of silvicultural systems also needs to take account of their wind stability under Irish conditions and the likely level of damage to the remaining trees in the shelterwood. These considerations and investigations are necessary in order to provide fuller recommendations on alternatives to clearfelling in Sitka spruce crops.

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The nursing of Sika spruce by Douglas fir

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Abstract
Nursing of Sitka spruce (*Picea sitchensis*) by Douglas fir (*Pseudotsuga menziesii*) arose unexpectedly in a field experiment established at Ballyhoura Forest in 1976. The original aim of the experiment was to examine the potential of intensive soil reclamation to improve the establishment of Sitka spruce and Douglas fir on poor Old Red Sandstone soils. The soil at the site was a modified podzol, changed from its original state by past management practices. It was nonetheless marginal for Sitka spruce, requiring frequent nitrogen fertilisation in the absence of nurse species.

The experiment layout placed plots of the two species immediately adjacent to one another. The nursing effect was first noted eight years after the establishment in plots of Sitka spruce adjacent to Douglas fir. Height, leader length and diameter of the Sitka spruce were measured in lines parallel and adjacent to the Douglas fir to determine the spatial progress of nursing. Foliage analysis indicated that the effect was nutritional, rather than due to shelter.

The nursing effect occurred in a less than ideal spatial arrangement of the two species; it is contended that a more favourable result for the Sitka spruce could have been achieved with an intimate mixture. Douglas fir/Sitka spruce mixtures should be considered on similar soils, the main benefits being the extended species choice, increased diversity, and reduced need for fertilisation.

Keywords
Douglas fir, nursing, mixtures, nitrogen fertilisation, nitrogen fixation, nutrition, Old Red Sandstone, Sitka spruce, soil reclamation.

Introduction
It is known that certain species (nurses) have a capacity to extract and make available nitrogen to other tree species growing in mixture. The nurse has the capacity to utilise scarce nitrogen, either by extracting it from a relatively unavailable fraction of some soils, and/or by fixing it from the atmosphere, and to contribute some of this nitrogen to a nursed species. Legumes, including broom (*Cytisus* spp.), false acacia (*Robinia* spp.), alder (*Alnus* spp.) and lupins (*Lupinus* spp.) have long been known to have beneficial nutritional effects on agricultural and forest species, having the capacity to fix up to 300 kg N/ha (*Robinia*) in their early years (Baule and Fricker 1967).

A number of coniferous species are known to be able to nurse Sitka spruce on nitrogen-poor sites. On mineral soils, Japanese larch (*Larix leptolepis*) and lodgepole pine (*Pinus contorta*) have been the best nurse species (OCarroll 1978, Carey et al. 1988), while the evidence from Britain (Taylor 1985) of a similar nurse effect by Scots pine (*Pinus sylvestris*) has not been confirmed in Ireland. On peat soils, lodgepole pine has been associated with successful nursing of Sitka spruce in Britain (Taylor 1985, Miller et al. 1986), although the authors are not aware of a convincing case in Ireland.

How the nurse species increases nitrogen availability is not known but may be due to its ability to take up soil nitrogen which is unavailable, or at least less available, to the nursed species (Miller et al. 1986). The transfer of nitrogen from nurse to receptor species is by

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root contact; this is clearly demonstrated by an observation in the experiment described here of the absence of any increase in foliage nitrogen levels of Sitka spruce where cut-off drains between nurse and nursed species prevented root contact.

The abundance of soils in Ireland with low reserves of nitrogen, or poor nitrogen availability, limits the ability of Sitka spruce to grow successfully on them without frequent applications of fertiliser nitrogen. The option of using nursing mixtures on such soils is clearly an attractive one, both from the point of view of reducing the need for fertiliser inputs and reducing any potential environmental impacts from repeated fertilisation.

This paper provides experimental evidence for a nursing effect of Douglas fir on Sitka spruce on an infertile soil derived from Old Red Sandstone in the foothills of the Ballyhoura Mountains, on the Cork-Limerick county boundary.

Background

The experiment in question, Ballyhoura 30/76, was not designed to investigate nursing effects, but rather to determine the effect of a variety of intensive reclamation techniques on the establishment of Sitka spruce and Douglas fir on Old Red Sandstone soils.

It was established in 1976 because the standard establishment techniques on such soils at that time – single mouldboard Clark ploughing, 500 kg ground rock phosphate/ha at planting, and nitrogen fertiliser when required – were found to be of limited value on infertile Old Red Sandstone soils. Severe growth-check usually developed in Sitka spruce within five years of planting, due to lack of nitrogen. Application of nitrogen brought about short-lived growth responses, but the frequent fertiliser applications necessary for satisfactory growth were economically questionable. One of the main objectives the experiment sought to examine was the potential of nitrogen-fixing leguminous species – furze (*Ulex gallii*), broom (*Cytisus scoparius*) and clover (*Trifolium* spp.) – to provide a supply of nitrogen to enable Douglas fir and Sitka spruce to be self-sustaining in terms of their nitrogen needs.

The emergence of the nursing effects, some eight years after the establishment of the experiment, was an unforeseen development.

Materials and methods

Site location

The experiment was located at an elevation of 120 m in Ballyguyroe North townland (national grid reference R 67 13), Ballyhoura (now Mallow) forest. The forest is owned and managed by Coillte, the Irish Forestry Board.

The predominant soil type was a podzol with some podzolised gleys. Detailed soil descriptions are given in the Appendix. The vegetation was a uniform poor heath type, with a poorly developed dwarf shrub layer (20 cm high, 30-40% cover, moss layer 85% cover) composed mostly of *Sphagnum* spp. There was no dominant species among the higher plants; *Erica tetralix, Molinia caerulea* and *Narthecium ossifragum* were the most common.

Treatments, experiment design and plot layout

Treatments

The main plot experimental treatments are given in Table 1. Each main plot was comprised of a pair of Douglas fir and Sitka spruce sub-plots. The plants were normal nursery stock (30-40 cm Sitka spruce and 40-60 cm Douglas fir).

Table 1. *Main plot treatments and nitrogen sources at Ballyhoura 30/76.*

Treatment	*Nitrogen source*	*Treatment designation*
Single mouldboard Clark ploughing at 2 m (control)	None	O
Complete Clark ploughing + rotovation + KCl + superphosphate + limestone + clover	Clover	C
Complete Clark ploughing + rotovation + KCl + furze (Ulex gallii)	Furze	U
Complete Clarke ploughing + rotovation + KCl + limestone + broom	Broom	B
Complete Clarke ploughing + rotovation + KCl + Calcium ammonium nitrate	Fertiliser	M

The fertiliser types and auxiliary nitrogen-fixing species used in the main treatments are further elaborated in Table 2.

Table 2. *Nutrient sources, rates of fertiliser application and auxiliary nitrogen fixing species used at Ballyhoura 30/76.*

Nutrient source	*Rate*
Basal treatment with ground rock phosphate	500 kg/ha (1975) + 350 kg/ha (1985)
KCl (potassium chloride)	250 kg/ha (125 kg K/ha)
Superphosphate	187 kg/ha (30 kg P/ha)
Limestone	1,253 kg/ha (1976) + 5,012 kg/ha (1979)
Clover (white)	4.5 kg seed/ha, broadcast
Furze (Ulex gallii)	7,500 seedlings/ha, spot-planted
Broom (common yellow)	4.5 kg seed/ha, spot-sown
CAN (calcium ammonium nitrate)	200 kg N/ha (1982) + 150 kg N/ha (1984)

Experiment design

The treatments were laid out in a split-plot design with three replications. The main plots were intensive reclamation treatments (32 x 64 m). Each main plot was split into Douglas fir and Sitka spruce sub-plots (32 x 32 m).

Experiment layout
The block, plot, and sub-plot layout is shown in Figure 1. The subplots are numbered 1 – 30. The treatment designations are as in Table 1.

Block I

1 U DF	*2 B* SS	*3 M* DF	*4 C* SS	*5 O* DF
10 U SS	*9 B* DF	*8 M* SS	*7 C* DF	*6 O* SS
		Block II		
11 O SS	*12 M* SS	*13 B* SS	*14 C* DF	*15 U* SS
20 O DF	*19 M* DF	*18 B* DF	*17 C* SS	*16 U* DF
		Block III		
21 B DF	*22 O* SS	*23 C* SS	*24 U* SS	*25 M* SS
30 B SS	*29 O* DF	*28 C* DF	*27 U* DF	*26 M* DF

Figure 1. *Block, plot and sub-plot layout at Ballyhoura 30/76* (SS: Sitka spruce, DF Douglas fir. *The nursing effect was measured in the shaded sub-plots: Sitka spruce, Douglas fir*).

Soil description and analyses

Soils typical of the experiment area were described by investigation of representative soil profiles, supplemented by laboratory analysis of soil samples taken from the selected soil profiles to determine their fertility status.

The soils of the area show many of the characteristics found in the classic podzols developed on Old Red Sandstone parent material. However, modifications have occurred in many of these podzols through, for example, removal of part or all of the peat from the surface of the soil for fuel, and/or cultivation of the soil, resulting in a mixing of the upper soil horizons. Left untouched, these soils would have been peaty podzols. The experiment area was largely covered by one soil type, a modified podzol (formerly a peaty podzol), with small areas of podzolised gleys (formerly peaty podzolised gleys). Douglas fir and Sitka spruce grew well on the free-draining podzols, but poorly where podzolised gleys occurred. The nursing of Sitka spruce by Douglas fir was consequently only evident on the free-draining modified podzols. Analytical descriptions of the soil types are given in the Appendix.

Growth assessments

Following the observation in 1985 of more vigorous growth and a greener foliage colour in Sitka spruce trees adjacent to Douglas fir plots it was decided to assess the Sitka spruce line by line (line 1 being nearest to Douglas fir and line 7 being furthest from Douglas fir). Seven lines of Sitka spruce were assessed separately in each of three plots (17, 22 and 23) for mean height (all trees in each line) in each year from 1985 and for diameter breast height (DBH) from 1991. The general yield class was based on the mean height of the two largest DBH trees per plot.

The general yield class was determined in 1992 and 2000 in Douglas fir plots (16, 28 and 29) adjacent to the nursed Sitka spruce plots (17, 22 and 23), based on the mean height of the two largest DBH trees per plot.

Nutrient content

Foliage samples were collected from the Sitka spruce from each of seven lines of trees with decreasing distance from the Douglas fir. Samples were collected on six occasions: in the dormant periods of 1985/86, 1987/88, 1990/91, 1991/92 and 1992/93. The foliage was analysed to determine nutrient content, particularly nitrogen, to establish if the difference in height growth between lines of Sitka spruce was related to nutritional differences. Total nitrogen was determined in the laboratory using a micro-Kjeldahl method (Jackson 1958).

Results

Growth of Sitka spruce

Height growth of the Sitka spruce is presented for representative years for the 15-year period, 1985-2000 (Table 3). The heights are the means of corresponding lines in three plots (plots 17, 22 and 23). From the 1990 assessment onwards there was an overall significant effect of distance from the Douglas fir on the height of the Sitka spruce, with significant differences between each line; height declined with distance from the nurse species. This trend continued over time, with an almost 6 m difference between lines 1 and 7 by 2000 (Table 3, Figure 2).

Table 3. *Effect of distance from Douglas fir on the height growth of Sitka spruce over the period 1985-2000.*

Year	*Age years*	*Line 1 (nearest to Douglas fir)*	*Line 3*	*Line 5*	*Line 7 (furthest from Douglas fir)*	*Fisher's LSD test ($p \leq 0.01$)[a]*
			m			
1985	10	3.36	2.75	2.68	2.44	Not significant
1990	15	7.45 A	5.00 B	4.53 C	3.62 D	Significant
1995	20	12.13 A	10.02 AB	8.38 BC	6.78 C	Significant
2000	25	16.71 A	14.03 AB	13.24 BC	10.85 C	Significant

[a] For a given year, means followed by the same letter do not differ significantly from each other at the $p \leq 0.01$ level.

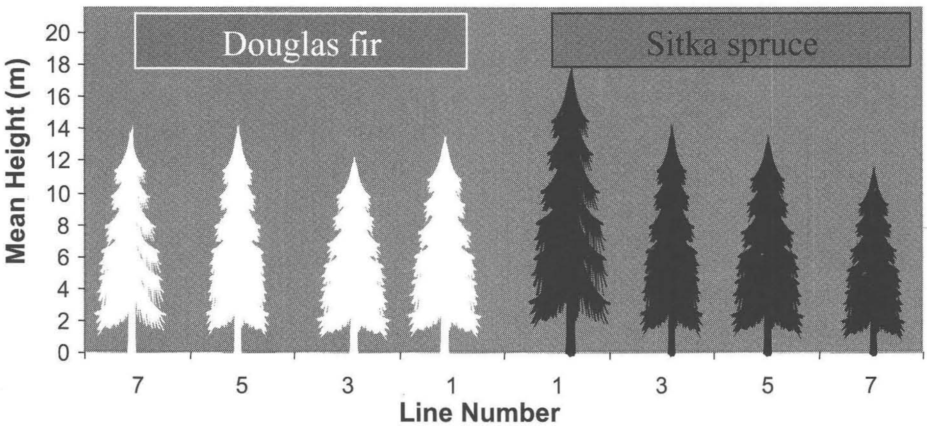

Figure 2: *Mean height of Douglas fir and Sitka spruce in 2000.*

The growth differences between Sitka spruce in the different lines was greater when expressed as general yield class (GYC). The difference in GYC evident at 10 years persisted to at least 25 years (2000), when last assessed (Table 4). The line nearest the Douglas fir improved from GYC 20 to 24, while the furthest away line improved from GYC 14 to 18. It took 15 years for line 5 to develop a productivity level (GYC 20 in 2000) equal to that of line 1 in 1985.

Table 4. *Effect of distance from Douglas fir on volume growth productivity of Sitka spruce over the period 1985-2000.*

Year	*Age years*	*Line 1 (line nearest to Douglas fir)*	*Line 3*	*Line 5*	*Line 7 (line furthest from Douglas fir)*
		GYC $m^3ha^{-1}year^{-1}$			
1985	10	20	16	16	14
1990	15	22	18	14	14
1995	20	24	20	18	16
2000	25	24	22	20	18

Growth of Douglas fir

The mean height of Douglas fir was measured for two representative years, 1992 and 2000 (Table 5). The line effect was determined in the plots adjacent to the Sitka spruce plots presented above, and in the same manner. In contrast to the growth of Sitka spruce, the height growth of Douglas fir showed no effect of line position.

Table 5. *Effect of distance from Sitka spruce on height growth of Douglas fir over the period 1992-2000.*

Year	*Age* *years*	*Line 1 (nearest to Sitka spruce)*	*Line 3*	*Line 5*	*Line 7 (furthest from Sitka spruce)*	*Fisher's LSD test ($p \leq 0.05$)*
				m		
1992	17	8.4	7.9	8.6	8.1	Not significant
2000	25	12.63	11.81	13.26	13.51	Not significant

There was no effect found of distance to the Sitka spruce on volume productivity of the Douglas fir (Table 6), which was to be expected given the uniformity of height growth of Douglas fir irrespective of line position.

Table 6. *Effect of distance from Sitka spruce on volume growth productivity of Douglas fir over the period 1992-2000.*

Year	*Age* *years*	*Line 1 (line nearest to Sitka spruce)*	*Line 3*	*Line 5*	*Line 7 (line furthest from Sitka spruce)*
			GYC $m^3ha^{-1}year^{1}$		
1992	17	16	14	16	16
2000	25	14/16	14	16	14/16

Nutrient content

For clarity of presentation, nutrient concentrations for only two of the periods, 1985/86 and 1992/93, are given. Nitrogen levels alone are presented (Table 7 and Figure 3) as it was the limiting nutrient at the site.

Table 7. *Effect of distance from Douglas fir on foliar N levels of Sitka spruce for the years 1985/86 and 1992/93 (L1 being Sitka spruce line nearest to the nurse).*

	Sitka spruce line							
Year of analysis	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Fisher's LSD test*
				Nitrogen % dry matter				
1985/86	1.55	1.40	1.23	1.11	0.99	1.03	1.04	Significant ($p \leq 0.05$)
1992/93	1.69	1.59	1.54	1.44	1.35	1.29	1.17	Significant ($p \leq 0.01$)

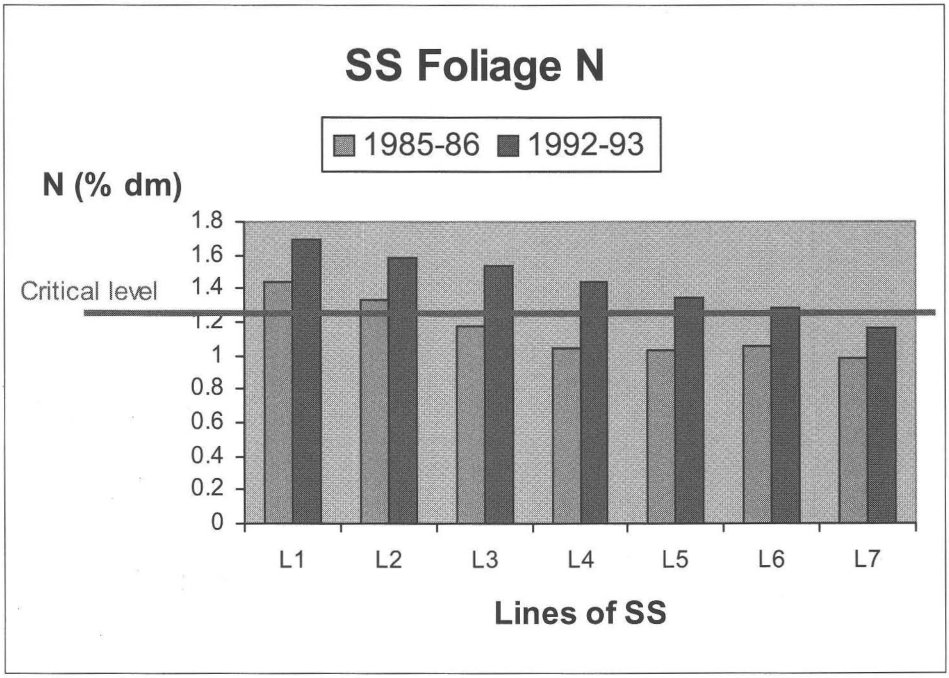

Figure 3. *Effect of distance from Douglas fir on foliar N levels of Sitka spruce for years 1985/86 and 1992/93 (L1 being Sitka spruce line nearest to nurse species).*

The main results were:

1. for any given year the nitrogen levels were greatest in the line (L1) of Sitka spruce nearest to the Douglas fir, decreasing with distance and lowest in the line (L7) most distant from the Douglas fir; the differences in foliage nutrient concentration between lines were significant at the $p \leq 0.05$ level in the 1985/86 analysis and significant at the $p \leq 0.01$ level in the 1992/93 analysis (Table 7);
2. nitrogen levels increased with time, by at least 0.13% from 1985/86 to 1992/93;
3. in 1985/86, only the two lines of Sitka spruce closest to the Douglas fir had nitrogen concentrations above the critical level (the level below which indicates deficiency or the level which indicates high probability of growth response to fertiliser treatment), while seven years later, by 1992/93, that had increased to six lines (Figure 3).

Discussion

Efforts to afforest poor Old Red Sandstone sites have been underway in Ireland since the 1920s (Wittich 1949) and have met with mixed results. While some have been successful silviculturally, they can be questioned on the grounds of economics (high cost of repeated N fertilisation in the case of Sitka spruce) or impracticality (use of nitrogen-fixing legumes). Although lodgepole pine grows vigorously on nitrogen-poor soils, because of its low nutrient needs (provided phosphorus supply is not limiting), it has generally poor stem form due to basal sweep and wind/snow damage. It is also susceptible to damage by pine shoot moth, pine beauty moth and pine sawfly.

The use of nurses in mixture with Sitka spruce has resulted in the enhancement of Sitka spruce growth on Old Red Sandstone sites where nitrogen deficiency is common (OCarroll 1978). The results presented here show that Douglas fir could be used as a nurse species in addition to Japanese larch, Scots pine and lodgepole pine. The higher foliage nitrogen levels found in Sitka spruce adjacent to Douglas fir tend to confirm that the latter was behaving in a nutritional manner rather than providing shelter. This is reinforced by the fact that non-nursed Sitka spruce in the fertiliser treatment plots had to receive fertiliser nitrogen twice in a three-year period, 1982-1984, to bring them out of recurring deficiency (results not reported here). By contrast, Sitka spruce nursed by Douglas fir has received no fertiliser nitrogen, as foliage analysis showed it was not required. Furthermore, Sitka spruce foliage nitrogen levels have increased over time, even in the lines furthest from the nurse.

Nevertheless, the arrangement of nurse (Douglas fir) to nursed (Sitka spruce) species in seven-line blocks is not efficient, as the nursing effect in lines furthest from the Douglas fir takes too long to achieve nitrogen sufficiency. This is particularly evident from the effect on volume productivity in the Sitka spruce (Table 4), ranging from GYC 24 in Sitka spruce nearest to Douglas fir to 18 in those furthest away. Indications from other current studies in the Ballyhoura area suggest that a 3/3-row mixture of nurse and nursed species is the best spatial arrangement.

Such mixtures also afford an opportunity to manipulate the composition of the final crop. For example, if the Douglas fir has excellent form, the Sitka spruce can be removed in thinnings, leaving the Douglas fir to grow to maturity as the final crop. On the other hand, if the form of the Douglas fir is less than satisfactory, it can be removed in thinnings once its nursing role has been fulfilled. Where both species are growing satisfactorily, consideration could be given when thinning to favouring the best stems of both species.

The evidence from this study suggests that Douglas fir has a commercial potential to complement its nursing role. A GYC of 16 for Douglas fir, at 17 years (1992), would yield a commercial return, particularly on such a difficult site, all the more so since the productivity was maintained up to 25 years (2000), with no indication of decline.

The finding that Douglas fir can nurse Sitka spruce opens up new silvicultural possibilities. First, it provides an additional nurse option, one in which it has commercial potential beyond that expected of the traditional nurse species. Second, Douglas fir/Sitka spruce mixtures can be expected to achieve high commercial productivity on *modified podzols*, soils which have been subject to intensive management in the recent or distant past, but which are nutritionally marginal for pure Sitka spruce. Additional benefits to use of Douglas fir/Sitka spruce mixtures would accrue from reduced need for fertilisation and increased species diversity.

Acknowledgements

The original experiment was designed by Jim Dillon and Michael Carey with inputs from the authors and Niall OCarroll. The following were involved in the field work associated with the general field experiment, and/or the nursing component of it: Michel Davoren, Joe Finn, Eddie Murphy and Michael O'Donnell. We are also grateful to Barbara Thompson, David Thompson and Ted Lynch for help with treatment of data, and to Elaine Khan and Taidgh Horgan for assistance with presentation of graphs.

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Appendix

Table 1. *Chemical analysis of a modified podzol at Ballyhoura 30/76.*

Horizon	*Depth cm*	*pH*	*OM %*	*P*	*K*	*Ca*	*Mg*
					µg/g		
Ap1	*0-10/20*	4.0	11	1	14	22	24
Ap2	*10/20-35/40*	4.3	5	1	11	4	13
B	*35/40-55/60*	4.7	2	0	15	1	6
C	*55/60 +*	4.8	2	1	24	1	8

Abbreviations: OM (organic matter), P (phosphorus), K (potassium), Ca (calcium) and Mg (magnesium).

Table 2. *Chemical analysis of podzolised gley at Ballyhoura 30/76.*

Horizon	*Depth cm*	*pH*	*OM %*	*P*	*K*	*Ca*	*Mg*
					µg/g		
Ap1	*0-10*	4.2	19	8	91	153	95
A21g	*10-25*	4.4	3	1	16	17	8
A22g	*25-35/40*	4.7	3	1	15	2	2
Bg	*35/40- 60*	4.9	3	1	25	6	6
Cg	*60- 80*	4.9	3	1	24	12	7

The analyses for both soils are quite similar with regard to soil reactions and P levels. Soil reactions are very acid, with pH ranging from pH 4.0/4.2 in the topsoil to pH 4.8/4.9 in the parent material. Soil P levels are very low, showing the clear need for application of P fertiliser at planting. The only point of difference in the analysis between the soils appears to be the relatively better overall nutrient status in the podzolised gley compared to that in the modified podzol.

Attracting Farmers into Forestry

Pat Lehane[1] and Barbara Maguire[2]

Abstract

The financial incentives to encourage farmers to convert land from agricultural to forestry use have been substantially increased. However, the rate of farmers entering the afforestation scheme has been lower than predicted. Many factors have had a role to play in this including increases in the price of land, lack of a forestry culture in Ireland and competing agricultural schemes. A lot of work needs to be done in the areas of market development and promotion of Irish timber if the full potential of the afforestation programme is to be realised.

Keywords: premium, targets, culture, broadleaves, markets, promotion.

Introduction

The paper addresses the problem of attracting farmers into forestry. In this context, it is important to examine recent developments in forestry in Ireland. Farmers have become more aware of forestry issues and their level of technical knowledge of the area has improved. Over 10;000 farmers have planted trees on more than 100,000 ha of land, with an estimated land value of €400 million. Currently farmers plant over 13,000 ha of land annually.

Farmer participation in the national afforestation scheme

The financial incentives to encourage farmers to convert land from agricultural to forestry use have been substantially increased. Current planting levels are much lower than the targets set out in the Government strategy document, *Growing for the Future* (Department of Agriculture, Food and Forestry 1996). Some reasons that might be advanced to explain this include:

- delays in reviewing forest premium levels;
- a reduction in the amount of land available for sale and an increase in the price of land;
- competing EU financial supports for conventional agricultural enterprises;
- advances in livestock management systems have made farming less labour intensive and more convenient (e.g. baled silage, slatted units and marts held at weekends);
- environmental restrictions such as Natural Heritage Areas and Special Areas of Conservation. The area threshold necessitating an environmental impact assessment has been reduced recently;
- no tradition or culture in farm-forestry;
- land converted to forestry cannot be changed back to agricultural use.

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Recent improvements in the grants and premiums for forestry, more efficient payment systems and positive changes in land classification, whereby the forestry premium is now paid at the same rate, whether the area is disadvantaged or not, have encouraged many farmers to consider forestry as a land-use option. However, other measures, such as the penalty system (a percentage of the grant or premium can be withheld for not complying with the conditions of grant aid) and requirements to comply with new environmental regulations discourage farmers from planting trees. To maintain the present level of planting at ca 13,000 ha, or to increase it, the IFA has identified a number of key areas that need to be addressed, otherwise this target will not be realised.

The afforestation premium

The forest premium must be made attractive to farmers. Annual returns need to be higher than those from other farming enterprises, especially since it involves a change in land use and the land is committed for forestry use thereafter. The premium should be index linked to the cost of living. Premium rates should be higher during the early years of the scheme, thus making it more attractive to older farmers. If complying with environmental regulations is likely to reduce the commercial return from a crop, then the farmer should be compensated through higher premiums.

Market for semi-mature plantations

There is an urgent need to develop a system for marketing semi-mature forests. The long rotation length (about 40-140 years) is a drawback for farmers wishing to draw down predicted future income. Farmers should be able to realise a reasonable early return on their investment, especially if they experience financial difficulty, ill health or they wish to retire.

Broadleaf forestry

Planting broadleaves may not be commercially attractive. Furthermore, there is a paucity of information on the potential financial returns from broadleaf forestry. In general, good quality land is required to grow broadleaves and farmers can probably derive a greater return from other farming enterprises. The successful establishment of a broadleaf crop requires ongoing maintenance and protection (e.g. preventing deer damage), which can be costly and time consuming.

A new programme is required to encourage farmers to plant broadleaf trees and help Ireland comply with the requirement under EU regulations that 30% of newly planted areas are covered by broadleaves. To this end, a substantial increase in the broadleaf premium or financial incentives for planting broadleaves on lower quality sites is needed.

Social welfare

Farmers may lose their social welfare entitlements if they receive forest premiums. However, €3,800 of income from the Rural Environmental Protection Scheme (REPS) is disregarded in means testing under the Farm Assist Scheme. A similar exemption should apply for beneficiaries of the forestry premium.

Timber markets
Until recently, few farmers were concerned about the market for timber. Many analysts claimed that there would be a shortage of timber in Ireland and the EU for the foreseeable future. Timber prices were expected to increase at least in line with inflation. However, there is increasing anxiety about this matter, especially since much of the land planted during the early part of the forestry grant scheme is now approaching the thinning stage (e.g. land planted under the Western Package Scheme). A recent Timber Industry Development Group (TIDG) report (Department of Enterprise, Trade and Employment 2001) did not advance any new ideas that are likely to solve this problem. Confidence in forestry could easily be shattered if the market for this timber is poor, and consequently many prospective growers will be discouraged. The current Government Strategy (Department of Agriculture, Food and Forestry 1996) on forestry has mainly focussed on encouraging tree planting. The problem of marketing timber and finding alternative uses for wood must also be addressed in any new plan. Furthermore, research is needed to find alternative uses for wood, including wood as an energy source.

The IFA is asking the Government to consider the proposal that a management programme is established to ensure that the farm-forestry resource is managed to its full potential. If this is not done, farmers may be dissuaded from becoming involved in forestry.

Promotion of forestry
The AgriAware programme has been highly successful in improving the image of farming and food production. A similar programme, perhaps called ForestAware, could be used to promote commercial and other forestry issues.

Forestry appears to attract a disproportionate amount of attention from environmental groups. Many farmers fear that environmental and other policies may be changed to favour the views of environmentalists and other groups, perhaps making commercial forestry less attractive to them.

The environmental benefits of forestry as a carbon sink to help reduce predicted global warming are well documented. However, mechanisms have not been put in place to allow forest owners to derive an income from carbon trading.

It has been suggested that new forestry developments lead to population declines in rural areas. These developments may be consistent with the National Spatial Strategy (Department of the Environment and Local Government 2002), wherein towns and villages are considered the most suitable locations for new homes. This policy may have adverse implications for the sustainability of rural communities and the fabric of rural Ireland. Forest sites should be considered as potentially suitable for one-off residential development. Such developments would likely provide more affordable housing for rural families in a private rural setting while blending well into the rural landscape. In addition, the potential economic value of forests would be enhanced if housing development were an option, thus making forestry investment more attractive.

Summary and conclusions
A large number of farmers have already been attracted into forestry. Their experience in forestry will influence others contemplating this step. The level of planting will continue to be influenced mainly by the premium value. However, the ease with which forests can be traded will influence the potential value of forests. Farmers are concerned also

that the market for timber is less robust than many analysts have suggested. Farmers are not confident that future Government policies will continue to be favourable towards forestry. To maintain the planting programme at its present level, forestry must be made more attractive to farmers. In addition to those currently establishing forests, about 1,000 farmers, investing more than €50 million, need to plant trees each year if the government-planting target is to be realised.

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Options for farmers in forestry

Donal P. Whelan[1]

Abstract

The current private forest estate in Ireland is described and assessed, and the challenges facing farm forest owners are defined. Potential strategies are identified by which the private growing sector can meet these challenges. Services and organisational structures required for the future are identified. Important conclusions can be drawn from this analysis and from the experiences of the Irish Timber Growers Association.

Farm forestry owners must be well informed and well organised in the future in order to successfully meet the challenges outlined. It is vital that they have access to ongoing support services and that timber growers have a strong representative voice in the development of future forestry strategy, regulations and legislation. Experience in Scandinavia suggests that an effective way to achieve these objectives is to develop strong timber-growing organisations. These not only provide information and back-up services to their members but are also involved in the marketing, harvesting, haulage and even the processing of members' forest produce.

Introduction

In order to address the options for farmers in forestry it is important to assess the current private forest estate in Ireland. From such an assessment we can then define the specific challenges which lie ahead for farm forest owners. The ways in which the private growing sector can meet these challenges can be defined from this assessment. The services and organisational structures required for future challenges can also be identified. Important conclusions can be drawn from this analysis and from the experiences of the Irish Timber Growers Association (ITGA). This assessment is most important for timber growers, but it is also valuable for the timber industry, and those supplying services to growers (for example members of the Society of Irish Foresters).

The private forest estate

The total area under forest in Ireland currently is ca 665,000 ha or just over 9% of the country. The area of private woodlands is about 270,000 ha or 41% of the total forest area. The majority of private planting has been by farmers – they accounted for over 91% of the land area planted in 2001 (Table 1).

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Table 1. *Annual area of public (now Coillte) and private sector afforestation from 1985–2001.*

Year	*Public*	*Private*	*Total*
		ha	
1985	4,625	617	5,242
1986	4,688	2,280	6,968
1987	5,395	2,954	8,349
1988	7,111	4,596	11,707
1989	6,629	8,497	15,126
1990	6,670	9,147	15,817
1991	7,855	11,292	19,147
1992	7,565	9,134	16,699
1993	6,827	9,171	15,998
1994	6,622	12,837	19,459
1995	6,367	17,343	23,710
1996	4,426	16,555	20,981
1997	851	10,583	11,434
1998	2,926	10,002	12,928
1999	891	11,776	12,667
2000	1,465	14,231	15,696
2001	316	15,147	15,463
		Total	**247,391**

Overall the development of the private forestry sector over the past 13 years has been dramatic. Farmers and others have responded to the attractive government (supported by the EU) grants and premiums. These supports emerged from a radical restructuring of the common agricultural policy (CAP) and the general downturn in the fortunes of the agricultural sector.

In order to address issues outlined at a later stage in the paper it is useful to examine the profile of a typical private forest owner. He or she is most likely to be:

- a full or part-time farmer;
- one who possesses little or no forestry tradition or expertise;
- one who is generally motivated by grant and premiums.

Farm-forestry plantations are characterised by:

- small average size;
- fragmented nature;
- predominantly planted in the past 14 years;
- diversity of species;
- poor access to public roads.

Based on data obtained from the 8,667 planting grants approved in Ireland from 1990-1996 (Gallagher and O'Carroll 2001), the average size of a plantation was 9.89 ha, but ranged from less than 2 to over 100 ha. A large proportion were between 10-50 ha, but fewer than 20% were greater than 50 ha.

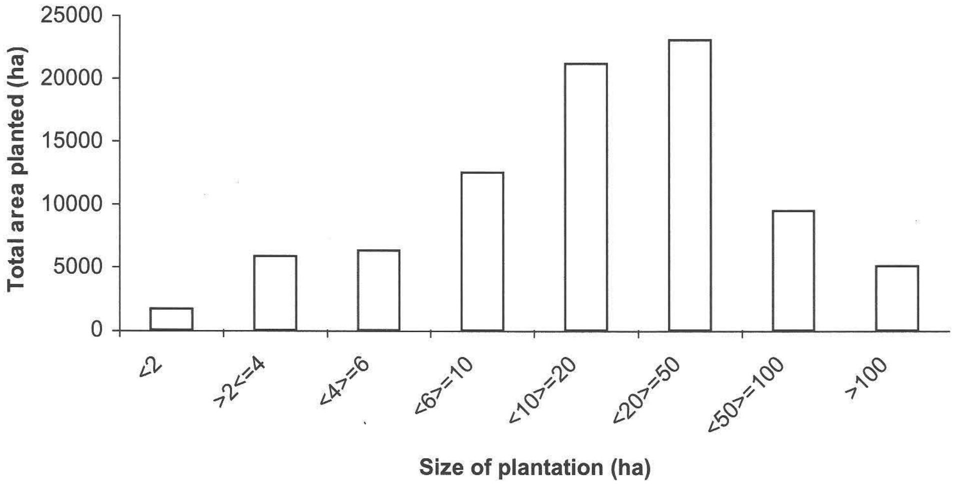

Figure 1. *Size distribution of plantations established between 1990-1996* (from *Gallagher and O'Carroll 2001*).

Challenges facing timber growers and their needs into the future

Forest owners face a number of major challenges including:

- lack of timber-growing culture in the farming community;
- ensuring a high standard of forest management;
- developing the most economic systems for the harvesting, marketing and haulage of timber from small fragmented farm plantations;
- developing future markets for the forecasted timber from private forests;
- potential over-regulation of Irish forestry;
- potential future certification requirements;
- developing appropriate private forest inventory and information technology systems.

Lack of timber growing culture

The first challenge to be addressed is the lack of a forestry tradition and timber-growing culture among those afforesting lands. Understandably, most timber growers and farm forest owners have little or no experience of forestry or forestry operations. The results of one survey conducted in Ireland (Wall and Ní Dhubháin 1998) support this view; 80% of woodland owners indicated that they would like to learn more about growing trees. While the availability of forestry training courses through Coillte and Teagasc has increased in recent years, new training and education courses in forestry need to be developed. These courses should focus on developing practical knowledge and skills training, such as those concerning planting, herbicide application and formative shaping. If a sufficient level of interest is aroused early enough it may be maintained into the crucial post establishment phase and beyond. This approach would help develop a forestry culture, bridging the gap between farming and forestry. Because a forestry culture is lacking, the level of owner participation in the establishment and management of private forestry plantations is low. Participation levels must be increased to help to ensure that private forests are well managed into the future.

It is important that all timber growers have access to professional advisory and support services. Farm forest owners must be informed of the various sources of professional forestry advice and information available to them. The Society of Irish Foresters must play a central role in providing this information and raising the profile of the profession among both the agricultural community and the general public.

Management and the harvesting, marketing and haulage of timber from farm plantations

The production of commercial timber is the primary objective of most woodland owners. However, because of the poor economies of scale in these plantations, it may be difficult to entice timber buyers to purchase wood (especially thinnings) from certain private woodlands. The difficulties include:

- small average size;
- fragmented nature;
- site access.

It can be concluded that, without the establishment and implementation of the appropriate structural and support services for farm forestry owners, the timber that is produced by the farm-forestry sector probably will not be fully exploited.

Development of future markets for forecasted output from private forests

A large increase in the availability of small diameter roundwood (particularly pulpwood) by 2015 is forecasted (Gallagher and O'Carroll 2001). It is vitally important that further markets are developed for this small diameter timber. Furthermore, the marketing and selling of the increasing volumes of Irish sawlog that are likely to become available in the future has been identified as "the single greatest challenge facing Irish forestry" (AIB Capital Markets/Merrill Lynch 2000). According to Gallagher and O'Carroll (2001), the annual production of roundwood from Irish forests will increase from current levels of ca 3.6 million m^3 to about 5 million m^3 by 2015 (Figure 2). The potential supply from the private sector is predicted to increase to over 1 million m^3 by 2015. Interestingly, most of the increase in roundwood production from 2006 to 2015 is forecasted to come from private forests. Private sector production could account for 23% of total timber production by 2015.

The production potential of the private forest sector is forecasted to increase dramatically from 2001 to 2015 (Figure 3), largely due to the fact that many of the forests established in recent years will reach the production stage during that period.

The small dimension of the material is reflected in the quantity of pulpwood in the forecasted increase in volume production. The private sector is predicted to account for more than 80% of the increase in pulpwood and small sawlog production (Figure 4).

The report of the Timber Industry Development Group (Department of Enterprise, Trade and Employment 2001) predicts a surplus over current demand levels of 600,000 m^3 of pulpwood and residues by 2005, and by extrapolation of the figures given in the Gallagher and O'Carroll study this is likely to increase to about 1.3 million m^3 by 2015. Markets must be developed for these predicted surpluses. Given the long lead-in time

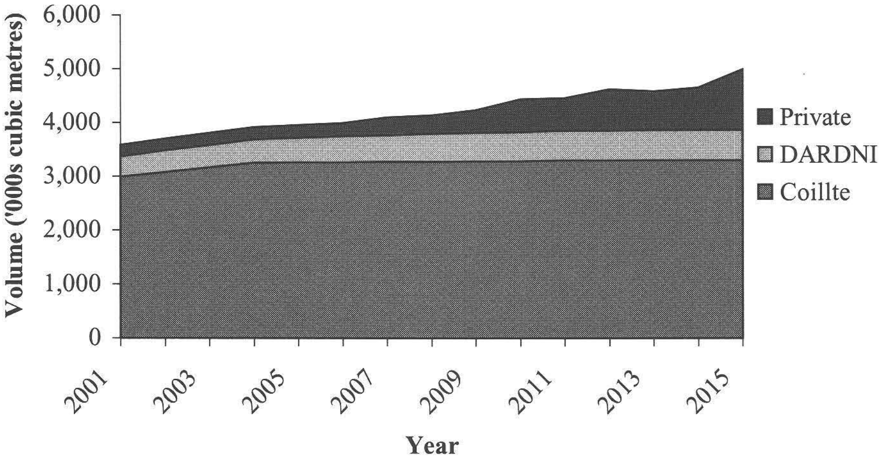

Figure 2. *Total annual forecasted roundwood production in Ireland over the period 2001–2015 (from Gallagher and O'Carroll 2001).*

required to attract new industries to use this timber, it is vital that a strategy is developed to address this problem. To this end, COFORD has helped establish a small working group to examine the feasibility of using wood for energy production. One initiative is already underway. Edenderry Power, a peat burning electricity power plant, has begun trials on the use of sawdust and wood chips for cofiring. It is likely that this will pose few problems for the power plant. If this initiative is successful, the proposed peat power plants at Shannonbridge and Lanesboro may be encouraged to burn wood also.

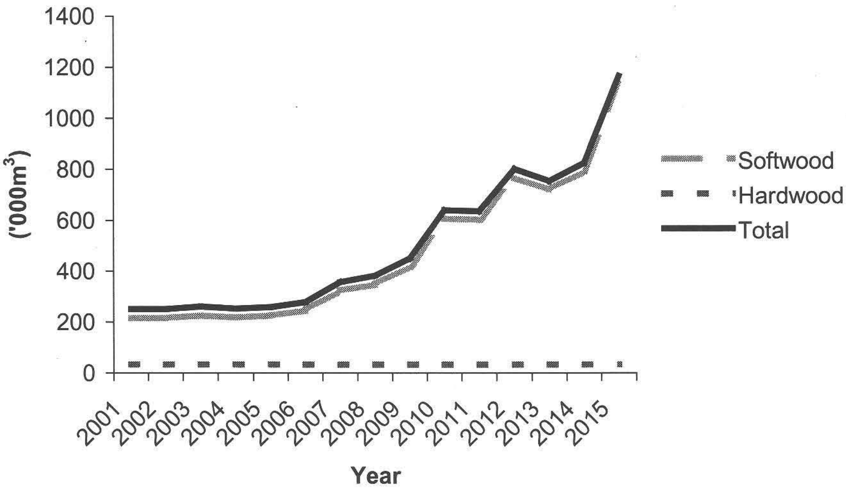

Figure 3. *Private sector forecasted roundwood production over the period 2001–2015 (from Gallagher and O'Carroll 2001).*

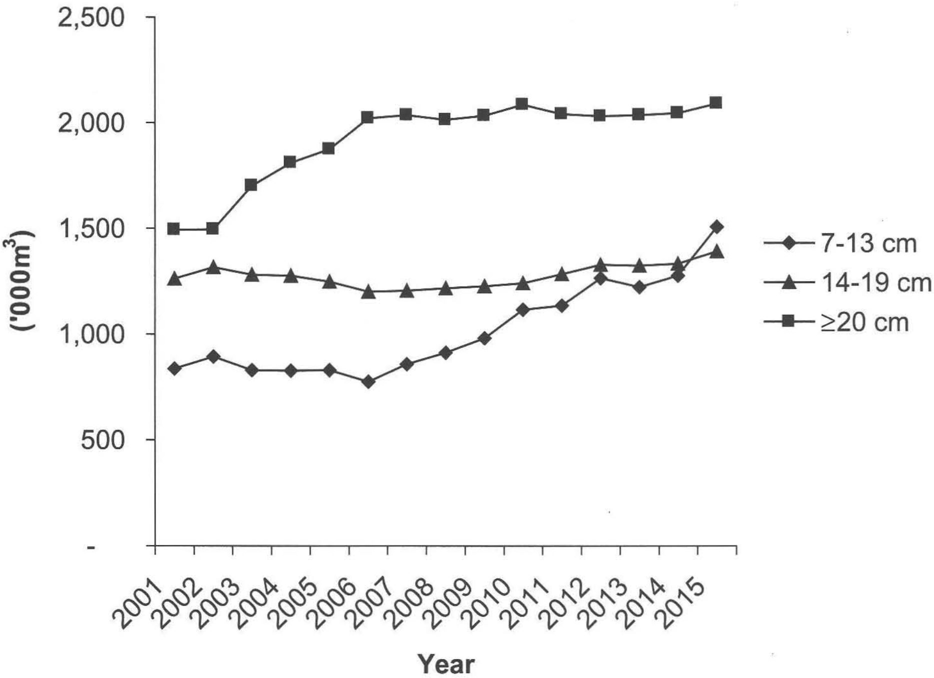

Figure 4. *Total annual softwood production by top diameter assortment class (from Gallagher and O'Carroll 2001).*

The UK timber market has been identified as having the greatest export potential for the increasing supply of sawn timber. It is predicted that the UK market will become increasingly competitive as other timber exporting countries such as Russia and the Baltic States also target this market. Furthermore, as outlined by Cormac O'Carroll (1999) it is expected that roundwood production output in the UK will almost double from 1996 to 2016. UK private woodlands will account for the bulk of this increase. When current market trends are taken into consideration it is likely that there will be a surplus of 2-2.5 million m^3 of unallocated roundwood in the UK by 2016. Unless new markets are found for this timber, it is likely that this surplus will depress UK timber prices.

It is worth noting that the price of roundwood in the UK has decreased by about 50% from 1995-2000. The processing industry in Ireland will have to become more competitive and integrated if it is to maintain the higher prices it pays to growers here than is paid in the UK. For example, the Nordic forest industry has become highly competitive in response to global competition; the Irish timber processing industry might learn from their experience.

The potential to market additional products and by-products from private forests must also be considered. In addition to the possibilities of marketing wood for energy, carbon trading from private forests should be examined as a means of maximising returns to growers. Appropriate structures should be established to promote such initiatives.

Potential over-regulation of Irish forestry
Grant conditions are more demanding, and environmental and other forestry regulations are becoming increasingly more stringent. Public consultation is now required before various forestry operations can commence. The time and costs involved in complying with all of these demands pose a threat to the economic sustainability of forestry. The forestry profession must take a more active role in informing the public of the environmental benefits of forestry and the advantages of expanding the woodland area in Ireland. There is a real risk that Irish forestry will become over-regulated.

Potential future certification requirements
It is important that woodland owners are seen to meet the demands of sustainable forest management (SFM). In order for growers to achieve good prices for their roundwood in the future, certification under an appropriate forest certification scheme may be desirable. Therefore, it is important that the ITGA and other organisations facilitate the process of group certification of private woodlands, should the owners wish to avail of certification.

Forest inventory
It is vital that an accurate inventory is made of the timber resource in private woodlands. The Forest Service and COFORD are making some progress on this matter. The forest inventory must be of practical benefit in the management of private woodlands. The ITGA have proposed that the inventory should include the following information: windthrow hazard risk, forest health, possible environmental constraints, infrastructure details, timber quality and regional roundwood volume forecast data.

Information technology
It is important that private woodland owners should benefit from the use of information technology in forestry. Appropriate structures should be put in place to promote and support new technology initiatives in forestry for the benefit of growers. Timber growers must embrace this new technology. This would also involve developing a forest inventory and planning system to help decide on harvesting and marketing schedules for private woodlands.

Organisation options for private timber growers
Afforestation has been the main focus of activity in private forestry over the past 20 years, which more recently has concentrated on reaching the national planting targets (Anon. 1996). It is essential that the forestry sector maximise financial and other returns from these forests. Structures need to be put in place to help steer the direction of future developments in forestry. These measures might consist of growers' organisations and support services, including structures to facilitate harvesting and marketing.

Organisations needed

<u>Growers' organisations and support services</u>
Farm forestry owners must be well informed and well organised if they are to successfully meet the challenges outlined above. Experience from Scandinavian countries suggests

that an effective way to achieve these objectives is to develop strong timber growers' organisations, which provide information and back-up services to their members and assist in the marketing, harvesting, haulage and processing operations. The growers may help influence the development of forest regulations and legislation through these organisations.

Harvesting, haulage and marketing of timber

Structures that facilitate the group harvesting, marketing and haulage of timber from private plantations need to be provided. There are many small, fragmented holdings, containing small volumes of timber which have relatively long extraction distances, and often have poor access to public roads. Farm forest owners must collaborate to improve the economies of scale of these operations. A group of woodlands may satisfy the demands of a potential timber buyer by offering a substantially greater volume of timber from a number of farm woodlands within close proximity of each other. This can be achieved if growers in a specific locality form co-operatives and then sell their timber as a group. In addition, the infrastructure needs to be improved and the logistics of all operations need to be planned to ensure success. An initiative has already been taken by the ITGA through a joint venture with Glanbia Plc with the establishment of the Forestry Development Association Co-Op. It is intended that the group marketing of timber harvested from farm-forests will be facilitated by this enterprise. The FDA Co-Op has now formed discussion groups. At a local level, the interest of neighbouring farm woodland owners can be channelled into these discussion groups – a format long familiar to farmers. Designed to be informal, holding meetings four times per year, the FDA Co-Op has now established six discussion groups and has had very good results. The need for long-term commitment and active management of farm woodlands is understood at the local level through this experience.

Lobbying, public relations and forest strategies

A strong representative voice for private forest owners in the development of future forestry strategies, regulations and legislation needs to be developed. Forest growers must have access to information and assistance through field days, seminars and workshops. Various organisations can help develop a cohesive, effective and accessible, integrated education and training strategy for private forest owners. Courses would improve their level of knowledge of forestry and related areas and encourage them to become involved in the management of their forests. The Forest Service of the Department of Communications Marine and Natural Resources plays a pivotal role in fostering such a strategy through the work of its forestry inspectorate.

The involvement and support of timber processors and sawmillers is crucial if the marketing of timber from these forests is to be successful. Furthermore, harvesting and haulage costs need to be reduced through increased efficiencies. These costs are the largest component of the cost of pulpwood. More economic means of mechanically harvesting and extracting timber from small farm-forest plantations must be developed. Forest owners, timber processors, harvesting and haulage contractors must work together to maximise overall cost efficiencies in this sector.

Conclusions

The private forestry sector has characteristics that pose unique challenges for the effective management and the marketing of farm forestry produce into the future. Successfully meeting these challenges has fundamental implications for the forest owners, the rural economy and the national forest industry. Education, information and support services are key methods of informing forest growers on how to implement best management practices. This can be achieved through a collaborative approach involving various forestry organisations and enterprises, both at state and private levels. The sale of timber from farm forests using a group marketing approach, through the use of co-operatives, is likely to prove the most appropriate future strategy. Timber grower organisations of the future, which develop such a strategy, will be best placed to serve their members' demands. The ITGA, through its quarterly publications, annual yearbook and industry directory, field days, annual seminars, FDA co-op joint venture with Glanbia and affiliation with the Western Forestry co-op is now ideally placed to further develop initiatives such as those advanced in this paper, enabling its large membership to maximise financial and other returns from their woodlands.

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Trees, Woods and Literature – 27

Cutting Firewood, October

South wind drives
a forest fire of fog
against the Sitka spruce, fans
the autumn flames of fern,
skunk cabbage, Devil's
club, and berry bushes
snapping at the green;
distant fog horns
like fire-engine ships
groping to the rescue.

From *Frames of Reference*, Poems by Richard Dauenhauer, published by the Black Current Press, Haines, Alaska, 1987. Reprinted by kind permission of the author.

Richard Dauenhauer was born in 1942 and was raised in Syracuse, New York. He has lived in Alaska since 1969. From 1981 to 1988 he served as the 7th Poet Laureate of Alaska. He is widely recognized as a translator, and several hundred of his translations of poetry from German, Russian, Classical Greek, Swedish, Finnish, and other languages have appeared in a range of journals and magazines since 1963. Since his move to Alaska, much of his professional work has focused on applied folklore and linguistics. He has taught at Alaska Methodist University and Alaska Pacific University in Anchorage, and teaches part time at the University of Alaska-Southeast in Juneau. From August 1983 to March 1997 he was Director of Language and Cultural Studies at Sealaska Heritage Foundation, Juneau. He lives in Juneau and works as a free-lance writer and consultant.

References to the "forest fire of fog" and "distant fog horns" well describe and connote the coastal, 'temperate rain forest' location of Sitka spruce in its native habitat along the shores of western North America. Further south from Alaska, were Sitka's range extends along coastal Washington and Oregon, climatic conditions are more similar to Ireland.

In the poem Dauenhauer extends the fire metaphor to the flames of the autumnal colours of "skunk cabbage, Devil's club, and berry bushes / snapping at the green." These images also have an ecological association; skunk cabbage (*Lysichitum americanum*) and devil's club (*Oplopanax horridum*) have a generally coastal range from Alaska to northern California and occur on moist to wet soils. Sitka spruce, of course, has a natural preference for moist soils which occur not infrequently in Ireland.

(Selection and note by *Lia coille*)

Forest perspectives

We have often heard that Ireland has lost its tree culture due to the low forest cover from the early Middle Ages. That this is not fully the case is shown in the paper by Dáithí Ó hÓgáin, this issue's article in the Forest perspectives series. His paper *Trees in Irish lore* collates the earliest recorded references to trees and forests, right down to the present day. There are many fascinating glimpses of the interaction of man and forest, long before the time when Ireland became a grazier society and was virtually denuded of its tree cover.

Dr Ó hÓgáin's paper was first delivered as the Society of Irish Foresters' Augustine Henry Lecture at the RDS in 2002. It is published here in full for the first time (Ed.)

Trees in Irish lore

Dáithí Ó hÓgáin[1]

Chuir Éire trí monga agus trí maola dhi ('Ireland was wooded three times over and denuded three times over') - old saying...

In a very interesting study, entitled *Proto-Indo-European Trees*, Professor Paul Friedrich uses the various names for trees in this great family of languages in an attempt to reconstruct the history of trees in the various parts of Europe.[2] In his conclusion, he lists from the linguistic evidence several tree-types. Eleven of these gave food to animals and men – apple-tree, cherry, beech, oak, hornbeam, hazel, walnut, chestnut, elm, ash, and linden. Nine trees served for tools and weapons – oak, ash, yew, elm, cedar, willow, pine, hazel, and aspen. Five figured prominently in religion – birch, linden, beech, yew, and oak. Friedrich mentions in particular how the oak had widespread symbolic linkage with four strong cultural symbols – namely fire, lightning, the sky, and the high god.

When we talk about the actual role of trees in a particular culture, of course, it is necessary to examine the practical role which trees have played and to decipher the progress of imagery associated with them. We will therefore find, again and again, the ideas that trees are impressive through their height, that they dominate the landscape, that they provide food and shelter, and that they are an example of rejuvenation as they restore themselves seasonally.

Natural giants

Perhaps most tellingly in the eyes of prescientific man, they ascend towards the heavens and in that are rivalled only by mountains. Particular mountains were considered to have the sky rest on them, preventing it from falling onto the earth, and trees could be considered to do likewise. One old belief was that the sky was held up by four great columns[3], and these could be envisaged as great trees, as in ordinary Irish speech we still refer to the highest things as reaching to *cranna na spéire* ('the trees of the sky'). In addition to such an imaginary function, however, trees uniquely gave immediate protection from rain and storms. Standing as intermediaries between heaven and earth, they had special connections with the otherworld and even deflected thunderbolts away from the people.

Let us begin by taking a look at two very important words denoting trees. The usual generic term in Irish for a tree is, of course, 'crann', and this represents a special Celtic semantic development from the Indo-European **kwrésnos*, which meant 'brushwood'.[4] The hazel had an importance of its own – the Irish word *coll* comes from the Indo-European word for it **kóslos*,[5] and so plentiful was the hazel in ancient Ireland that this

1 Department of Irish Folklore, University College Dublin, Belfield, Dublin 4, Ireland (daithi.ohogain@ucd.ie).
2 Friedrich (1970).
3 See the references in Cross (1952), 26-7 [Motifs A841-3].
4 See Mallory and Adams (1997), 598-9.
5 *Ibid*, 260.

particular tree has given us the word *coill* for a wood. It was also a tree associated with wisdom in early Ireland – the well from which the river Boyne rose was the source of poetry and prophecy and was surrounded by nine hazel-trees.[6] The basic Indo-European word for a tree was **dóru*, which indeed is the background to 'tree' in English, but in Irish it gives 'dair', a variant of Celtic **darus*.[7] The use of this word in Celtic languages specifically for the oak reflects a very early tendency to consider the oak as the tree *par preference*.

In line with this, in the 1st century AD, the Greek writer Maximus of Tyre reported that "the Celts devote a cult to Zeus, but the Celtic image of Zeus is a great oak".[8] He was not, of course, referring to the Greek deity Zeus, but to his Celtic cognate *Devos. This, like Deus, Dyaus, Jovis, Tiw, etc, was a variant of the name of the Indo-European sky god.[9] In Celtic tradition in Ireland this Celtic *Devos was called **dago-Devos*, meaning 'good sky', from which comes the name of the Irish father-deity the Daghdha.[10] The mystical union of this sky-father with the earth-mother was believed to bring prosperity to the agricultural world of the early Irish.[11]

Probably due to the influence of pre-Celtic religion in Ireland, the Daghdha tended to be identified with the sun rather than with the sky in general.[12] This strengthened the association of a sacred oak with the sun, a notion which was frequent among the Indo-Europeans, probably based on the ritual burning of an oak at Midsummer in an attempt to give more fire to the sun. The tall oak, connecting the sky with the earth, could be imagined as a virtual extension of the sun itself. It is therefore not surprising that an early Irish glossary gives *daur* (oak) as a synonym for *dia* (god).[13] Indeed, a poem as early as the 6th century AD refers to the Eó Rosa (a celebrated yew-tree at Old Leighlin in Co Carlow) as *dia dronbhalc*, that is, 'a firm strong god'.[14] This Irish word *dia* is, we may add, derived from the Celtic **devos* on which the name of the Daghdha is based. Such an image of a great tree could be envisaged as connecting in either direction – the sky with the earth or the earth with the sky.

A case in point may be the archaeological discoveries at Eamhain Mhacha (the hill-fort of Navan, a few miles west of Armagh city). This site was inhabited since the neolithic era, but traces of earlier structures were erased by ploughing before the major settlement there, which began in the 7th century BC. These Bronze Age inhabitants erected a palisaded enclosure on the top of the hill, with wooden huts inside it. At the beginning of the 1st century BC a whole new and larger enclosure was raised, within which were four concentric rings of oak posts and a circle of timber uprights towards the centre. In this circle again was a large oak-post sunk into a hole. It is thought that the whole inner structure may have

6 Gwynn 3 (1913), 26-39, 286-8; W Stokes in *Revue Celtique 15*, 315-6, 456 & in *Irische Texte 3*, 195.

7 Mallory and Adams (1997), 598.

8 *Dissertationes* 2.8 [8.8].

9 For sources relevant to this postulated sky-god, see Ó hÓgáin (1999), 59-61, 226. The forms of his name include Indic Dyâus, Latin Deus, Greek Zeus, Celtic Devos. Jupiter is from *Iu* (< Greek *Zev,* cognate with Umbrian *Iuve* i.e. Jove) + *Piter* (cognate with *Pater*); while Tyr (an alternative name for Odin) is from an earlier *Tiv-*.

10 See E Windisch in *Irische Texte 1*, 463; C-J Guyonvarc'h in *Ogam 11*, 284-5 and *12*, 49.

11 See the episode of the Daghdha in Gray (1982), 44. See also Ó hÓgáin (1999), 59-64.

12 On this issue, see Ó hÓgáin (1999), 59-60, 137-40.

13 W Stokes in *Revue Celtique 1*, 259.

14 Henry (1978), 145.

been roofed. There are no traces of human habitation, and there is therefore scarcely any doubt but that the function of the site was ceremonial.

Curiously, at some stage the inner structure was filled with limestone blocks and its walling burned, and finally it was sealed by covering it over with sods.[15] It has been suggested that this destruction was a ceremonial act carried out by the devotees themselves, or more simply the destruction may have been done by an enemy group. It is difficult to say but, at any rate, the striking circular plans, the use of great oak posts, and the sealing off of the whole building, leave little doubt but that those responsible for both construction and destruction were in awe of the site and regarded it as sacred.

That the site had a mystical importance emerges also from the literature, which – in addition to celebrating the place as the headquarters of the ancient Ulstermen – uses the term 'Eamhain' in general as a designation for otherworld places. Scholars are generally of the opinion that a reference which long predates any writing in Irish is the first mention of the actual site - this being the reference to *Isamnion* in his description of the country by the Graeco-Egyptian geographer Ptolemaeus in the 2nd century AD.[16] If so, the original form of Eamhain would probably have been Celtic 'Isomnis' – *is* meaning 'strong' or 'sturdy' and *omnis* being a plural variant of the word *omon* with a meaning such as 'tree-bole' or 'post'.[17] The development of this toponymic within archaic Irish would have been of the following order: *isomnis* > *ihomniah* > *eumania*. This latter form is in fact attested in early Irish literature as the designation of the Ulster capital,[18] and from it the standard form Eamhain derives.

What interests us particularly here is that the tree-posts at the site were of oak, and that the great central post may have been a ritual variant of the great world tree linking the earth with the sky. Standing at the sacred centre of the community's territory, it would have been a symbol of the prosperity of the tribe or sept, with important ceremonies centring on it. That such continued long after the destruction of the site is clear from the several references to the *óenach* or assembly of Eamhain in Christian times.[19] It is worth mentioning that the legendary Ulster warriors, whose headquarters was Eamhain Mhacha, were known to mediaeval literature as the heroes of the *craebh ruadh*. This designation has been rather simplistically translated as the 'red branch' by 19th century writers. The mediaeval writers, however, explained it as being the name of the palace of the legendary Ulster king, Conchobhar, and described that palace as an edifice constructed on red poles.[20] It may not

15 D A Simpson in *Emania 6*, 31-3; and other sources listed in Ó hÓgáin (1999), 171-3, 243.

16 See T F O'Rahilly (1946), 12-13; J Pokorny in *Zeitschrift für celtische Philologie 21*, 127 and *24*, 120; A Mac an Bhaird in *Ainm 5*, 11.

17 For *is*, meaning 'energetic' - which may have been a borrowing by the Continental Celts from the Illyrians – see Walde / Pokorny, 1 (1930), 4; Pokorny, 1 (1959), 299-301. For *omon*, meaning 'tree-bole' and later 'oak', see *ibid*, 1, 177 and Royal Irish Academy Dictionary (1913-1975) – s.v. 'omna'.

18 Hennessy and MacCarthy, 1 (1887-1901), 66-7.

19 References in Gwynn, 3 (1913), 20; E Windisch in *Irische Texte 1*, 81, 255; D Binchy in *Ériu 18*, 126.

20 References in Van Hamel, (1933), 20; W Stokes in *Ériu* 4, 26-7 & in *Irische Texte* 2 (2), 135; Cecile O'Rahilly (1970), 131; Gwynn, *4* (1924), 128, 130.

be too imaginative for us, nowadays, to consider this as a faint memory of the actual posts at the ritual centre.[21]

The toponymic Eamhain came to be given the meaning of an otherworld or mystical place, the word being used especially in the case of the otherworld island Eamhain Abhlach ('Eamhain of the Apples').[22] This was a version of the isle in the west to which the Celts believed their ancestors went. There are several other examples of the motif in early sources, but the specific island in question here seems to have developed from ideas of the British Celts concerning the Isle of Man. We may presume that, on picking up this tradition concerning the Isle of Man, the early Irish considered the island as a double of the great sacred centre on land.[23] Its association with apples reflects a general tendency in early Irish and other European sources to imagine the otherworld as a place where delicious apples could be had. From this Celtic version of the Hesperides, of course, came the Arthurian island of Avalon, which meant also 'the place of apples'.

Trees and tribes

While on the subject of mystical understandings, it is as well to mention that certain Celtic tribes referred to themselves as devotees of particular trees. In northern Gaul there were tribes called by names such as Dervones ('oak-people'), Eburovices ('conquerors by the yew'), and Viducasses ('agile woodsmen').[24] The most striking example in Ireland is the Eoghanacht, the leading dynasty in Munster from the 4th or 5th century AD until the Middle Ages. The origins of this tribe are obscure, but it would appear that they were one of two main branches of a people called Venii, whose mythical ancestor was one Ovogenos ('sheep-conceived'). The Venii were well established in the south of Ireland in the 2nd century AD, perhaps having been recent arrivals there from south-west Britain or Brittany. At some stage, a strong section of them broke off from the rest and began to move northwards, establishing a kingdom west of the Shannon. These retained the lore of an ancestor called Ovogenos, while the group who apparently were their kinsmen in the south substituted for it the form Ivogenos ('son of yew'). The latter may indeed have been a name given to a real early leader of the sept. There must have been a ritual reason for it, as the cult of the yew-tree was known in Ireland as this time, as evidenced from its occurrence in the common personal name Ivocatus ('yew-battler'). At any rate, alteration of this type to their ritual genealogy would have underlined the desired separate identity for the two septs.[25]

With the development of Celtic into Old Irish, the tribal name Ivogeni became Eoghanacht, and their ritual ancestor Ivogenos came to be known as Eoghan.[26] The image of the yew-tree as the sept's talisman continued, however, as is clear from a legend written down in the 8th century AD. This uses Christian imagery, purporting to tell of the establishment

21 The colour attributed to the poles would, of course, be mediaeval fiction. The word *ruadh* ('red') was a mistaken interpretation of *rudh* in the compound *rudhraighe* (literally 'lordly ones'), the designation of the leading group among the ancient Ulstermen.

22 Examples and discussions in Mac Mathúna (1985), 33-43; Kuno Meyer (1912), 78; W Stokes in *Irische Texte 3*, 193.

23 On this, see further Ó hÓgáin (1999), 150-2.

24 For these tribes in history see index to Ó hÓgáin (2002).

25 For the words *Ivogenos, *Ovogenos see O S Bergin in *Ériu 11* (1932), 142 & *12* (1938), 224-5; J Pokorny in *Celtica 3* (1956), 306-8; McManus (1991), 102-3; McCone (1996), 25, 131.

26 For Eoghan as a mythical ancestor, see O'Brien (1962), 618-9.

of the sept's great headquarters at Cashel, which may indeed have been a Christian foundation. The legend, however, uses other older lore, as will appear from a synopsis. We read that a nobleman of the sept, called Conall Corc, was exiled abroad for a while, but that he determined to return to his patrimony. Arriving in Munster with his wife and children, he was caught in a snowstorm and could only decipher the great Rock in the distance. On that very same day, a local swineherd had a vision of a yew-tree on top of the Rock, with angels ascending to an oratory in front of it. The swineherd told this to the local king, whose druid explained that this meant that the kingship of Munster would be centred there and that the first person to light a fire under the yew-tree would be king of the province. The local king wished to go at once, but the druid advised him to wait till morning. Thus it happened that Conall arrived at the rock before him and, quite unaware of the prophecy, lit a fire there. When the locals arrived and submitted to him, Conall understood all, and within a week had established himself as king of Munster. The place was accordingly known as Caiseal Coirc ('the castellum of Corc').[27]

Notwithstanding the role of the legendary Conall Corc, the real ritual ancestor of that dynasty was the eponymous Eoghan, and the sacred yew-tree was his symbol. There were in fact three branches of the Eoghanacht – that at Cashel, another in the east Limerick area centring Knockainey, and another at Loch Léin (the Killarney Lake).[28] All three groups had traditions of yew-trees,[29] but the east Limerick one is the most dramatic. Knockainey (Cnoc Áine) was the mystical seat of the sept's tutelary goddess Áine,[30] and she is described as daughter of the otherworld man Eoghabhal, whose name meant simply 'fork of yew'.[31] A variant of the septal name Eoghanacht was Fir Í (from Celtic **veri iwi*, 'men of the yew'), and this name was personified as a son of Eoghabhal called Fear Í or Fear Fí.[32] This character was said to have been a musician who lived in a yew-tree at the waterfall on the river Maigue at Caherass.[33] Undoubtedly referring to the same tree, another tradition claims that *cíthear a scáth thíos isin uisce go follas, agus ní fheictear hé féin for tír* - that is, that the yew itself could not be seen at that place, only its reflection in the water.[34]

It is clear that the Eoghanacht envisaged their spiritual ancestor as residing in the yew, and we may enquire as to how such a notion came about. It is appropriate to mention, first of all, that the general tendency among the ancient Celtic tribes was to regard their tribal deity as their natural ancestor. The account we have just given of the Eoghanacht sept accords exactly with that tendency, and we may suppose therefore that they envisaged their god as synonymous with the yew-tree. That species of tree is particularly noted for its longevity, for its great height, and for the pliability and strength of its timber, thereby rendering it a suitable symbol for a dynasty. It may be that its special connection with a

27 V Hull in *Proceedings of the Modern Language Association 56*, 937-50. For the Conall Corc legends in general, see Ó hÓgáin (1990), 105-7.

28 For the history of the Eoghanacht, see Byrne (1973), 165-201.

29 The yew on the Rock of Cashel – Hull, *op cit*, 942; Imleach Iubhair ('Umbilicus at the Yew' i.e. Emly) – Heist (1965), 290; Achadh Dá Eo ('Field of the Two Yews', i.e. Aghadoe) – Hogan (1910), 8.

30 For Áine, see Ó hÓgáin (1990), 20-2.

31 O'Daly (1975), 38-41, 76-81; O'Grady, 2 (1892), 2, 575. See T F O'Rahilly, 288-90.

32 O'Daly, 40-1, 58-61, 76-81; Gwynn, 4 (1924), 58; O'Grady, 2, 575.

33 O'Daly, 40, 80.

34 Printed in Todd (1848), 220.

great ancestor developed from a custom of planting a tree over the burial mound of a leader – when the tree grew, the descendants of that leader would naturally imagine it to contain the spirit of the dead person.[35] Similarly, after each shedding of its leaves the tree restored itself, and this could be taken when appropriate as reflecting the tribe's fortunes. We can therefore see why it was considered a disastrous defeat if a rival group cut down the tribal tree,[36] and why it is still believed wrong to interfere with a tree growing on a tumulus or even in a graveyard.[37]

The other supposed branch of the Venii, which moved northwards, took over the fertile and prestigious plain of Meath in the 4th century AD. They still claimed descent from an ancestor called Ovogenos (by then pronounced Ughan), but they used the title Condos (meaning 'wise head') for their leaders.[38] This title became Conn, and the sept therefore came to call themselves Connachta. They developed a legend that they had had a great king called Conn Céadchathach, whose career was used to reflect their rivalry with the great southern sept. Accordingly, lore grew up which claimed that Conn Céadchathach had fought a war against Eoghan Mór, legendary leader of the Eoghanacht, as a result of which these two worthies divided Ireland between them into two halves.[39] Nor were the Connachta slow to turn tree-lore to their own advantage. By the 8th or 9th century AD they were claiming that a great seer of old called Fionntan mac Bóchna, who had survived the Biblical flood, got a handful of berries and sowed these in the ground at different places.[40] From these berries grew up the five great trees of Ireland, which we shall enumerate presently.

Trees and kings

More specifically, the Connachta sept claimed that on the night of the birth of Conn, as the beginning of a great new era, the landscape of Ireland took on its modern shape. Among the wonders to appear was a great oak tree which had been hidden for ages – this tree was growing on the plain of Mughain (in the south of modern Co Kildare). It was claimed to be 'the son of the tree of Paradise', and it gave three yields of acorns each year.[41] The symbolic connection of Conn with trees is underlined again in a source from the same period, which states that during his reign "a hundred clusters grew on each stem, a hundred nuts in each cluster".[42]

Tradition claims that Conn had as his initial rival the mythical Leinster king Cathaoir Mór. We may surmise that this name Cathaoir (from Celtic **Catuveros*, 'man of battle')

35 Several motifs in folklore may be survivals of, or connected with, this idea e.g. spirits or souls of the dead surviving within trees, trees bleeding when cut, trees being co-oeval with their planters, people confiding their secrets to trees, voices and strange sounds heard from trees. For such motifs, see Ó Súilleabháin (1942), 280-1; Plummer (1910), *1*, cliii.

36 See A T Lucas in *Journal of the Cork Historical and Archaeological Society 68* (1963), 21, 25-6.

37 *Ibid*, 21, 33-4, 42-4; Ó Súilleabháin (1942), 280-1.

38 See T F O'Rahilly, 184-92, 281-5; Ó hÓgáin (2002), 204, 211-3, 218.

39 For this, and references, see Ó hÓgáin (1990), 116-9, 182-3.

40 Vendryes (1953), 4-5; R I Best in *Ériu 4*, 151; K Meyer in *Anecdota from Irish Manuscripts 1*, 35; For Fionntan in general, see Ó hÓgáin (1990), 224-5.

41 Vendryes (1953), 4-5; Jackson (1938), 51.

42 *Ibid*, 26. A similar image of plenty became associated with the reign of another legendary Connachta hero, Cormac mac Airt – see Ó hÓgáin (1990), 126-7.

was in reality a title given to ancient kings of the Laighin or Leinstermen, who were indeed displaced from Tara by the Connachta in or about the 4th century AD.[43] Whereas lore of this mythical Cathaoir is extant from as early as the 6th and 7th centuries AD, the only account connecting him with a tree is found in an 11th-century poem. Here we read that, in the prime of his life, Cathaoir dreamed that a beautiful lady appeared to him. She was pregnant for a long time and then gave birth to a son. Cathaoir next dreamed that he saw on a great hill nearby a fragrant golden tree which gave all kinds of fruit and from which most pleasant music came. On awakening, Cathaoir called his druid, who interpreted the dream for him. The lady was the Sláine (river Slaney), her son was the harbour of Loch Garman, and the great hill was Cathaoir's own power. The wonderful tree, a protection from storms, was Cathaoir himself. Its music was his "noble eloquence when appeasing a multitude", and the wind which shook down its fruit was his great generosity.[44]

This poem, like texts in some other European literatures, makes use of the Biblical account of the tree seen by the Babylonian king Nabuchadnezzar in a dream, which personified that king himself.[45] There is, however, something of very old native Irish tradition involved in the description of Cathaoir as a tree 'branching wide, full of fruit – yourself in your kingship over sweet Banba, and over every dwelling in Ireland.' In this, he is the ideal Irish king who protects his followers. The very word for a king, *righe*, incorporates this function, for it is based on a root meaning to 'stretch out', and indeed the word *righe* is still used for the forearm in Irish. The arm of the king, ceremonially stretched forth, parallels the spreading branch of a tree, and as a tree is protective so also should the proper king be.[46]

This symbolism of a king as a great protective tree is common in Indo-European languages, but is particularly marked in Irish, where another word serves to identify the two. This is *bile*, from the Celtic *bilios*, which originally signified a large tree but has come to mean also a social champion. Although this word *bile* is now obsolete in spoken Irish, it is perhaps the most frequent word to describe a large tree in the literature and it is well attested in placenames throughout the country.[47] It is much used in praise of individual leaders in encomiastic verse. Since the tree was a symbol of protection, the man whose function was the protection of the tribe was closely associated with it. Thus, kings and chieftains were inaugurated by their people underneath the great tribal tree. This custom survived into the Middle Ages and later. Under a remarkable tree in Clooney, Co Clare, the O'Briens were inaugurated as kings of Thomond; the Ulaidh kings were inaugurated at Craobh Tulcha, a wide-spreading tree near Glenavy in Co Antrim; the Maguires had for the same purpose a thorn-tree at Lisnaskeagh fort in Co Fermanagh; while a number of inauguration trees are referred to at the O'Neill inauguration site at Tullaghogue in Co Tyrone.[48]

Within this same context we can discuss the custom of deriving personal names from trees. The ancient Celts on the Continent and in Britain did this, as for example in the case

43 See K Meyer in *Sitzundsberichte der Königlich Preussischen Akadamie de Wissenschaften* 3 (1913), 45; Ó hÓgáin (2002), 204, 211.

44 Gwynn, *3* (1913), 174-83. For Cathaoir in general, with references, see Ó hÓgáin (1990), 76-7.

45 *Book of Daniel* 4.4-27.

46 See Benveniste, 2 (1969), 9-42; Ó hÓgáin (1999), 153-4; Royal Irish Academy Dictionary – s.v. 'rige', 'rigid'.

47 A good selection is given in Lucas, 16, 36-9, 52-4.

48 Lucas, 25-6. See also Plummer, 1 (1910), civ.

of the individuals called Eburos ('the yew-man'), Deruacos ('man connected with the oak'), Viduogenos ('conceived from the tree'), Dervogenos ('conceived from the oak'), Vernogenos ('conceived from the alder').[49] In early Ireland we find similar personal names - for both fictional and historical persons – such as Mac Caerthainn ('son of rowan'), Mac Iubhair ('son of yew'), and Mac Dara ('son of oak'). The name Mac Cuill ('son of hazel') is indeed given by the mediaeval writers to a leading personage among the divine people, the Tuatha Dé Danann – one of a trio, the other two of which were Mac Cécht ('son of healing') and Mac Gréine ('son of the sun').[50] A particular Gaulish god bore the name Ollovidios, meaning simply 'great tree'.[51]

Trees and places

In the case of placenames, the associations with trees can be derived either from tribal names or – more usually – from the existence of a prestigious tree at the location. A very long list could be given here, but a few will suffice. For instance, Magh Bhile ('the plain of the tree') in Cos Down and Donegal; Maigh Eo ('the plain of the yew'), anglicised as Mayo; and the several places called Cnoc an Bhile, Ráth Bhile, etc. Newry, of course, is an tIúr ('the yew-tree') or – in extended form Iúr Cinn Tráchta ('the yew at the head of the strand'). Its anglicised form probably comes from reference to the actual town which grew up there – viz Baile an Iúraigh. In this form the nominative was Iubharach, from Celtic 'Eburacum' ('place of the yew-tree'). In Britain this placename Eburac- became York, either from a yew-tree growing there or from the settlement there of the Gaulish tribe called Eburaci ('devotees of the yew').

On the eastern verge of ancient Celtdom, Strabo described how the Galatian judicial council assembled at a place called Drunemeton ('great sanctuary') in Asia Minor.[52] Several places in the western Celtic world were also referred to by this word 'nemeton', indicating that these were sacred centres. Instances are Nemetodurum (Nanterre in France), Nemetobriga in Spain (now Puente-de-Navéa), Medionemeton in Scotland (now Kirkintilloch), and Vernemeton between Lincoln and Leicester in England.[53] The word 'nemeton' is based on the element **nem-* ('sky'), indicating the divine status of the firmament, and many such shrines are thought to have been situated in forest clearings.[54] This tendency towards arboreal settings appears also from the Greek *némos* for a wood and the Latin *nemus* for a forest sanctuary.

The Irish form of the word is 'neimheadh', and this is a designation used for several sites - for instance, one in the Fews Mountains in Co Armagh, one at Downpatrick, and one apparently near Newgrange in Co Meath.[55] The word was sometimes prefixed with *fiodh* ('tree') to indicate such a location, and a sacred tree itself could be referred to by this word.[56] An Irish poem from the 7th century AD states a prohibition against cutting down

49 MacCulloch (1911), 202.

50 For these various names, see Macalister, 5 (1956), 14-7, 78-9; Plummer, 1 (1910), cliv-clv; Lucas, 22; Henry, 233; Comyn (1902), 222.

51 Ross (1967), 225-6; Green (1992), 166.

52 *Geographicon* 12.5.

53 Piggott (1974), 54-7; Dottin (1915), 505; Chadwick (Cardiff, (1966), 13-4.

54 See especially Le Roux and Guyonvarc'h (1986), 226-31.

55 Hogan, 554 – s.v. 'nemed'; Royal Irish Academy Dictionary - s.v. 'neimed'.

56 Royal Irish Academy Dictionary - s.v. 'fid'; Lucas, 27-8.

such trees,[57] and an Old Irish glossary states that it was in the *fiodhneimhidh* 'that the seers used to perform their rituals'.[58] Another word in early Irish for such a site was *défhidh*, meaning literally 'divine wood'.[59] We can, accordingly, relate the imagery of sacred sanctuaries in Ireland to those of the Celts abroad.

The ancient Celts had a goddess called Dea Advinna in the Ardennes and another called Dea Abnoba in the Black Forest, and in Celtic areas of northern Italy a type of fairies was known as Dervones or 'oak-spirits'.[60] The forest was regarded as a particularly otherworldly place by these Continental Celts. The Spanish writer Pomponius Mela claimed that the druids taught their students in 'secluded dales'.[61] This practice is again referred to by another Spanish writer in Latin, Lucan, who in sarcastic verses addressed the druids: 'To you alone it is given to know the truth about the gods and deities of the sky, or else you alone are ignorant of this truth; the innermost groves of far-off forests are your abodes.'[62] On this issue of groves, Pliny gives his famous, if rather dubious, account of the Gaulish druids' ceremonies in the forest. We will not refer to it here, beyond remarking that the basic situation described by him is quite plausible: 'They choose groves formed of oaks for the sake of the tree alone, and they never perform any of their rites except in the presence of a branch of it... In fact, they think that everything that grows on it has been sent from heaven and is a proof that the tree was chosen by the god himself.'[63]

It is strange that no lore seems to have survived in Ireland concerning actual forest spirits. Perhaps the common motif of poets and musicians encountering the fairies in sylvan settings and gaining inspiration from them is an echo of such. There is one little story told in an Old Irish text (dating from the 8th or 9th century AD) which is of interest as it may preserve some ancient Celtic narrative tradition of the forest, although its imagery has - as you will notice - been fused with an international narrative plot, that which occurs in the story of Joseph and Potiphar's wife in the Old Testament.[64] The story tells that the great hero Fionn mac Cumhaill had a servant called Dearg Corra. A paramour of Fionn made advances to this servant, who rejected her, and she in revenge claimed that he had tried to rape her. Believing the false charge, Fionn banished the servant from his presence, but later while hunting came across him again in the forest. Dearg Corra was sitting in a tree, eating a meal along with a blackbird, a trout and a stag. His identity was hidden by a druidic 'cloak of concealment', but he was recognised by Fionn, who had magical knowledge.[65] It may be that Cernunnos, the horned Continental Celtic deity, patron of animals, is reflected here, for Cernunnos was represented iconographically in a seated position, surrounded by various animals.[66]

57 D A Binchy in *Celtica 9*, 156-9; Henry, 144, 233.

58 W Stokes in *Archiv für celtische Lexikographie1*, 272.

59 Royal Irish Academy Dictionary - s.v. 'defhid';

60 MacCulloch (1911), 198; Vries, (1961), 90, 117; Dottin, 112, 316.

61 *De Situ Orbis* 3.2.18-9.

62 *Pharsalia* 1. 450-8.

63 *Historia Naturalis* 16.249.

64 *Genesis* 39:7-23.

65 K Meyer in *Revue Celtique* 25, 344-9. See also E J Gwynn in *Ériu* 11, 152-3 and Ó hÓgáin (1988), 46-9.

66 For Cernunnos, see Mac Cana (1970), 42-8; Ross, 421-3, 517; Thevenot (1968), 144-52; Green (1986), 190-9.

Trees and saints

The term *fiodhneimheadh*, meaning 'a sacred place of trees', which we have already discussed, survived from pre-Christian times into the Christian culture of Ireland. It is noticeable that many of the sites of early Christian foundations were in fact earlier cultic sites, and in his very scholarly paper entitled 'The Sacred Trees of Ireland' Dr A T Lucas suggests that the presence of trees was an important element in the changeover. Thus the early Irish laws explain the term *fiodhneimheadh* in a very Christian way as *fiodh cille*, and the word *neimheadh* itself came to be used as a term for a consecrated place such as a small chapel or oratory. There was indeed, a sacred grove at Armagh, site of St Patrick's most important foundation, and it could well be that this grove predated the saint's presence there. It can hardly be doubted that St Brigid's Christian foundation was originally the site of an oak cult, as the Christian toponymic Cill Dara ('church of the oak') suggests.[67]

That this association of saint with tree persisted is clear from a story in the mediaeval literature concerning St Ruán of Lorrha in Co Tipperary. According to this, Ruán had a wondrous tree growing near his monastery, the sap of which provided full sustenance for all who tasted of it. The other saints of Ireland grew jealous of him on account of this tree and of his holiness, but he reconciled them to himself by entertaining them with a fine feast, which he miraculously produced.[68] On a wider plain, many claims are made throughout Ireland that particular woods and trees were originally planted by the patron-saint of the area in question.[69]

Nowhere is this fusion of pre-Christian with Christian elements brought out clearly than in the tradition of St Colm Cille, whose great foundation in Ireland was of course at Doire (meaning 'oak-wood'). It was said that Colm Cille had left a curse on anybody who unnecessarily felled a tree in that wood, and in illustration of this the Annals indeed record how a man wounded his foot with his own axe when cutting a piece of wood at Derry in the year 1188.[70] Later tradition claimed that Colm Cille changed the design of his church there from facing east so as not to interfere with the trees, and it was said that the most frightening thing to him was 'the sound of an axe in Derry'.[71] Other saints also were fiercely opposed to interference with their forests. A fanciful life of St Kevin claims that he was so enamoured of the forest at Glendalough that he left the promise of 'hell and short life to anyone who should burn either fresh or dry wood from this forest till doom'.[72]

In reality, of course, such was not simply a pious saintly injunction – it was a survival of the pre-Christian notion among the Celts that a forest was sacred. It is a little ironic, and quite amusing, to consider that the opposite view prevailed among Christians working in Celtic areas abroad. Thus, church sources in early Christian Gaul condemned the belief that certain trees were too sacred to be cut down. St Martin of Tours, indeed, was allowed to destroy a Celtic temple, but the people would not permit him to attack a much venerated pine-tree which stood beside it.[73] The reversal of Christian attitudes to favour the sacred

67 On the historicity of St Brigid, see Lucas, 32; Ó hÓgáin (1999), 202-4.
68 Plummer, 1 (1922), *1*, 320-1 [translation = 2, 311-2].
69 Lucas, 27-40. See also Plummer (1910), *1*, clii-clv.
70 Hennessy and MacCarthy 2, 212-3.
71 O'Kelleher and Schoepperle (1918), 82-5.
72 Plummer (1922), *1*, 127.
73 MacCulloch (1911), 204.

tree in Ireland is enlightening in terms of the unique nature of Irish Christianity, which was rural in character and blended more easily into pre-Christian tradition.

The great ones

The most celebrated of the great old trees of Ireland was the Bile Tortan, which was situated at Ardbraccan, near Navan in Co Meath. It was in the territory of a tribe called the Uí Tortan, and it is significant that both tree and tribe bore the same name. We may presume that, accordingly, Tortu was the name by which the ancestor deity was referred to in that district. It is described as an ash-tree, and it fell in the 7th century AD. The mediaeval placelore cites much of the lore concerning this tree, which is both enlightening and fanciful, and it is as well to synopsise it here. We read that the men of Tortu used to assemble around the huge tree, which gave them protection from storms. It towered above the forest, being fifty cubits in thickness and three hundred cubits in height. It gave out a deep sound during storms, as the wind tore leaves from it. After standing there for centuries, age began to take its toll and the tree began to lose its colour. It was finally knocked down by the wind, crushing one hundred and fifty men. After the tree's collapse, the plain of Tortu lost much of its prosperity. One very mystical account echoes the notion of a world tree, stating that the Bile Tortan existed since the beginning of the world, and that its branches reached to the very sky, being full of fruit and of singing birds.[74]

Around the same time, as we read, fell the Eó Mughna, termed the 'Yew of Mughain', although it seems to have been in fact an oak. It was situated – as its name shows - in the area of Mughain, in present-day Co Kildare. The placelore claims that this tree was thirty cubits in girth and three hundred cubits in height, that over a thousand people could shelter in its shadow, and that it produced annually nine hundred sackfulls of acorns. Quite extraordinarily, it bore fruit no less than three times a year and, even more extraordinarily, gave three kinds of fruit – namely acorns, nuts, and apples. The motif of such a fanciful yield parallels the varied fruitage given by the Elysian trees in Classical mythology, and may indeed be a direct borrowing from that source. Even stranger was the cause given for the tree's collapse – that, having been satirised by the well-known poet Ninine, it withered away and then fell southwards over the plain of Ailbhe in south Kildare. The story was that Ninine composed the satire after a demand of his was refused by the local king.[75] Needless to say, this is scarcely historical, and the poet Ninine seems to have lived in the 6th century, a few generations earlier.[76]

It is said that another great tree, the Craobh Uisnigh, fell in that same period in the 7th century. This was an ash, and was situated at Uisneach in Co Westmeath, reputedly the exact centre of Ireland,[77] from which we can surmise that it was especially symbolical of the world-tree. Although the Craobh Uisnigh crashed, this tradition lived on for a long time, for an aged thornbush in the townland of Loughanstown in that same county was

74 Bieler (1979), 162-3; Stokes (1887), 185; Stokes in *Revue Celtique 16*, 279; Gwynn 3, 148-9 & *4*, 240-7, 440-1; Hennessy (1866), 77.

75 For the sources on this tree, see Henry, 145; Gwynn, 3 (1913), 144-9, 505; Stokes (1905), 258-9 & in *Revue Celtique 15*, 420 & *16*, 279; Vendryes, *op cit*, 4.

76 For the sources on this tree, see Henry, 145; Gwynn, 3 (1913), 144-9, 505; Stokes (1905), 258-9 & in *Revue Celtique 15*, 420 & *16*, 279; Vendryes, *op cit*, 4.

77 For references, see Lucas, 18. On the importance of territorial centres in Celtic cultures, see Le Roux and Guyonvarc'h, 217-26.

claimed by local inhabitants over a thousand years later to mark the 'navel of Ireland'.[78] The other two great trees of early Ireland were the afore-mentioned Eo Rosa and the Craobh Dháithí. The Eo Rosa ('Yew of Ros'), stood at Old Leighlin, Co Carlow. The rather imaginative account of its fall is that the saints of Ireland coveted its timber for church-building and gathered around it to fast and pray for its collapse. The prayers caused its roots to move, but only the prayer of St Laserian was powerful enough to actually bring the tree down.[79] The Craobh Dháithí seems to have been named from the famous king of the western Connachta tribe in the 5th century AD, Nath Í or Daithí. It stood at Farbill in Co Westmeath, which placename derives from the tribal name *Fir Bhile* ('men of the tree'), which actually meant the tribe devoted to this particular tree.[80]

The veneration of individual great trees continued for a long time, and vestiges of it can still be noticed in popular practice. Old trees at holy wells, in churches, and in grave-yards, are held in high regard, and it is regarded as almost sacrilegious to interfere with them. Echoes of older pre-Christian tradition may be identified in the widespread belief that a tree which stands alone in a field, especially if it is a white-thorn, should never be felled – such a tree is called a *crann sí* or 'fairy bush'. Many stories are told of people who interfered with these trees, and who suffered some misfortune as a result. The timber of a tree which grows beside a holy well is especially efficacious – people often take chips of such timber with them for protection when going on journeys abroad, and it is said that the timber will not burn in a fire. A common migratory legend tells of a person attempting to cut down such a tree for fuel. He imagines that he sees his house on fire and runs to extinguish it. Finding that he was mistaken, he returns to his work at the felling; but the illusion is repeated and he rushes home again a second time, to find his house still intact. He again resumes the felling and cuts down the tree, but when he goes home this third time he finds that his house is indeed burnt to the ground.[81]

The protective quality of the old great trees was not just against the weather, but also against lightning – a natural enough supposition, as lightning would first strike the highest object in the landscape and the tree would therefore function as a rudimentary lightning-conductor. We find this function being shared since mediaeval times with church buildings, for it is often said that lightning will not strike within hearing distance of the bell of a particular church.[82] Christian culture has, however, reciprocated by making its own contributions to Irish tree-lore. Such is from the ordinary stock of European Christian lore, such as the attribution of various aspects of the landscape to imagined events in the life of Christ. It is said, for instance, that the elder sheds its leaves early and the ivy is evergreen because the former refused to shelter the refugee Jesus whereas the latter willingly did so. With a slightly more poetic touch, the fuchsia which grows plentifully on the bushes in many parts of Ireland is called *deora Dé*, 'God's tears' as he observes the wayward world.[83]

78 Lucas, 48.
79 O'Hanlon, 4 (1875ff), 218.
80 W Stokes in *Revue Celtique 16*, 279.
81 See Lucas, 40-1, 46-7; Ó Súilleabháin, 463, 469.
82 See Thompson (1955-1958), motif D2141; Ó Súilleabháin, 403-4; Ó hÓgáin (1985), 61, 327.
83 This term is now general in the Gaeltacht of West Kerry.

A community of trees

Some words should be said about the qualities residing in some trees, according to popular lore. Although the oak was especially associated with Continental druids, and seems to have been to the fore in early Ireland also, it is less stressed than other trees in post-mediaeval tradition. The rowan-tree, in Irish *caorthann* and popularly known in English as 'mountain ash', was regarded as having particular magical powers, and one old source calls it *fiodh na ndruadh* ('the tree of the druids').[84] In the mediaeval literature wizards are described as using branches of it, or timber from it, to weave spells;[85] and we read that the Irish druids slept on rods of rowan in anticipation of a vision.[86] It was usual until recently for a sprig of rowan to be kept in the house in the belief that it prevented fire, or to be put in the milk-pail and around the churn to prevent magical milk-stealing. If tied into the halter of a horse, it protected it from the 'evil eye' and from other misfortunes, and if placed in the collar of a greyhound, it guaranteed speed at racing.[87] The power of the hazel was also preserved in later folk tradition – for instance, a hazel-rod was believed to be efficacious against spirits and various misfortunes.[88]

On the other hand, the whitethorn (usually called *uath* in Old Irish and *sceach gheal* in the modern language) was considered a dangerous bush, closely connected with the fairies, and nobody would bring a sprig of it into the house.[89] An old Irish text describes how a group of poets would gather at a whitethorn bush in order to chant a satire against their enemy.[90] Miscellaneous motifs could attach to various trees in folk tradition – for instance, the willow was often regarded as lucky while the alder was unlucky[91] – and many and various were the uses made of trees and plants in folk medicine.[92] The ash is, of course, highly appreciated as the material for making hurleys, and in modern parlance 'the clash of the ash' has become a synonym for the national game. A great friend of mine, who was both a hurler and hurley-maker, once told me that the old generation considered the female ash to be superior to the male for making hurleys, because the female had more give in it.[93] More spring! Or more tolerance, perhaps!

84 K Meyer in *Archiv für Celtische Lexikographie* 2, 298-9.
85 See in particular the 16th-century Fianna text *Bruidhean Chaorthainn*, edited by Mac Piarais (1908) and also Joyce, 1 (1903), 236-7; MacCulloch, 201.
86 Plummer (1922), *1*, 34-5 [translation = *2*, 33-4]; Dinneen (1908), 348-50.
87 Lucas, 45.
88 Ó Súilleabháin, 282.
89 See Ó Súilleabháin, 282-3.
90 W Stokes in *Revue Celtique12*, 119-21. See also Le Roux / Guyonvarc'h, 176-7; Mary Claire Randolph in *Folk-Lore 53-54*, 362-7.
91 Ó Súilleabháin, 281-2.
92 *Ibid*, 281-8. On this, see also Logan (1972).
93 Told to me about twenty years ago by the late Pádraig Ó Caoinleáin (Paddy Quinlan), a native of Bottomstown, Co Limerick.

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Book reviews

Forest Policy for Private Forestry: Global and Regional Challenges. Edited by Lawrence Teeter, Benjamin Cashore and Daowei Zhang. CABI Publishing. Xvii + 307 pp. Price Stg. £65.

The chapters in this book were selected from papers presented at a conference on *Global Initiatives and Public Policy: First International Conference on Private Forestry in the 21st Century*, organised by the Forest Policy Centre of Auburn University in 2001. While a serious attempt is made to deliver on the global aspects of private forestry policy there is a considerable emphasis on private forestry in the United States. The papers were edited by the staff or adjunct staff of Auburn University with the assistance of Benjamin Cashore of Yale University.

The book is well laid out with brief notes on the authors and a subject index. For those who have access to the Internet all the papers are available at: www.auburn.edu/academic/forestry_wildlife/forest_policy.

The publication's tone is set in the Preface where the editors write "forests are no longer seen solely as economic development engines, but also as important protectors of ecosystems, watersheds, endangered and threatened species, and homes for endangered cultures and rural communities. As a result, much more attention needs to be placed on developing polices governing private forestry, and the impacts they might have on economic, social and environmental goals."

The papers address key issues in private forestry with experience and examples from around the world. The book is in four parts: Part 1 Changing philosophies of forest management, Part 2 Designing and implementing policies for private forestry, Part 3 Sustainable forestry economics and Part 4 Perspectives on forest certification. It is not a book to read from cover to cover but one to use as a research tool and as a pointer to a series of references, which extend far beyond the normal remit of CAB Forestry Abstracts. It is all the more refreshing for that as it looks at forestry and private forest policy from many different viewpoints. In this sense it adopts a truly postmodern approach.

Part 1contains one of the most interesting papers by John Schelhas, which directly addresses the question of whether there really is a postmodern attitudes to forest management, His paper is entitled "New trends in forest policy and management: an emerging postmodern approach?" Perhaps as equally interesting as the content of this paper is the fact that the author is a member of the Department of Sociology, Anthropology, Criminology and Social Work at Auburn University and has recently been elected a Fellow of the Society for Applied Anthropology. The book is worth accessing just for this paper alone.

Part 2 deals with designing and implementing forest policies for private forestry. The major paper in this Part - from a European point-of-view - is by Jacek Siry dealing with the future of private forestry in Central and Eastern Europe. In most of these former centralised economies - now moving to free market systems - there has been some restoration of forest lands (which had been nationalised or centralised under Communism) to their original owners. This has proved to be a mixed blessing as those who travelled in Romania on the Society's recent tour experienced. Not all of these countries have returned all forest land – Poland being a notable example, retaining most forest land in state ownership and issuing privatisation bonds against other state industries which were being privatised. Siry points to the fact that while the Forest Stewardship Council (FSC) has favoured larger scale industrial forest holdings the situation in the EU more is that half the harvest comes from small-scale forest holdings. This has led to the development of an alternative certification scheme – the Pan European Forest Certification Council (PEFC Council) which is being developed by organisations which represents the twelve million private forest owners in Europe. It seems that the FSC process is driven by NGOs while the PEFC certification process is being driven by owners.

George Weyerhaeuser gives an interesting overview of how a family firm responds to outside pressures. He indicates that it is not clear to him that the current institutions and policy framework are ready to meet complex international challenges like those now arising. He indicates that "society is going to expect different outcomes from private forest management than those that our policy frameworks were designed to deliver".

Sustainable forest economics are dealt with in Part 3, where there are a number of thought provoking papers. Birger Solberg, of the Department of Forest Science, Agricultural University of Norway, who has contributed to many European Forest Institute (EFI) publications in this field, gives a brief overview of the situation in Europe through summaries of various studies which have been carried out. Anyone wishing to pursue this area would do well to follow up these studies at the EFI website www.efi.fi). A paper by Peter Ince and Alexander Moiseyev indicates that it would be wise for the forest industry to keep a close eye on developments in other related land use industries, such as agriculture, and in particular the area of short rotation forestry or biomass production.

The final Part 4 of the book deals with the rise of forest certification and how it affects the forest industry. Erika Sasser gives details of the increasing participation and power of NGOs in the development of forest certification. Since 1993 he has identified at least 23 such organisations – mostly national but some like the FSC increasingly national. He mainly deals with the situation in the US as do most of the other papers in this section.

Many of the arguments, discussions, contentions situations, approaches etc. found in this book have their echoes in developments which are ongoing in the Irish forest industry today. In the Irish case it could be argued that the development of policy for private forestry was in the hands of those with a state forestry ethos and that hard lessons were learned and still need to be learned in the management of neophyte private farm foresters. The major problem is the passage of time, while policies are put in place. We are always trying to catch up. As George Weyerhaeuser points out it takes so long for a policy to be agreed that it may be obsolete before it ever comes to fruition. However we still need a policy framework.

No one size fits all but this book offers a spectrum of ideas, and potential policy options, which are immensely valuable for all students of private forestry.

Mike Bulfin

(Mike Bulfin is Head of Forest Research in Teagasc, the national farm research and advisory board, and is current Vice-President of the Society of Irish Foresters.)

A Guide to Forest Tree Species and Silviculture in Ireland. Ted Horgan, Michael Keane, Richard Mc Carthy, Michael Lally and David Thompson. Ed. Joe O'Carroll. COFORD. X+ 255 pp. Price €30.

Choosing the appropriate species for a given site can be regarded as a fundamental tenet in the establishment of sustainable forests. The choice of species is one of the most important decisions the tree grower/forester has to make. Selecting the species suited to the site will help to ensure the healthy development and growth of the crop and go a long way to achieve the objectives of the grower. If these objectives are financial it is all the more important that the species requires the minimum input of resources and grows to produce a crop at the end of the rotation that is readily saleable and of maximum value. To achieve the maximum return on a forest investment therefore requires careful consideration of all the factors involved, such as soil type, fertility, climatic exposure and drainage. All too often a species that is very soil and site demanding, such as ash, is planted on unsuitable sites just because the end product is in great demand. Although the early growth stage may be satisfactory such crops will rarely achieve the intended objective at maturity. It is therefore imperative to match the species to the site. This latest publication from COFORD will repay careful study in this regard.

The authors bring with them a wide spectrum of expertise, spanning decades of forest research in the Forest Service and Coillte, ranging from soil science through silviculture to forest genetics. An early chapter deals briefly with the three main functions of forests; economic, environmental and social, with a short discourse on the inputs required and the future value of the investment. This is followed by a lengthy chapter on site productivity which deals with factors of climate and site and is one of the key features of the book. The section on soils and forestry potential is particularly informative and could serve as a useful primer for students and the forestry enthusiast. The text is presented in simple language that is easy to understand and is complemented by tables, figures and photographs. The soil groups covered range from the dry mineral soils such as the brown earths, podzols and intergrades to the wet mineral soils and peatland. While it is unlikely that the poorer podzols and peatland will ever assume the same importance in afforestation as in the middle of the last century their inclusion is to be welcomed from the point of view of the difficulties involved in growing a crop on such poor sites. The view that trees will prosper where everything else fails to grow is long outmoded.

A short chapter on species selection guidelines is presented mainly in the form of tables that are intended to simplify the matching of tree species to sites. They are colour coded tabular summaries of species match to soil type showing their suitability from 'optimal to unsuitable' on a range of sites. This is supplemented by a further table which ranks silvicultural characteristics and site suitability factors for each species on a scale of 1-5. While the tables provide a useful overview the authors warn that they are not intended as a 'quick fix' solution to species selection. They should be read only in conjunction with the other chapters in the book.

The authors make a strong case for mixed plantations. There are many sound reasons for planting mixtures among them aesthetics and biological diversity and the shelter effect provided for some species in early stages of development. The latter is particularly noticeable in the establishment of broadleaves species and this is illustrated by some classical trials in Ballyhooley Forest. Details of the various mixture types are provided for both conifers and broadleaf species and conifer/broadleaf mixtures with figures illustrating group and band options for the latter. Some require more silvicultural attention than others but even the more robust mixtures will demand a greater degree of management than single species crops. Before embarking on the establishment of mixed species plantations it is vitally important that the advantages and disadvantages of each mixture type are understood. This chapter will be a considerable help in that regard.

The final chapter providing 'notes' for each of the tree species, referred to in previous chapters, occupies more than half the book. Beginning with broadleaves it describes the requirement of each species (in alphabetical order) in relation to climate, site suitability, provenance, planting, spacing, growth and yield, rotation length and wood properties etc. Conifers are treated in similar fashion and the chapter concludes with notes on native trees and shrubs. In all, the characteristics of some sixteen broadleaves and nineteen conifers are described. Silvicultural information on many of the species, such as alder and birch, which were considered minor species in the past but have now assumed greater prominence, is to be welcomed and this chapter will provide the reader with a quick reference as to their characteristics.

The book is beautifully presented with numerous colour photographs, and colour is used liberally throughout to highlight figures and tables. Every effort seems to have been taken to avoid technical terms but for those with any difficulty there is a comprehensive glossary. The more scientific minded will find the common and botanical names of tree species, native shrubs and vegetation species in the appendices. Surprisingly there is no index. Evidently the authors concluded that it would be superfluous given the detailed table of contents. The early section on economic aspects is somewhat sketchy and the internal rate of return (IRR) for Sitka and Norway spruce, with afforestation and premium grants in Table 2.2, appear to be overly optimistic at 11.8% and 10.0% respectively. However, the book does not purport to be a text on forest economics; its theme is the selection of tree species and their silviculture and as such it will be of particular interest to the tree grower and tree enthusiast whose wishes to improve his/her knowledge of forest trees and native shrubs without recourse to more advanced and less readable texts.

Padraic M Joyce

(Padraic Joyce is Professor Emeritus of Forestry at University College Dublin. He is the author of *Growing Broadleaves* and *Sitka spruce in Ireland* (co-authored with Niall OCarroll).

60th Annual Study Tour
Romania
6-13 September, 2003

Introduction

Forty-three Society members assembled early on 6 September 2003 at Dublin Airport to begin the 60th study tour and the Society's first visit to Romania. The flight to Bucharest was via Budapest with Malev Hungarian Airlines.

Dr Ioan Abrudan, Senior Lecturer at the Department of Silviculture, Transylvania University at Brasov met the group at Bucharest Airport. Ioan was the perfect host and guide for the week; he worked tirelessly and efficiently to look after the needs of the group. The Society is deeply indebted to him. En route to our hotel in Bucharest Ioan gave a brief summary of Romania.

Romania is surrounded by five countries: to the north east by Moldova, to the north by the Ukraine, to the north west by Hungary, to the south west by Serbia-Montenegro and the Danube (which drains the entire country), which also forms the southern boundary with Bulgaria. To the east Romania has a coastline on the Black Sea. With an area of 237,500 km^2 the country is about three times larger than the island of Ireland. It has a population of 22 million.

Throughout its long history Romania has had wave after wave of invasion which has led to great diversity in both culture and architecture.

Romanian forests cover 6.3 million ha (close to the total area of the Republic of Ireland), or 27% of the land area of the country. The long-term objective is to increase the area to 35%. Currently 17,200 ha are regenerated annually, 8,200 ha (48%) by natural regeneration and 9,000 ha through planting.

Broadleaves comprise 69% of the forest area, beech (31%) and oak (19%) being the most common. Conifers comprise the remaining 31%, mainly Norway spruce (23%), with a smaller amount of silver fir (5%) and other species. About 65% of the forests are located in the Carpathian Mountains. (It was at Brasov in the centre of these forests that the tour was located for the week.)

Romania has the highest percentage of natural forests, including some of the last and largest tracts of old growth forests, remaining in Europe. On the lower slopes of the Carpathians oak (sessile and pedunculate) grows. Higher up beech dominates, giving way to conifers at the higher elevations.

In 1948, prior to communism, only 28% of Romania's forests were state owned. Towns, communities, religious and educational institutions owned half of the forests, while 23% were privately owned. After 1948 almost all forests were taken into state ownership. After the fall of communism (in 1989) the process of forestland restitution began in 1991. Initially 350,000 ha were given back to the former owners. According to the restitution legislation one hectare is given to private individuals, regardless of the initial forest area. Under the current act over 3 million ha are being handed over. When the process is completed it is expected that 50% of the forest will be in private hands.

Forestry, because of its importance, has traditionally played a significant role in Romania's social and economic development. It has provided a major source of employment and income from logging with wood processing and income from non-wood products sustaining the mostly rural economy. However, forestry's contribution to the

The tour host, Dr Ioan Abrudan (to left) pictured with Aeneas Higgins, President of the Society.

economy could be greatly increased through competitive wood marketing and the introduction of improved harvesting, processing, and manufacturing technology. Nevertheless, the forestry sector remains a significant contributor to the Romanian economy.

Romsilva, a financially autonomous organisation under the authority of the Minister of Agriculture, Food, and Forests, manages the state forests.

It is estimated that there are 30,000 people employed in administration and management, including 26,000 foresters. The sawmilling sector has 67,000 employees, 21,000 are employed in the pulp and paper sector, with a further 104,000 in furniture manufacturing. Exports of wood and wood products amount to over €1,000 million, or 11% of the Romanian total. The sector's contribution to overall GDP is about 4.5%

After the fall of communism in 1989 economic recovery was slow but in the last three years there has been a lot of inward investment and a dramatic increase in economic activity. Romania expects to enter the EU in 2007.

John Mc Loughlin Convener

Day reports

Sunday 7 September

Tour participants availed of the free time in the morning to walk to the city centre and nearby parks. An early morning stroll close to the Gara de Nord where the Ibis Hotel is located revealed the contrasting life styles of the city. Little over 300 metres from the hotel, dozens of people were gathering their meagre belongings together after a night of sleeping rough. While Romania is striving valiantly to prepare for EU membership in 2007, it is difficulty to disguise the fact that this is a country with deep-rooted social and economic problems, where 44% of the population live below the poverty line. The first impression of Bucharest is a city of extremes in both living standards and architecture. It is a hotchpotch of fine architecture, garish new buildings and slums, often within metres of each other.

In the afternoon, the group visited the main landmarks including the Piata Revolutiei, the site of the old Royal Palace, where the television cameras recorded Ceausescu's downfall when he was famously interrupted in his speech from the balcony of the Central Committee Building on December 21, 1989. Bullet marks can still be seen on some on the surrounding buildings, a tangible sign of the two days of street fighting that occurred during that turbulent time. Many of the buildings have since been replaced by modern office blocks.

After our tour of the Piata Revolutiei, we visited the Centru Civic. Ceausescu initiated the Centru Civic project as a massive state administrative centre. His plan was to rebuild the city as "the first socialist capital for the new socialist man". Over five square kilometres were cleared, including the historic city centre. Some 40,000 inhabitants were relocated to the suburbs. Towering over all this is Ceausescu's monument, the building now known as the Palace of Parliament. This is reputed to be the second (to the Pentagon) largest building in the world. By all accounts, it was still not finished. Our guide quoted some impressive data about the building: it measures 270 x 240 m in area and is 86 m tall, 20,000 workers were employed per shift in its construction, 4,500 chandeliers were completed out of the 11,000 planned, together with lavish decoration of gold leaf and marble. For years after Ceausescu's death the authorities did not quite know what to do with the building, known as Casa Nebunului – Madman's House – by ordinary Romanians. Eventually they decided that it should house the Senate and Parliament and that it would be a venue for international conferences and a tourist attraction.

Next stop was the Village Museum which was established in 1936. It contains over 300 houses and other rural buildings from all regions of Romania. It is a fascinating selection of vernacular architecture with echoes of our own Bunratty Folk Village. Unfortunately access to most of the buildings was prohibited.

In the evening the group dined at the Burebista restaurant and overnighted in the Hotel Ibis.

Monday 8 September

The group made its way north from Bucharest along the E60, through the rich agricultural land of the southern plain until we came to our first forest stop south of Ploiesti, in Prahova County. The area is well developed industrially with significant American, French and German investment. Towns and villages have good infrastructure; for example 99% of homes have electricity. The county comprises the southern Carpathians (37%), foothills (26%) and plains (37%).

The first stand visited had an area of 332 ha and comprised mainly ash (40%) aged 110 years, along with 130-year-old pedunculate oak (Quer*cus robur*), with a selection of other native species including poplar (*Populus*). The ash stand was part of the 800 ha of seed stands in the region. It was also one of the many protected stands managed by the Prahova Forest Directorate in Prahova County.

Romanian forests are divided equally between those with production and protection functions; no clearfelling is allowed in the latter and timber removal is kept to a minimum, mainly for sanitary and conservation purposes. Stands are opened out gradually so that canopy is never fully closed and natural generation is encouraged.

Aeneas Higgins, President of the Society opened the proceedings, with the Chief of the Forest Directorate Costache Avrel responding by welcoming the group and providing an interesting overview of the forests in his area. Further information was provided by the Chief of the Forest District, Cristea Mitraie.

Prahova Forest Directorate has 125,000 ha of forests stretching from the plain to the Carpathian Mountains and alpine meadows. The forests are predominantly in the hills and mountains but there are excellent (mainly broadleaf) woods, such as the seed stand visited, located in the plains.

Funding for the Directorate comes mainly from wood and non-wood products. Over 40% of income from timber comes from exports. A diverse range of forest product industries has grown up around the forest in the region, including sawmilling, veneer production, furniture, crafts such as boxes, cases and souvenir items, and charcoal manufacturing from beech. Non-wood products are an important aspect of forest management and include hunting, fishing, camping, trout farming, wild fruits and medicinal plants.

Mr Costache also discussed the State Restitution Laws beginning with the first law in 1990 which returned a maximum of one hectare of forestland to pre 1948 owners. Many of the owners however, have sold the trees to get some cash benefit. The second restitution law in 2000 provided up to 10 ha for individuals, with a maximum of 20 ha for community forests and 30 ha for church forests. In Prahova, 30% of the forest is non-state. This is the maximum that will be privatised in the county.

We learned that the Forest Directorate is responsible for management of state forest and the regulation of all forests in its region. There are eight districts in the Directorate, varying in size from 9,000 to 30,000 ha. These are further divided into sub-districts managed by forest rangers. All forests – state and private – must have a 10-year forest management plan by compartment (lowest forest unit), which must be approved by the Ministry of Agriculture, Food and Forests.

There was a brief discussion on regeneration and harvesting in Romania. There are three silvicultural systems applied throughout Romania, and all are variations of regeneration under shelterwood in high forest. Currently, 17,000 ha of state forests are regenerated annually, of these 8,000 ha are regenerated naturally. The aim is to reach 60% natural regeneration/40% artificial regeneration. Regeneration is mainly by native species. In Prahova 250 ha out of 450 ha has been regenerated naturally. Transplants for planting are supplied from their own nursery, with the seed sourced from the 800 ha of seed stands.

The average growth rate is 6.3 m^3/ha/annum. The annual allowable cut in the region is 320,000 m^3 out of an increment of 410,000m^3. Close to 80% of logging is carried out by private companies, with the balance by Directorate staff.

Our next stop was Beizadele Nursery, south east of Ploiesti. This is a 62 ha nursery with 54 ha in production. The nursery produces mainly ash (*Fraxinus excelsior*), pedunculate and sessile oak (*Quercus petraea*), willows (*Salix* spp) for wickerwork, Austrian pine (*Pinus nigra*), cherry (*Prunus* spp), silver fir (*Abies alba*) and Norway spruce (*Picea abies*). Drought was a problem during the summer but the nursery manager was confident that they would solve this with their new irrigation system, which had a reservoir with a capacity of 500,000 litres. However, the overall husbandry and layout of the nursery was poor by Irish standards. There was a reliance on manual labour rather than technology or chemicals in areas such as weed control.

The final stop was close to Sinai, located in the uplands at an altitude of 1150 m. We visited a forest which featured a mixture containing 70% silver fir, 20% Norway spruce with almost 10% beech (*Fagus sylvatica*) and a small percentage of European larch (*Larix decidua*). This is a typical mixture of those Romanian forests located between the plains and the mountains. Beech was the understorey to silver fir. The average age of the plantation was 160 years; the silver fir had an average height of 32 m, with an average diameter of 54 cm. The standing volume was very high at 608 m^3/ha. The forest was extremely well managed and the stem form was excellent.

We overnighted at the Hotel Aro in Brasov.

Donal Magner

Tuesday 9 September

We left the Hotel Aro at 8 a.m. for the first of three wood processing stops.

First was the MTI Company where the General Manager of the garden furniture factory, Mr Korner was our host. The factory was built in 1996, as a joint venture between French and Romanian companies. It occupied an area of 7.5 ha, with 14,000 m^2 under cover.

Three hundred people were employed, working on three 8 hour shifts. The average wage for industrial workers was €150/month, based on a piece-rate system.

Raw material is sourced as sawnwood from Romanian sawmills and is converted to garden and leisure products: seats, tables, fencing panels, trellis, etc. The main markets are in western Europe, particularly French chain stores. Annual production is 8,000 m^3 with over 1000 items in the product portfolio. Products are pressure treated with Tanalith E, one of the replacements for CCA treatment for domestic-use wood products.

The main species used are acacia, oak and Norway spruce. All sawnwood is graded upon arrival; the lower grades are used for pallet manufacture with the better quality going to added value uses. One and half month's raw material in held in stock to allow the wood to air dry.

It is the first factory in Romania to have FSC chain of custody certification. The sawnwood is bought from a sawmill supplied with certified wood from Romania's national parks. Mr Kroner stated that he paid between 10 and 15% more for certified wood but as his factory was the only market for it, a true market price did not exist. Kiln drying is used for final drying to specific moisture contents, depending on species. The kilns were fuelled with sawdust and off-cuts.

Our second stop was at a traditional hardwood sawmill, Forex. Mr Enache, the Sales Director was our guide. The mill was privatised in 1990 and is now fully Romanian owned. Roundwood intake was 25,000 m^3/year, 75% beech, as well as oak, maple and cherry. The average mill-gate price for logs was €79/m^3 (including approx. €11/m^3 for haulage). A maximum of 12,000 m^3 was held in stock due to the seasonal nature of hardwood harvesting. Half the timber was harvested by the sawmill and half bought at roadside.

The markets for the produce were primarily foreign, with Germany taking 60%, followed by Spain, Portugal, and then the Far East, including Japan and Hong Kong. The ultimate end-product markets were flooring, kitchen panels and furniture. All products are sawn, chemically steamed (for insect and fungal protection), air-dried to 35% moisture content and then kiln dried to 12%. The sawn timber is then graded, baled and exported in containers at an average ex-mill price of €300 to €320/m^3. Sawn timber recovery ran at approx 50%, with the sawdust going to fire the kilns and the slabs going to a local MDF factory at 20/tonne (ex-mill). Average wages for industrial workers were €120/month.

Our final visit was to a slicing veneer company – Losán – where the Technical Director, a Mr Frunza was our host. The factory site was another green-field development, established within the last five years. It has 52 employees and is a wholly-owned subsidiary of the Spanish wood processing company Wemhoner. It produces aesthetic grade veneer for kitchen, domestic and office furniture.

Roundwood intake is 24,000 m^3/year. Beech (60%), oak, cherry, sycamore and Spanish chestnut (of a diameter greater than 45 cm) are the main species used. The company is the largest producer of white beech veneer in Europe. As well as sourcing raw material in Romania it also purchases in Georgia and the Ukraine, and Mr Frunza was even buying 100 m^3/month of Spanish chestnut from England.

As with the hardwood sawmill at the previous stop, large stocks of roundwood are carried, as no felling takes place during the summer months. Logs are stored under a sprinkler system within the log yard, but beech will nevertheless degrade due to fungal infection, because of high temperatures and moisture. Mr Frunza stated that the average mill-gate price for logs was between €300-€400/m^3, and that the average ex-mill price for finished veneer was about €800/m^3. The markets for the veneer are northern Europe, Holland and Spain. It is sold through a network of agents.

The factory had four veneer slicing lines operating on a 24-hour basis, making it one of the five largest veneer mills in Europe. The veneer production process was as follows:

1. the log is cut to length,
2. debarked,
3. sawn into a square cant,
4. placed in water at a temperature of 40 °C to facilitate slicing,
5. sliced (on one of four lines),
6. the veneer is dried,
7. pressed,
8. graded and
9. cut to length.

The recovery rate from roundwood to finished veneer was 40%, the balance being bark, slabs and the centre cant (left over after the slicing process, which is sold on to the pallet and packaging sector).

The day was most informative, showing investment in the latest technology, with western European countries providing capital where there was a large timber resource.

So next time you go for a teabag from the cupboard, the door you're holding could well have come from Brasov, a rapidly developing part of eastern Europe!

Richard Lowe

Wednesday 10 September

Brasov – walking tour of the Old Town

Brasov is a medieval city located at the foot of Mount Tampa, on the old trade routes across the Carpathian Mountains to the Turkish Empire and the Orient.

A defensive wall surrounds the old town, it was originally 12 m high and 3 km in length. Seven defensive bastions were located at exposed points on the wall. Each bastion was defended by a particular guild, such as the weavers or the blacksmiths. The Weavers' Bastion (south east of the old square) is the best preserved of the seven. It is now a museum and houses a scale model of the town as it was in 1896.

Piata Statului, the old market square, located in the German section of the town, has many fine, well-preserved buildings dating from the 13th, 14th and 15th centuries. The most impressive of these is the Black Church – one of the largest Gothic churches in Europe – built between 1383 and 1477. The church organ, built by Bucholz of Berlin has 4,000 pipes. During the summer Piata Statului is a popular venue for concerts and has hosted famous singers such as Johnny Logan and Ray Charles.

Faculty of Silviculture and Engineering – University of Brasov

During our visit the Dean of the Faculty, Professor Gheorghita Ionascu, outlined the courses available at the university, which moved here in 1958 from Bucharest.

The faculty currently has 850 students and is the largest forestry faculty in Europe. More than 100 students graduate each year but most of them must emigrate to find employment. The faculty provides degree courses in silviculture and forest management and in wood engineering; it also offers a 3-year forest engineering diploma course, masters courses and a PhD programme, with fifteen specialities. Practical training for the students is provided on a 32,000 ha forest managed by the faculty. It also manages a pheasant farm and several hunting lodges.

The campus at Brasov also houses the Faculties of Sports Medicine and Arts. About 15,000 students attend the university, where many of the courses are also available in English, French and German.

The Mohos Nature Reserve

This protected area of the Ciomatic Massif is famous for its twin volcanic craters of Mohos and Saint Ana. Although it was originally volcanic, the Mohos is now a peat bog, which is a very rare ecotype in Romania. The main trees growing here are Scots pine (which accounts for less than 1% of Romanian forests) and Norway spruce. Interestingly the reserve is managed by a NGO.

Furniture factory of Mobexpert Ltd in Seculesc

This former state owned factory was bought by Mr Oliver Tamas in 1999. He paid €0.5 m for the buildings on 8 ha and invested a further €0.4 m in re-equipping it. This was a brave move for the then 30-year-old cabinetmaker, at a time when bank interest rates were 24% and annual inflation was running at 63%.

When he bought the premises there were 25 employees making just one product – kitchen chairs. He now has 120 employees, producing 105 products. His main markets are Holland, Germany, Hungary, Israel and other furniture factories in Romania.

Furniture manufacturing is an important component of the Romanian economy, it accounted for 5.6% of exports in 2000. However, the Romanian furniture industry is very fragmented – in 1999 there were approximately 2000 separate factories and workshops producing furniture, usually in small quantities.

The greatest difficulties Mr Tamas encountered in the transition from state factory to private enterprise were raising skills levels and improving product design. His first action on acquiring the premises was to fit it out with good quality, second hand German machinery. He then trained the staff to operate them and finally he began to repair and renovate the buildings which had been badly neglected while in state ownership. Staff training was the biggest hurdle. While you might expect to find a pool of skilled labour coming from the state factory, this was not the case, as it made one product only and there was little emphasis on quality and none whatsoever on design.

His current throughput is 500 m^3/month of roundwood (200 m^3 of sawnwood). The species mix is 50% pine, 30% oak and 20% beech. He plans to double his throughput by the end of 2006. At the moment, his priority objectives are to improve product design by working in co-operation with his customers and to increase the size of order runs – currently his average run size is only five pieces.

Pat O'Sullivan

Thursday 11 September

We departed Brasov in the direction of Zarnesti and ascended to an elevated forest property. The area is used by the forestry faculty of the University of Brasov, as a diversity of vegetation is found in an undisturbed state on its slopes.

As the bus climbed to the summit a broad, clear view could be seen of the city of Brasov. Some old buildings are still visible on the hillside which were used as lookout posts in the past when the danger of a Turkish invasion was ever present.

There were four elevational vegetation types, each with its constituent tree species, a reflection of climatic and soil conditions. At low elevation pedunculate oak was the most common species. As the elevation increased the oak merged into beech, which eventually became dominant, changing to beech/Norway spruce mixtures, which in turn gave way to pure conifers near the summit.

As we descended we were informed that hunting plays an important role in the Romanian economy and is significant source of forest income: twenty five percent of forest revenue is from non-wood sources. Bear hunting, which is strictly controlled and monitored, is very lucrative as animals of the size and age sought by German hunters occur in the extensive broadleaved forests.

On leaving the distinctive silvicultural zones Scots pine was planted on slopes, it looked healthy and vigorous. We next stopped at a 40-year-old beech stand. Like most broadleaved stands in Romania it was established by natural regeneration. Harvesting had caused some damage to the emerging natural regeneration; this was a problem of recent origin and was causing some concern. Forests in the past were managed according to an inflexible plan but this practice is now changing, as the market place is dictating the pace of change.

Climatic and site conditions are very favourable to natural regeneration, almost all over the country. Shelterwood is the most common silvicultural system used in production forests. In most beech stands following a mast year, in excess of 300,000 seedlings/ha can survive through to the next year. In the first 10-20 years there are high densities of seedlings and intense natural competition; these conditions are characteristic of beech forests in Romania.

Cleaning starts at 17-22 years-of-age when the trees have a height of 8–10 m. Natural pruning also begins at this stage. Cleaning involves removing undesirable species and stems with defects. It reduces the canopy closure index to 0.75–0.8. Two cleanings are normally carried out, after the second operation stocking is reduced to about 2500-3000 stems/ha and basal area to 18-20 m^2/ha.

We departed the beech stand in the Zarnesti Forest District and travelled to the Piatra Craiului National Park. The park is well known nationally and internationally because of its spectacularly long and high calcareous ridge and the unique flora and fauna that occur. It is an enclosure area for the study of wolves and bears. The scenery is spectacular as the extensive area of low hills is covered with broadleaves which look their best from September when the leaves change colour.

Land tenure in the area is unsettled, landowners who have recovered their lands in recent years are selling to wealthy outsiders who are building extensive summer residences without planning permission and as a result are coming into conflict with local and national planning regulations.

We were met by Zotta Mihai, chief ranger and tourism/education officer. He explained that in 1938 an area of four hundred ha was declared a special reserve and has been protected since 1970, the park being finally established in 1999. It is now one of 17 national parks in addition to the Danube Delta (which has its own administration and terms of reference). There is on-going discussion with citizens who are opting to take back land which their ancestors lost in the late 1940s. They are being encouraged to retain the forest, as their farming skills and husbandry may not be as keen as those who have had uninterrupted involvement with farming over the decades.

Zotta Mihai spends quite a lot of his time in consultation with non-governmental organisations (NGOs) in connection with his work and his future plans for the national park. Some difficulties can arise, as there is no history of consultation in the country, it is a new feature of environmental management. He has noticed that there is a new awareness in the public mind about amenity and environmental aspects of the landscape. He frequently visits schools as he finds them to be an effective place to consult and inform the public on existing and planned developments in the surrounding district. He also communicates with five NGOs and has adopted a policy of transparency, which is much favoured by the NGOs, and it has prevented disagreement in the past.

Frank Nugent

Friday 12 September

As we left the Hotel Aro in Brasov the drizzling rain reminded us of home. The road to our first stop at Peles Castle ran through forest-clad hills of naturally regenerated beech and Norway spruce in mixture. The beech was just starting to show off its autumn colours.

We arrived at Sinaia at 10.45 and walked the 'Royal Mile' from the bus park to Peles Castle. Prior to 1948 this was the residence from May to October of the Romanian Royal Family. The architecture and decoration of the castle show European and Turkish influences. It is surrounded by a forest of beech and Norway spruce, with individual exotic specimens in the grounds around the castle.

Our second stop was at the headquarters of the Bucegi Natural Park in the Dambovita Forest Region where Daniel Dumitru the Regional Director, Viorel Voicu the District Manager and George Puscariu the Park Manager met us.

Dambovita Forest Region occupies 95,000 ha and includes all forest types, from flood plains to alpine meadows. The annual cut of 249,000 m^3 is sold to private mills and as firewood. Other forest products include fruits, mushrooms, charcoal and trout. Wolves, bear, chamois, roe deer, red deer and wild boar form the wildlife of the region. An attempt is being made to re-introduce bison.

The Forest District is 9,000 ha in area and covers an altitude range from 400-2500 m. Annual increment for the district is 45,000 m^3, with an allowable cut of 40,000 m^3. Norway spruce (55%) and beech (39%) are the main species. The entire district is a protection forest, which places special restrictions on felling. Turnover is about 900,000/year. Roundwood is either sold standing or at roadside, with some conversion being done at the district's own mill. Hunting is an important source of revenue for the district, with hunters paying as much as 10,000 for a red deer trophy.

The area of the Natural Park is 32,000 ha, with 60% forest cover. The objectives of the park are to protect wilderness areas, improve trails, conserve biodiversity, provide areas for scientific research and education, and manage tourism in an ecologically sympathetic way. There are 14 nature reserves in the park (totalling 12,000 ha) in which harvesting is forbidden. It is the location of many caves and spectacular gorges due to the limestone bedrock.

Our third stop was at a business unit of the Dambovita Forest Region. It consisted of a small sawmill and trout farm. The sawmill produces various items of furniture, parquet flooring, doors, windows and chalet huts. The trout farm was built in 1979/1980 and caters for the full cycle of production from egg to sale of rainbow trout, which takes about 1.5 years, at which stage the are 1.5 kg.

At Doicesti we entered the Romanian plain and proceeded on to Targoviste where we ate lunch. This town was the capital of Romania during the rule of the notorious Vlad the Impaler. It was here at the local military base that the communist dictator Nicolai Ceausescu and his wife were executed.

Our fourth stop was at Gaetsi Central Nursery, another unit of the Dambovita Forest Region. It was established in 1962 and grows oak, poplar, sycamore and ash for planting in the forests where natural regeneration is inadequate and for planting on degraded farmland. In an attempt to increase revenue the nursery has commenced the production of ornamental species including acacia, cherry, box, privet, *Picea pungens,* juniper and hibiscus. Some species are started off as cuttings in plastic tunnels in a bed of 50% peat and 50% sand. The production cycle is 3 years.

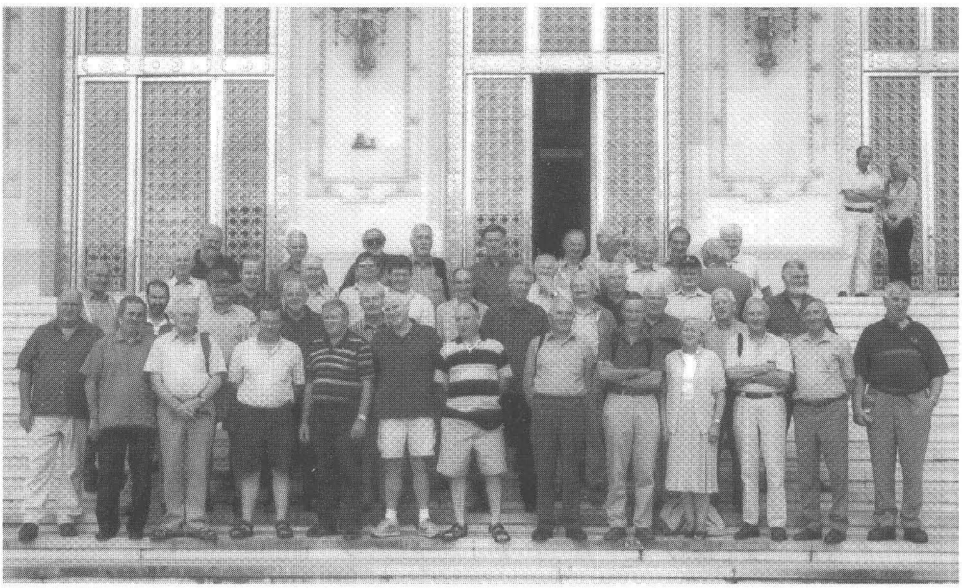
The last stop of the day was a visit to Bolovani pedunculate oak forest. This is a remnant of the forest of the Romanian plain, where oak and ash are the typical forest species. The oak at Bolovani was 120 to 140 years old. The stand had been heavily thinned to encourage natural regeneration. There is already regeneration of ash and oak and the forester will favour the oak in future tending and spacing operations. There are roe and fallow deer in this area and a wild boar enclosure for research purposes.

After an interesting day we proceeded to our overnight stop at the Hotel Ibis in Bucharest.

Bob Dagg

Saturday 13 September

The morning was free and many participants took the opportunity to visit a furniture exhibition in Bucharest. In the afternoon the group headed for the airport, en route to the airport, the President, Aeneas Higgins paid tribute once again to Dr Ioan Abrudan for his assistance in providing such a wonderful and varied tour, taking in all aspects of forestry in Romania as well as areas of cultural interest.



Study tour participants on the steps of the Centru Civic (Ceausescu's place) in Bucharest.

John Mc Loughlin

Participants

Marie Aherne, Peter Alley, PJ Bruton, Michael Bulfin, Michael Carey, Tadhg Collins, John Conneff, Jim Crowley, Bob Dagg, Frank Drea, Ken Ellis, Paul Finnegan, Jerry Fleming, Matt Fogarty, Gerhardt Gallagher, Tony Gallinagh, Sean Galvin, Tomas Gerety, Christy Hanley, Aeneas Higgins (President), George Hipwell, Larry Kelly, Richard Lowe, Michael Lynn, PJ Lyons, Donal Magner, Tony Mannion, Pat McCloskey, Kevin McDonald, Tom McDonald, John McLoughlin, (Convenor) PJ Morrissey, Liam Murphy, Jim Neilan, Frank Nugent, Michael O'Brien, Pat O'Callaghan, Liam O'Flanagan, Derry O'Hegarty, Tim O'Regan, Denis O'Sullivan, Pat O'Sullivan and Joe Treacy.

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